National Clinical Guideline Centre

Final

Fractures (non-complex): assessment and management

Fractures: diagnosis, management and follow-up of fractures

NICE Guideline NG38

Appendices J - Q

February 2016

Final

Commissioned by the National Institute for Health and Care Excellence

Disclaimer
Healthcare professionals are expected to take NICE clinical guidelines fully into account when exercising their clinical judgement. However, the guidance does not override the responsibility of healthcare professionals to make decisions appropriate to the circumstances of each patient, in consultation with the patient and, where appropriate, their guardian or carer.

Funding
National Institute for Health and Care Excellence

Contents

Appendices

Appendix J: Forest plots

J.1 Initial pain management and immobilisation

J.1.1 Initial pharmacological pain management

J.1.1.1 Intranasal Opioid versus Intravenous Opioid - Children

Figure 1: Pain at 30 minutes (Final Score)

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Borland 2007	-4	6.12	100.0%	-4.00 [-15.99, 7.99]
Total (95% CI)			**100.0%**	**-4.00 [-15.99, 7.99]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.65 (P = 0.51)

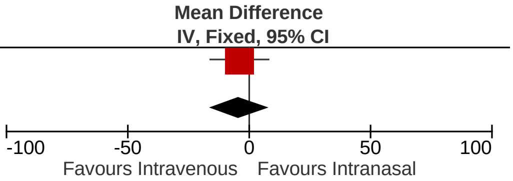


Figure 2: Pain Score at 30 minutes (Final Score)

Study or Subgroup	Intravenous Mean	Intravenous SD	Intravenous Total	Intranasal Mean	Intranasal SD	Intranasal Total	Weight	Mean Difference IV, Fixed, 95% CI
Furyk 2009	4.03	2.3	37	3.51	2.4	35	100.0%	0.52 [-0.57, 1.61]
Total (95% CI)			**37**			**35**	**100.0%**	**0.52 [-0.57, 1.61]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.94 (P = 0.35)

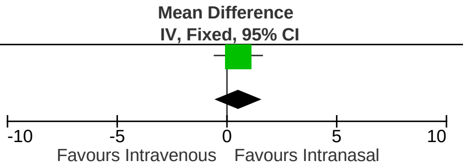


Figure 3: Nausea

Study or Subgroup	Intranasal Events	Intranasal Total	Intravenous Events	Intravenous Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Borland 2007	1	32	0	33	25.2%	3.09 [0.13, 73.19]
Furyk 2009	0	35	1	37	74.8%	0.35 [0.01, 8.36]
Total (95% CI)		**67**		**70**	**100.0%**	**1.04 [0.15, 7.29]**
Total events	1		1			

Heterogeneity: Chi² = 0.90, df = 1 (P = 0.34); I² = 0%
Test for overall effect: Z = 0.04 (P = 0.97)

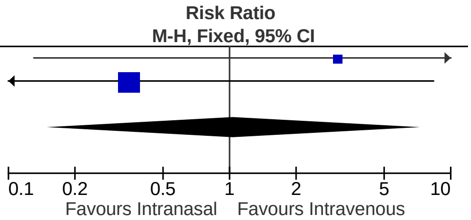
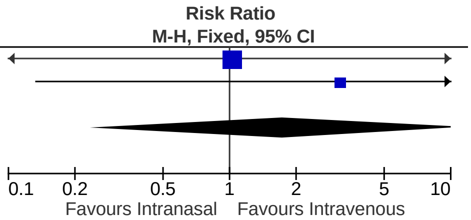


Figure 4: Need for further analgesia

Study or Subgroup	Intranasal Events	Intranasal Total	Intravenous Events	Intravenous Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Borland 2007	1	33	1	34	66.9%	1.03 [0.07, 15.80]
Furyk 2009	1	35	0	37	33.1%	3.17 [0.13, 75.24]
Total (95% CI)		**68**		**71**	**100.0%**	**1.74 [0.24, 12.77]**
Total events	2		1			

Heterogeneity: Chi² = 0.28, df = 1 (P = 0.60); I² = 0%
Test for overall effect: Z = 0.54 (P = 0.59)



J.1.1.2 Oral Codeine versus Oral Codeine (Children)

Figure 5: Pain at 180 minutes (Change Score)

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Charney 2008	-0.4	0.15	100.0%	-0.40 [-0.69, -0.11]
Total (95% CI)			**100.0%**	**-0.40 [-0.69, -0.11]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 2.67 (P = 0.008)				

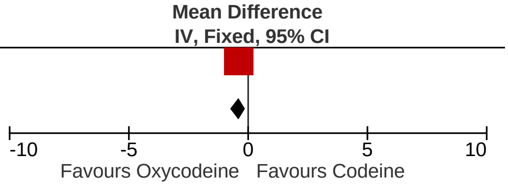
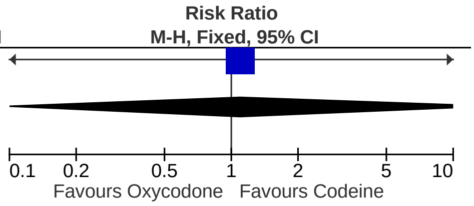


Figure 6: Nausea

Study or Subgroup	Oxycodone Events	Oxycodone Total	Codeine Events	Codeine Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Charney 2008	1	51	1	56	100.0%	1.10 [0.07, 17.10]
Total (95% CI)		**51**		**56**	**100.0%**	**1.10 [0.07, 17.10]**
Total events	1		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.07 (P = 0.95)						



J.1.1.3 Oral NSAIDs versus Oral Codeine (Children)

Figure 7: Pain at 60 minutes (Changes Score)

Study or Subgroup	Oral NSAIDs Mean	Oral NSAIDs SD	Oral NSAIDs Total	Oral Codeine Mean	Oral Codeine SD	Oral Codeine Total	Weight	Mean Difference IV, Fixed, 95% CI
Clark 2007	-29	25.26	58	-7	3.61	50	100.0%	-22.00 [-28.58, -15.42]
Total (95% CI)			**58**			**50**	**100.0%**	**-22.00 [-28.58, -15.42]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 6.56 (P < 0.00001)								

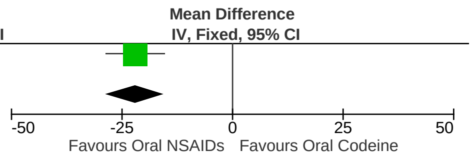


Figure 8: Nausea

Study or Subgroup	Oral NSAIDs Events	Oral NSAIDs Total	Oral Codeine Events	Oral Codeine Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Koller 2007	0	22	0	22		Not estimable
Total (95% CI)		**22**		**22**		**Not estimable**
Total events	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						

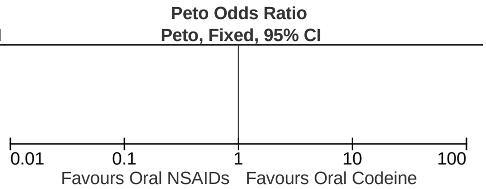
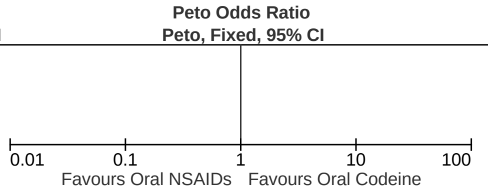


Figure 9: Need for further analgesia

Study or Subgroup	Oral NSAIDs Events	Oral NSAIDs Total	Oral Codeine Events	Oral Codeine Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Koller 2007	0	22	0	22		Not estimable
Total (95% CI)		**22**		**22**		**Not estimable**
Total events	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						



J.1.1.4 Oral NSAIDs versus Oral Paracetamol (Children)

Figure 10: Pain at 60 minutes (Change Score)

Study or Subgroup	Oral NSAIDs Mean	Oral NSAIDs SD	Oral NSAIDs Total	Oral Paracetamol Mean	Oral Paracetamol SD	Oral Paracetamol Total	Weight	Mean Difference IV, Fixed, 95% CI
Clark 2007	-29	25.26	58	-14	18.21	51	100.0%	-15.00 [-23.20, -6.80]
Total (95% CI)			**58**			**51**	**100.0%**	**-15.00 [-23.20, -6.80]**

Heterogeneity: Not applicable
Test for overall effect: Z = 3.59 (P = 0.0003)

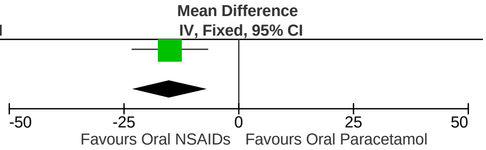


Figure 11: Nausea

Study or Subgroup	Oral NSAIDs Events	Oral NSAIDs Total	Oral Paracetamol Events	Oral Paracetamol Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Shepard 2009	2	29	0	43	100.0%	12.41 [0.72, 213.59]
Total (95% CI)		**29**		**43**	**100.0%**	**12.41 [0.72, 213.59]**
Total events	2		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.73 (P = 0.08)

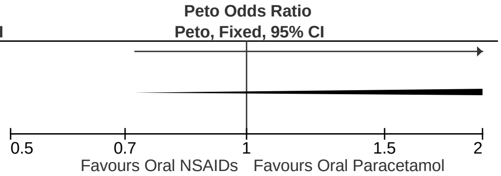


Figure 12: Delayed Union

Study or Subgroup	Oral NSAIDs Events	Oral NSAIDs Total	Oral Paracetamol Events	Oral Paracetamol Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Shepard 2009	0	29	0	43		Not estimable
Total (95% CI)		**29**		**43**		**Not estimable**
Total events	0		0			

Heterogeneity: Not applicable
Test for overall effect: Not applicable

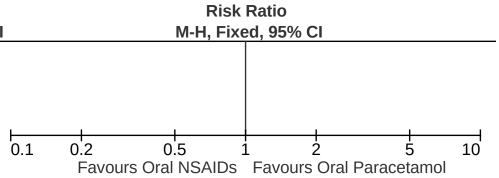


Figure 13: Need for further analgesia at 2 hours

Study or Subgroup	Oral NSAIDs Events	Oral NSAIDs Total	Oral Paracetamol Events	Oral Paracetamol Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Shepard 2009	4	29	3	43	100.0%	1.98 [0.48, 8.19]
Total (95% CI)		**29**		**43**	**100.0%**	**1.98 [0.48, 8.19]**
Total events	4		3			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.94 (P = 0.35)

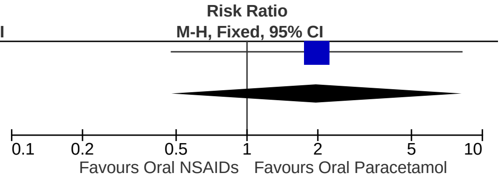
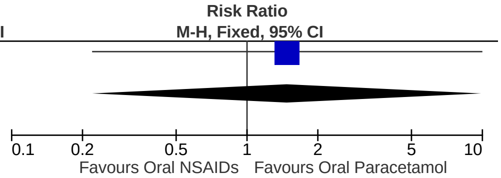


Figure 14: Need for further analgesia at 48 hours

Study or Subgroup	Oral NSAIDs Events	Oral NSAIDs Total	Oral Paracetamol Events	Oral Paracetamol Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Shepard 2009	2	29	2	43	100.0%	1.48 [0.22, 9.94]
Total (95% CI)		**29**		**43**	**100.0%**	**1.48 [0.22, 9.94]**
Total events	2		2			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.41 (P = 0.68)

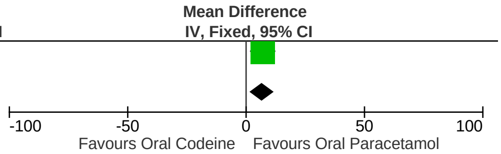


J.1.1.5 Oral Codeine versus Oral Paracetamol (Children)

Figure 15: Pain at 60 minutes (Change Score)

Study or Subgroup	Oral Codeine Mean	Oral Codeine SD	Oral Codeine Total	Oral Paracetamol Mean	Oral Paracetamol SD	Oral Paracetamol Total	Weight	Mean Difference IV, Fixed, 95% CI
Clark 2007	-7	3.61	50	-14	18.21	51	100.0%	7.00 [1.90, 12.10]
Total (95% CI)			**50**			**51**	**100.0%**	**7.00 [1.90, 12.10]**

Heterogeneity: Not applicable
Test for overall effect: Z = 2.69 (P = 0.007)



J.1.1.6 Oral Opioid versus Intravenous Opioid (Children)

Figure 16: Pain at 30 minutes (Final Score)

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Mahar 2007	-10.94	4.94	100.0%	-10.94 [-20.62, -1.26]
Total (95% CI)			**100.0%**	**-10.94 [-20.62, -1.26]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 2.21 (P = 0.03)				

Mean Difference
IV, Fixed, 95% CI

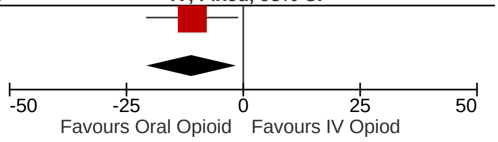


Figure 17: Pain at 60 minutes (Final Score)

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Mahar 2007	-14.4	5	100.0%	-14.40 [-24.20, -4.60]
Total (95% CI)			**100.0%**	**-14.40 [-24.20, -4.60]**
Heterogeneity: Not applicable				
Test for overall effect: Z = 2.88 (P = 0.004)				

Mean Difference
IV, Fixed, 95% CI

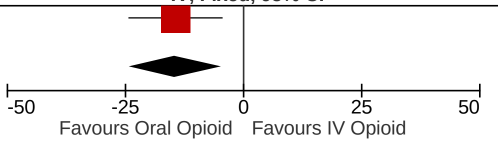
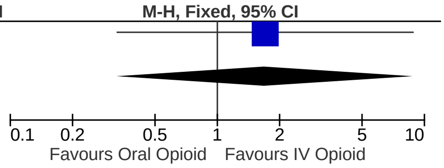


Figure 18: Nausea

Study or Subgroup	Oral Opioid Events	Oral Opioid Total	Intravenous Opioid Events	Intravenous Opioid Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Mahar 2007	4	47	2	40	100.0%	1.70 [0.33, 8.81]
Total (95% CI)		**47**		**40**	**100.0%**	**1.70 [0.33, 8.81]**
Total events	4		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.63 (P = 0.53)						

Risk Ratio
M-H, Fixed, 95% CI



J.1.1.7 Oral NSAIDs versus Oral Tramadol (Children)

Figure 19: Nausea

Study or Subgroup	Oral NSAIDs Events	Oral NSAIDs Total	Oral Tramadol Events	Oral Tramadol Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Neri 2013	0	60	2	65	100.0%	0.14 [0.01, 2.33]
Total (95% CI)		**60**		**65**	**100.0%**	**0.14 [0.01, 2.33]**
Total events	0		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.36 (P = 0.17)						

Peto Odds Ratio
Peto, Fixed, 95% CI

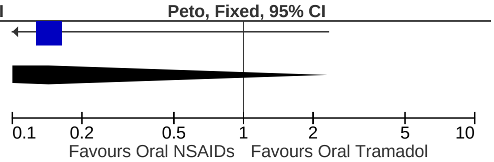
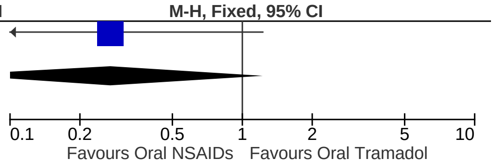


Figure 20: Need for further analgesia

Study or Subgroup	Oral NSAIDs Events	Oral NSAIDs Total	Oral Tramadol Events	Oral Tramadol Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Neri 2013	2	60	8	65	100.0%	0.27 [0.06, 1.23]
Total (95% CI)		**60**		**65**	**100.0%**	**0.27 [0.06, 1.23]**
Total events	2		8			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.70 (P = 0.09)						

Risk Ratio
M-H, Fixed, 95% CI



J.1.1.8 Oral NSAIDs versus Oral Paracetamol-Codeine combination (Children)

Figure 21: Pain at 30 Minutes (Change Score)

Study or Subgroup	Oral NSAIDs Mean	Oral NSAIDs SD	Oral NSAIDs Total	Oral Para/Codeine Mean	Oral Para/Codeine SD	Oral Para/Codeine Total	Weight	Mean Difference IV, Fixed, 95% CI
Friday 2009	-1.4	1.4	34	-0.8	1.94	32	100.0%	-0.60 [-1.42, 0.22]
Total (95% CI)			**34**			**32**	**100.0%**	**-0.60 [-1.42, 0.22]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.43 (P = 0.15)

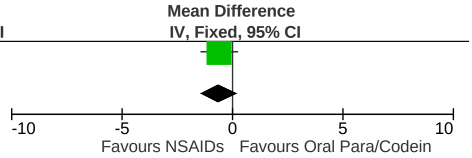


Figure 22: Pain at 60 Minutes (Change Score)

Study or Subgroup	Oral NSAIDs Mean	Oral NSAIDs SD	Oral NSAIDs Total	Oral Para/Codeine Mean	Oral Para/Codeine SD	Oral Para/Codeine Total	Weight	Mean Difference IV, Fixed, 95% CI
Friday 2009	-2.1	2.2928	34	-2.3	1.9415	32	100.0%	0.20 [-0.82, 1.22]
Total (95% CI)			**34**			**32**	**100.0%**	**0.20 [-0.82, 1.22]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.38 (P = 0.70)

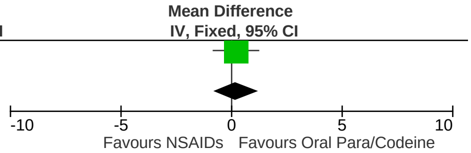
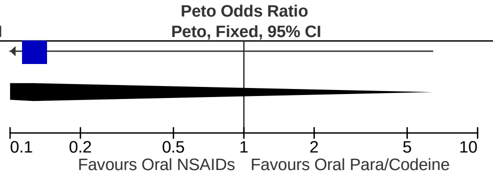


Figure 23: Nausea

Study or Subgroup	Oral NSAIDs Events	Oral NSAIDs Total	Oral Para/Codeine Events	Oral Para/Codeine Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Friday 2009	0	34	1	32	100.0%	0.13 [0.00, 6.42]
Total (95% CI)		**34**		**32**	**100.0%**	**0.13 [0.00, 6.42]**
Total events	0		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.03 (P = 0.30)



J.1.1.9 Oral NSAIDs versus Oral NSAIDs and Codeine combination (Children)

Figure 24: Nausea

Study or Subgroup	Oral NSAIDs + Codeine Events	Oral NSAIDs + Codeine Total	Oral NSAIDs Events	Oral NSAIDs Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Koller 2007	1	21	0	22	100.0%	7.75 [0.15, 390.96]
Total (95% CI)		**21**		**22**	**100.0%**	**7.75 [0.15, 390.96]**
Total events	1		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.02 (P = 0.31)

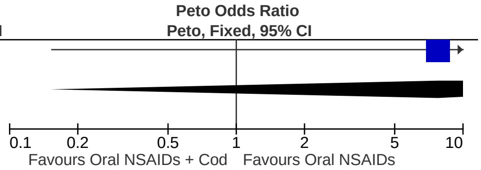
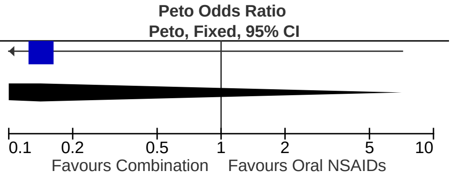


Figure 25: Need for further analgesia

Study or Subgroup	Oral NSAIDs + Codeine Events	Oral NSAIDs + Codeine Total	Oral NSAIDs Events	Oral NSAIDs Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Koller 2007	0	21	1	22	100.0%	0.14 [0.00, 7.15]
Total (95% CI)		**21**		**22**	**100.0%**	**0.14 [0.00, 7.15]**
Total events	0		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.98 (P = 0.33)



J.1.1.10 Oral Codeine versus Oral NSAIDs Codeine and Oral Codeine combination (Children)

Figure 26: Nausea

Study or Subgroup	Oral NSAIDs + Codeine Events	Total	Oral Codeine Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Koller 2007	1	21	0	22	100.0%	7.75 [0.15, 390.96]
Total (95% CI)		**21**		**22**	**100.0%**	**7.75 [0.15, 390.96]**
Total events	1		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.02 (P = 0.31)

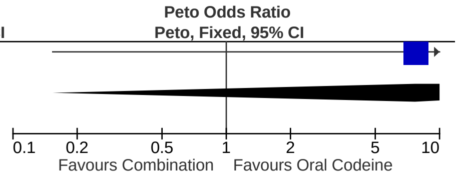
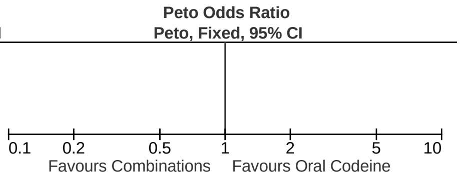


Figure 27: Need for further analgesia

Study or Subgroup	Oral NSAIDs + Codeine Events	Total	Oral Codeine Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Koller 2007	0	21	0	22		Not estimable
Total (95% CI)		**21**		**22**		**Not estimable**
Total events	0		0			

Heterogeneity: Not applicable
Test for overall effect: Not applicable



J.1.1.11 Oral NSAIDs versus Oral Morphine (Children)

Figure 28: Pain at 4 hours (Change Score)

Study or Subgroup	NSAID Mean	SD	Total	Morphine Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
Poonai 2014	1.3	1	68	1.5	1.2	66	100.0%	-0.20 [-0.57, 0.17]
Total (95% CI)			**68**			**66**	**100.0%**	**-0.20 [-0.57, 0.17]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.05 (P = 0.30)

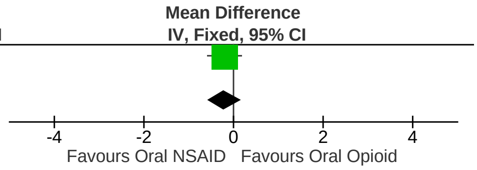


Figure 29: Nausea

Study or Subgroup	NSAID Events	Total	Morphine Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Poonai 2014	2	68	10	66	100.0%	0.19 [0.04, 0.85]
Total (95% CI)		**68**		**66**	**100.0%**	**0.19 [0.04, 0.85]**
Total events	2		10			

Heterogeneity: Not applicable
Test for overall effect: Z = 2.17 (P = 0.03)

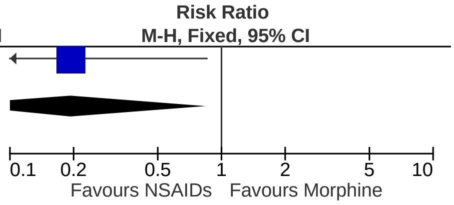
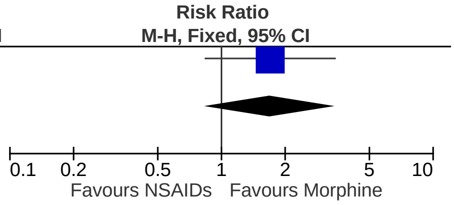


Figure 30: Need for rescue analgesia

Study or Subgroup	NSAID Events	Total	Morphine Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Poonai 2014	17	68	10	68	100.0%	1.70 [0.84, 3.44]
Total (95% CI)		**68**		**68**	**100.0%**	**1.70 [0.84, 3.44]**
Total events	17		10			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.48 (P = 0.14)



J.1.1.12 Oral Opioid versus Intravenous Opioid (Adults)

Figure 31: Pain at 30 minutes (Final Score)

	Oral Opioid			Intravenous Opioid				Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Fixed, 95% CI**
Jalili 2012	5	1.8	49	5	1.7	50	100.0%	0.00 [-0.69, 0.69]
Total (95% CI)			**49**			**50**	**100.0%**	**0.00 [-0.69, 0.69]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.00 (P = 1.00)								

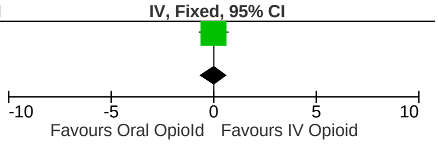


Figure 32: Pain at 60 Minutes (Final Score)

	Oral Opioid			Intravenous Opioid				Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Fixed, 95% CI**
Jalili 2012	2.2	0.7	44	2.2	0.7	45	100.0%	0.00 [-0.29, 0.29]
Total (95% CI)			**44**			**45**	**100.0%**	**0.00 [-0.29, 0.29]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.00 (P = 1.00)								

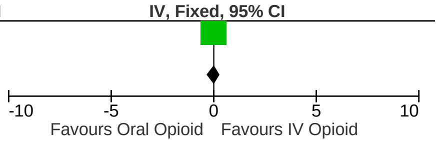


Figure 33: Nausea at 30 minutes

	Oral Opioid		Intravenous Opioid			Risk Ratio
Study or Subgroup	**Events**	**Total**	**Events**	**Total**	**Weight**	**M-H, Fixed, 95% CI**
Jalili 2012	7	49	6	50	100.0%	1.19 [0.43, 3.29]
Total (95% CI)		**49**		**50**	**100.0%**	**1.19 [0.43, 3.29]**
Total events	7		6			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.34 (P = 0.74)						

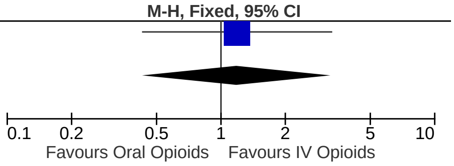
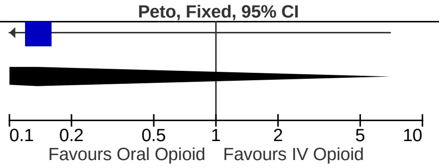


Figure 34: Nausea at 60 Minutes

	Oral Opioid		Intravenous Opioid			Peto Odds Ratio
Study or Subgroup	**Events**	**Total**	**Events**	**Total**	**Weight**	**Peto, Fixed, 95% CI**
Jalili 2012	0	44	1	45	100.0%	0.14 [0.00, 6.98]
Total (95% CI)		**44**		**45**	**100.0%**	**0.14 [0.00, 6.98]**
Total events	0		1			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.99 (P = 0.32)						



J.1.1.13 Oral Codeine versus Oral Codeine (Adults)

Figure 35: Pain at 30 Minutes (Change Score)

	Oxycodone			Hydrocodone				Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Fixed, 95% CI**
Marco 2005	-3.7	2.3	32	-2.5	2.2	30	100.0%	-1.20 [-2.32, -0.08]
Total (95% CI)			**32**			**30**	**100.0%**	**-1.20 [-2.32, -0.08]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 2.10 (P = 0.04)								

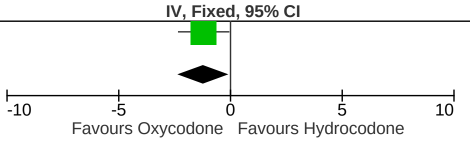


Figure 36: Pain at 60 Minutes (Change Score)

	Oxycodone			Hydrocodone				Mean Difference
Study or Subgroup	**Mean**	**SD**	**Total**	**Mean**	**SD**	**Total**	**Weight**	**IV, Fixed, 95% CI**
Marco 2005	-4.4	2.9	26	-3	2	21	100.0%	-1.40 [-2.81, 0.01]
Total (95% CI)			**26**			**21**	**100.0%**	**-1.40 [-2.81, 0.01]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.95 (P = 0.05)								

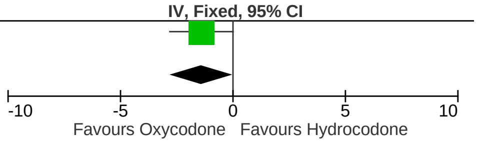


Figure 37: Nausea

Study or Subgroup	Oxycodone Events	Oxycodone Total	Hydrocodone Events	Hydrocodone Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Marco 2005	1	16	2	18	100.0%	0.56 [0.06, 5.63]
Total (95% CI)		**16**		**18**	**100.0%**	**0.56 [0.06, 5.63]**
Total events	1		2			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.49 (P = 0.62)

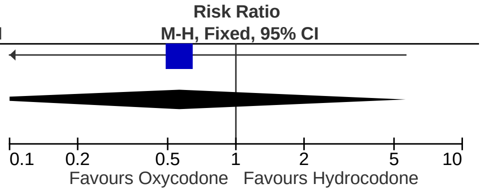
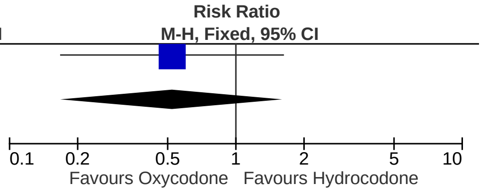


Figure 38: Need for further analgesia

Study or Subgroup	Oxycodone Events	Oxycodone Total	Hydrocodone Events	Hydrocodone Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Marco 2005	4	35	7	32	100.0%	0.52 [0.17, 1.62]
Total (95% CI)		**35**		**32**	**100.0%**	**0.52 [0.17, 1.62]**
Total events	4		7			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.12 (P = 0.26)



J.1.1.14 Intravenous Opioids versus Intravenous Paracetamol (Adults)

Figure 39: Pain at 30 minutes (Final Score)

Study or Subgroup	IV Opioid Mean	IV Opioid SD	IV Opioid Total	IV Paracetamol Mean	IV Paracetamol SD	IV Paracetamol Total	Weight	Mean Difference IV, Fixed, 95% CI
Craig 2011	55	29.7	27	63.5	22.3	28	100.0%	-8.50 [-22.42, 5.42]
Total (95% CI)			**27**			**28**	**100.0%**	**-8.50 [-22.42, 5.42]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.20 (P = 0.23)

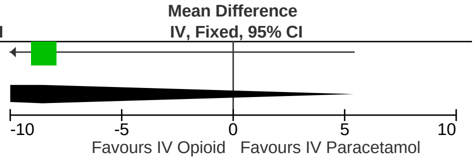


Figure 40: Pain at 60 minutes (Final Score)

Study or Subgroup	IV Opioid Mean	IV Opioid SD	IV Opioid Total	IV Paracetamol Mean	IV Paracetamol SD	IV Paracetamol Total	Weight	Mean Difference IV, Fixed, 95% CI
Craig 2011	44	22.6	27	52.9	27.4	28	100.0%	-8.90 [-22.15, 4.35]
Total (95% CI)			**27**			**28**	**100.0%**	**-8.90 [-22.15, 4.35]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.32 (P = 0.19)

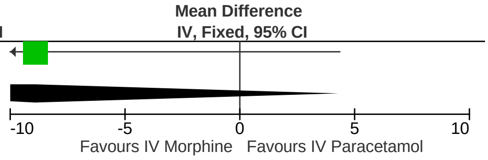
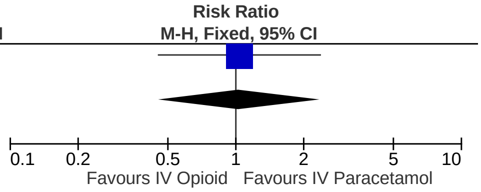


Figure 41: Need for further analgesia

Study or Subgroup	IV Opioid Events	IV Opioid Total	IV Paracetamol Events	IV Paracetamol Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Craig 2011	8	27	8	28	100.0%	1.04 [0.45, 2.37]
Total (95% CI)		**27**		**28**	**100.0%**	**1.04 [0.45, 2.37]**
Total events	8		8			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.09 (P = 0.93)

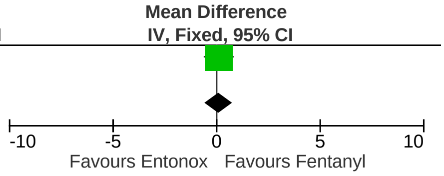


J.1.1.15 Entonox versus Intravenous Opioid (Adult)

Figure 42: Pain at 60 Minutes (Change Score)

Study or Subgroup	Entonox Mean	Entonox SD	Entonox Total	IV Opioid Mean	IV Opioid SD	IV Opioid Total	Weight	Mean Difference IV, Fixed, 95% CI
Kariman 2011	7.9	1.7	50	7.8	1.8	50	100.0%	0.10 [-0.59, 0.79]
Total (95% CI)			**50**			**50**	**100.0%**	**0.10 [-0.59, 0.79]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.29 (P = 0.78)

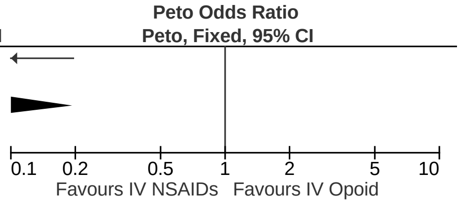


J.1.1.16 Intravenous NSAIDs versus Intravenous Opioid (Adult)

Figure 43: Nausea

Study or Subgroup	IV NSAIDs Events	IV NSAIDs Total	IV Opioid Events	IV Opioid Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Rainer 2000	0	75	27	73	100.0%	0.09 [0.04, 0.20]
Total (95% CI)		**75**		**73**	**100.0%**	**0.09 [0.04, 0.20]**
Total events	0		27			

Heterogeneity: Not applicable
Test for overall effect: Z = 5.81 (P < 0.00001)



J.1.2 Paediatric nerve blocks femoral fractures

J.1.2.1 Fascia iliaca compartment block versus IV morphine

Figure 44: Change in Pain at 5 minutes

	Fascia iliaca			IV morphine				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
Wathen 2007	1.65	0.79	26	0.95	0.78	29	100.0%	0.70 [0.28, 1.12]
Total (95% CI)			**26**			**29**	**100.0%**	**0.70 [0.28, 1.12]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 3.30 (P = 0.0010)								

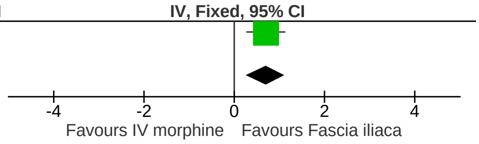


Figure 45: Change in Pain at 30 minutes

	Fascia iliaca			IV morphine				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
Wathen 2007	3.34	1.53	26	1.95	1.54	29	100.0%	1.39 [0.58, 2.20]
Total (95% CI)			**26**			**29**	**100.0%**	**1.39 [0.58, 2.20]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 3.35 (P = 0.0008)								

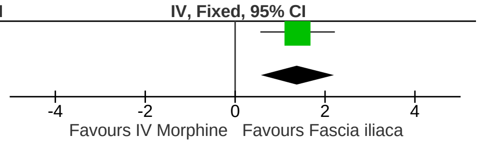


Figure 46: Respiratory depression

	Fascia iliaca		IV morphine			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Fixed, 95% CI
Wathen 2007	1	26	6	29	100.0%	0.19 [0.02, 1.44]
Total (95% CI)		**26**		**29**	**100.0%**	**0.19 [0.02, 1.44]**
Total events	1		6			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.61 (P = 0.11)						

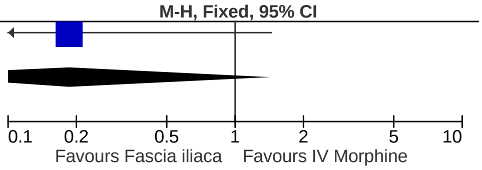


Figure 47: Nerve and vascular damage

	Fascia iliaca		IV morphine			Peto Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	Peto, Fixed, 95% CI
Wathen 2007	0	26	2	29	100.0%	0.14 [0.01, 2.39]
Total (95% CI)		**26**		**29**	**100.0%**	**0.14 [0.01, 2.39]**
Total events	0		2			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.35 (P = 0.18)						

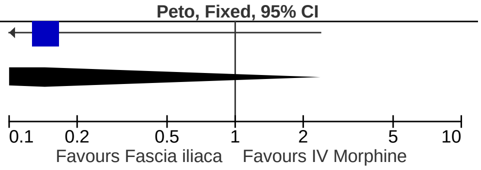
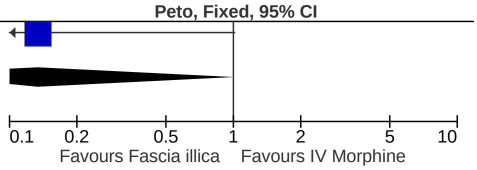


Figure 48: Nausea and vomiting

	Fascia iliaca		IV morphine			Peto Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	Peto, Fixed, 95% CI
Wathen 2007	0	26	4	29	100.0%	0.13 [0.02, 1.01]
Total (95% CI)		**26**		**29**	**100.0%**	**0.13 [0.02, 1.01]**
Total events	0		4			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.95 (P = 0.05)						



J.2 Acute stage assessment and diagnostic imaging

J.2.1 Selecting patients for imaging - clinical prediction rules for knee fractures

J.2.1.1 Diagnostic accuracy of validated knee fracture prediction tools

Figure 49: Diagnostic accuracy of the Ottawa in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Atkinson 2004	7	30	0	35	1.00 [0.59, 1.00]	0.54 [0.41, 0.66]
Cheung 2013A	12	121	2	45	0.86 [0.57, 0.98]	0.27 [0.21, 0.35]
Jalili 2010	21	146	1	115	0.95 [0.77, 1.00]	0.44 [0.38, 0.50]
Jenny 2005	16	65	0	57	1.00 [0.79, 1.00]	0.47 [0.38, 0.56]
Ketelslegers 2002	27	160	0	74	1.00 [0.87, 1.00]	0.32 [0.26, 0.38]
Konan 2013	6	77	0	23	1.00 [0.54, 1.00]	0.23 [0.15, 0.32]
Richman 1997	22	163	4	162	0.85 [0.65, 0.96]	0.50 [0.44, 0.55]
Seaberg 1998	84	487	3	176	0.97 [0.90, 0.99]	0.27 [0.23, 0.30]
Stiell 1996B	63	522	0	511	1.00 [0.94, 1.00]	0.49 [0.46, 0.53]
Stiell 1997A	58	483	0	446	1.00 [0.94, 1.00]	0.48 [0.45, 0.51]
Tigges 1999	42	271	1	64	0.98 [0.88, 1.00]	0.19 [0.15, 0.24]

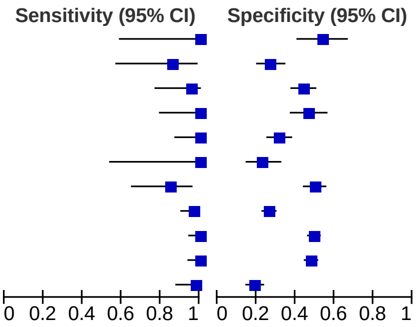


Figure 50: Diagnostic accuracy of the Pittsburgh in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Cheung 2013A	12	81	2	85	0.86 [0.57, 0.98]	0.51 [0.43, 0.59]
Konan 2013	3	13	3	87	0.50 [0.12, 0.88]	0.87 [0.79, 0.93]
Seaberg 1994	12	26	0	95	1.00 [0.74, 1.00]	0.79 [0.70, 0.85]
Seaberg 1998	90	264	1	390	0.99 [0.94, 1.00]	0.60 [0.56, 0.63]
Simon 2006	9	60	4	79	0.69 [0.39, 0.91]	0.57 [0.48, 0.65]

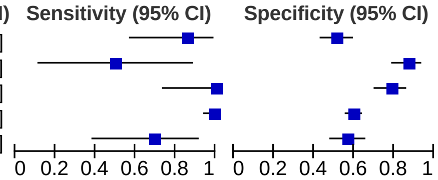


Figure 51: Diagnostic accuracy of the Bauer in adults

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Richman 1997	22	166	4	159	0.85 [0.65, 0.96]	0.49 [0.43, 0.55]

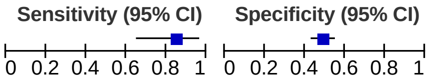
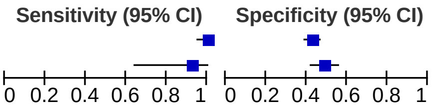


Figure 52: Diagnostic accuracy of the Ottawa in children

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Bulloch 2003	70	389	0	291	1.00 [0.95, 1.00]	0.43 [0.39, 0.47]
Khine 2001	12	113	1	108	0.92 [0.64, 1.00]	0.49 [0.42, 0.56]



J.2.2 Selecting patients for imaging - clinical prediction rules for ankle fractures

J.2.2.1 Ottawa versus clinical assessment

Figure 53: Number with X-rays

Study or Subgroup	Ottawa Events	Ottawa Total	Clinical assessment Events	Clinical assessment Total	Weight	Risk Ratio M-H, Random, 95% CI
Fan 2006	58	62	54	61	100.0%	1.06 [0.95, 1.18]
Total (95% CI)		**62**		**61**	**100.0%**	**1.06 [0.95, 1.18]**
Total events	58		54			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.97 (P = 0.33)

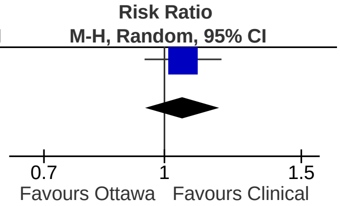
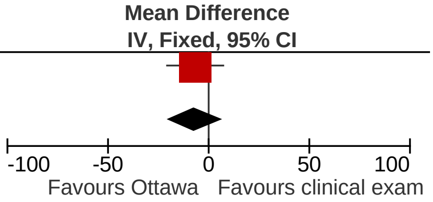


Figure 54: Length of stay in Emergency department (minutes)

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Fixed, 95% CI
Fan 2006	-6.7	7.12	100.0%	-6.70 [-20.65, 7.25]
Total (95% CI)			**100.0%**	**-6.70 [-20.65, 7.25]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.94 (P = 0.35)



J.2.3 Imaging of scaphoid

J.2.3.1 Early MRI versus delayed X-ray

Figure 55: Pain

Study or Subgroup	MRI Mean	MRI SD	MRI Total	X-ray Mean	X-ray SD	X-ray Total	Weight	Mean Difference IV, Fixed, 95% CI
1.1.1 14 days								
Patel 2013	2.9	2.6628	45	3.5	3.3934	39	54.5%	-0.60 [-1.92, 0.72]
Subtotal (95% CI)			**45**			**39**	**54.5%**	**-0.60 [-1.92, 0.72]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.89 (P = 0.37)								
1.1.3 42 days								
Patel 2013	1.8	3.3285	45	2.7	3.3934	39	45.5%	-0.90 [-2.34, 0.54]
Subtotal (95% CI)			**45**			**39**	**45.5%**	**-0.90 [-2.34, 0.54]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 1.22 (P = 0.22)								
Total (95% CI)			**90**			**78**	**100.0%**	**-0.74 [-1.71, 0.24]**

Heterogeneity: Chi² = 0.09, df = 1 (P = 0.76); I² = 0%
Test for overall effect: Z = 1.48 (P = 0.14)
Test for subgroup differences: Chi² = 0.09, df = 1 (P = 0.76), I² = 0%

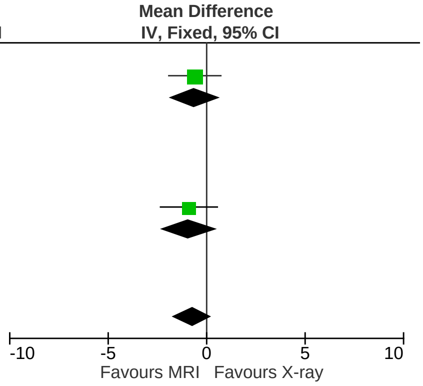


Figure 56: Fracture clinic appointments

Study or Subgroup	MRI Mean	MRI SD	MRI Total	X-ray Mean	X-ray SD	X-ray Total	Weight	Mean Difference IV, Fixed, 95% CI
Patel 2013	1.1	0.5	45	2.3	0.8	39	100.0%	-1.20 [-1.49, -0.91]
Total (95% CI)			**45**			**39**	**100.0%**	**-1.20 [-1.49, -0.91]**

Heterogeneity: Not applicable
Test for overall effect: Z = 8.10 (P < 0.00001)

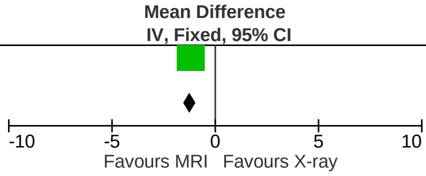
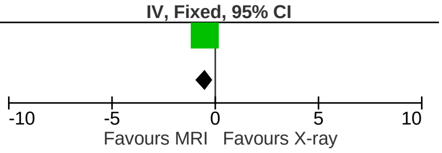


Figure 57: Additional radiation exposure

Study or Subgroup	MRI Mean	MRI SD	MRI Total	X-ray Mean	X-ray SD	X-ray Total	Weight	Mean Difference IV, Fixed, 95% CI
Patel 2013	1.2	0.8	45	1.7	1.1	39	100.0%	-0.50 [-0.92, -0.08]
Total (95% CI)			**45**			**39**	**100.0%**	**-0.50 [-0.92, -0.08]**

Heterogeneity: Not applicable
Test for overall effect: Z = 2.35 (P = 0.02)



J.2.4 Hot reporting

J.2.4.1 Hot reporting versus cold reporting

Figure 58: Change in quality of life (EQ-5D; baseline to 8-weeks post-intervention)

Study or Subgroup	Hot reporting Mean	Hot reporting SD	Hot reporting Total	Cold reporting Mean	Cold reporting SD	Cold reporting Total	Weight	Mean Difference IV, Fixed, 95% CI
Hardy 2013A	0.34	0.3327	383	0.345	0.3314	380	100.0%	-0.00 [-0.05, 0.04]
Total (95% CI)			**383**			**380**	**100.0%**	**-0.00 [-0.05, 0.04]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.21 (P = 0.84)

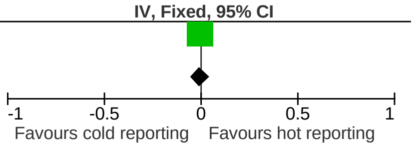


Figure 59: Patient recalled

Study or Subgroup	Hot reporting Events	Hot reporting Total	Cold reporting Events	Cold reporting Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Hardy2013	0	752	7	750	100.0%	0.13 [0.03, 0.59]
Total (95% CI)		**752**		**750**	**100.0%**	**0.13 [0.03, 0.59]**
Total events	0		7			

Heterogeneity: Not applicable
Test for overall effect: Z = 2.65 (P = 0.008)

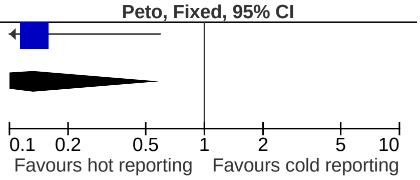
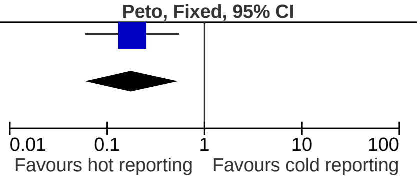


Figure 60: Missed fractures

Study or Subgroup	Hot reporting Events	Hot reporting Total	Cold reporting Events	Cold reporting Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Hardy2013	1	752	12	750	100.0%	0.18 [0.06, 0.54]
Total (95% CI)		**752**		**750**	**100.0%**	**0.18 [0.06, 0.54]**
Total events	1		12			

Heterogeneity: Not applicable
Test for overall effect: Z = 3.07 (P = 0.002)



J.3 Management and treatment plan in the emergency department

J.3.1 Reduction anaesthesia – distal radius fractures

J.3.1.1 Haematoma block compared to IV regional anaesthesia for reduction of displaced distal radius fractures

Figure 61: Need for re-manipulation

	Haematoma block		IV regional anaesthesia			Risk Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Fixed, 95% CI
Kendall 1997	17	70	4	72	42.5%	4.37 [1.55, 12.35]
Wardrope 1985	12	36	6	45	57.5%	2.50 [1.04, 6.01]
Total (95% CI)		**106**		**117**	**100.0%**	**3.30 [1.68, 6.45]**
Total events	29		10			
Heterogeneity: Chi² = 0.67, df = 1 (P = 0.41); I² = 0%						
Test for overall effect: Z = 3.48 (P = 0.0005)						

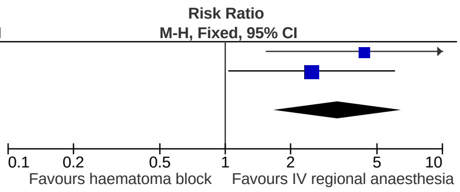


Figure 62: Need for surgical fixation

	Haematoma block		IV regional anaesthesia		Peto Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Peto, Fixed, 95% CI
Abbaszadegan1990	4	49	0	50	8.04 [1.10, 58.85]

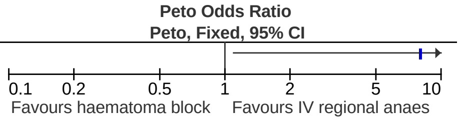


Figure 63: Pain score during reduction

	Haematoma block			IV regional anaesthesia				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Fixed, 95% CI
Abbaszadegan1990	2.5	2.3	49	1	2.3	50	71.8%	1.50 [0.59, 2.41]
Kendall 1997	5.3	4.4	70	2.8	4.4	72	28.2%	2.50 [1.05, 3.95]
Total (95% CI)			**119**			**122**	**100.0%**	**1.78 [1.01, 2.55]**
Heterogeneity: Chi² = 1.32, df = 1 (P = 0.25); I² = 24%								
Test for overall effect: Z = 4.55 (P < 0.00001)								

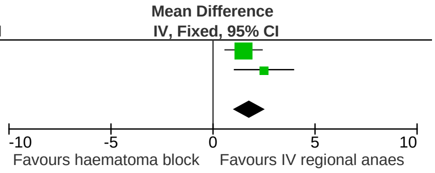


Figure 64: Painful/very painful during reduction

	Haematoma block		IV regional anaesthesia		Risk Ratio
Study or Subgroup	Events	Total	Events	Total	M-H, Fixed, 95% CI
Wardrope 1985	16	37	11	42	1.65 [0.88, 3.09]

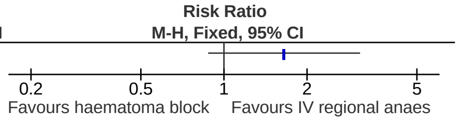
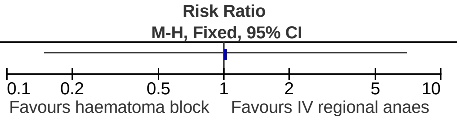


Figure 65: Median nerve decompression

	Haematoma block		IV regional anaesthesia		Risk Ratio
Study or Subgroup	Events	Total	Events	Total	M-H, Fixed, 95% CI
Abbaszadegan1990	2	49	2	50	1.02 [0.15, 6.96]



J.3.1.2 Entonox compared to IV regional anaesthesia for reduction of displaced distal radius fractures

Figure 66: Need for re-manipulation

Study or Subgroup	Entonox Events	Entonox Total	IV regional anaesthesia Events	IV regional anaesthesia Total	Risk Ratio M-H, Fixed, 95% CI
Goh 2002	8	35	2	32	3.66 [0.84, 15.96]

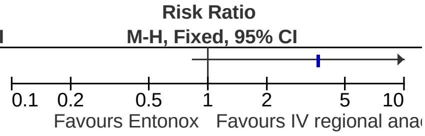


Figure 67: Need for surgical fixation

Study or Subgroup	Haematoma block Mean	Haematoma block SD	Haematoma block Total	IV regional anaesthesia Mean	IV regional anaesthesia SD	IV regional anaesthesia Total	Weight	Mean Difference IV, Fixed, 95% CI
Abbaszadegan1990	2.5	2.3	49	1	2.3	50	60.4%	1.50 [0.59, 2.41]
Kendall 1997	3	3.4	70	1.5	3.4	72	39.6%	1.50 [0.38, 2.62]
Total (95% CI)			**119**			**122**	**100.0%**	**1.50 [0.80, 2.20]**

Heterogeneity: Chi² = 0.00, df = 1 (P = 1.00); I² = 0%
Test for overall effect: Z = 4.18 (P < 0.0001)

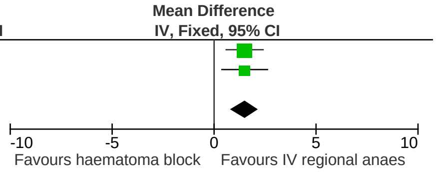
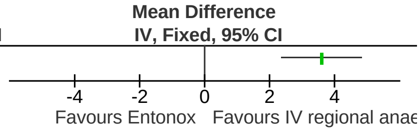


Figure 68: Pain score during reduction

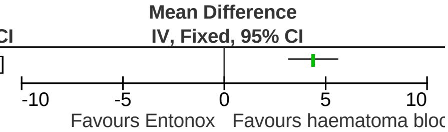
Study or Subgroup	Entonox Mean	Entonox SD	Entonox Total	IV regional anaesthesia Mean	IV regional anaesthesia SD	IV regional anaesthesia Total	Mean Difference IV, Fixed, 95% CI
Goh 2002	5.8	2.8	35	2.2	2.3	32	3.60 [2.38, 4.82]



J.3.1.3 Entonox compared to haematoma block for reduction of displaced distal radius fractures

Figure 69: Pain score during reduction

Study or Subgroup	Entonox Mean	Entonox SD	Entonox Total	Haematoma block Mean	Haematoma block SD	Haematoma block Total	Mean Difference IV, Fixed, 95% CI
Man 2010	7.19	2.76	33	2.8	2.2	34	4.39 [3.19, 5.59]



J.3.1.4 Haematoma block compared to regional nerve block for reduction of displaced distal radius fractures

Figure 70: Need for re-manipulation

Study or Subgroup	Haematoma block Events	Haematoma block Total	Regional nerve block Events	Regional nerve block Total	Risk Ratio M-H, Fixed, 95% CI
Bajracharya 2002	1	50	1	50	1.00 [0.06, 15.55]

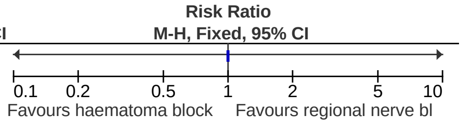


Figure 71: Pain score during reduction

Study or Subgroup	Haematoma block Mean	Haematoma block SD	Haematoma block Total	Regional nerve block Mean	Regional nerve block SD	Regional nerve block Total	Mean Difference IV, Fixed, 95% CI
Bajracharya 2002	2.08	0.85	50	1.7	0.64	50	0.38 [0.09, 0.67]

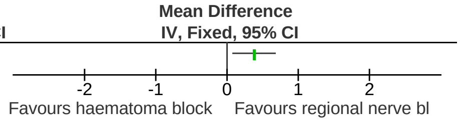


Figure 72: Bronchial spasm

Study or Subgroup	Haematoma block Events	Haematoma block Total	Regional nerve block Events	Regional nerve block Total	Risk Ratio M-H, Fixed, 95% CI
Bajracharya 2002	0	50	1	50	0.33 [0.01, 7.99]

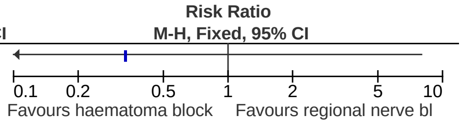


Figure 73: Moderate/severe pain during reduction

Study or Subgroup	Haematoma block Events	Haematoma block Total	Regional nerve block Events	Regional nerve block Total	Risk Ratio M-H, Fixed, 95% CI
Haasio 2002	6	19	9	16	0.56 [0.25, 1.24]

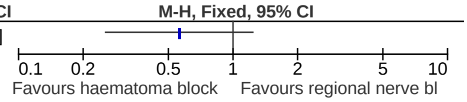
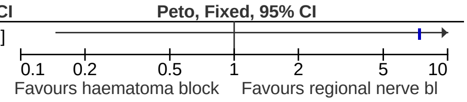


Figure 74: Infection (at block site)

Study or Subgroup	Haematoma block Events	Haematoma block Total	Regional nerve block Events	Regional nerve block Total	Peto Odds Ratio Peto, Fixed, 95% CI
Bajracharya 2002	1	50	0	50	7.39 [0.15, 372.38]



J.3.2 Treatment of torus fractures

J.3.2.1 Rigid cast versus removable splint

Figure 75: mild to moderate pain on activity at 3 weeks

Study or Subgroup	Rigid cast Events	Rigid cast Total	removable splint Events	removable splint Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Karami 2012	24	73	28	64	100.0%	0.75 [0.49, 1.15]
Total (95% CI)		**73**		**64**	**100.0%**	**0.75 [0.49, 1.15]**
Total events	24		28			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.30 (P = 0.19)

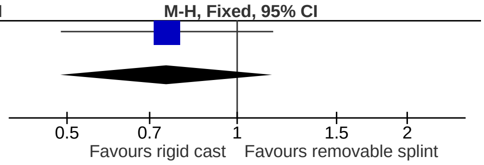


Figure 76: proportion finding treatment convenient at 3 weeks

Study or Subgroup	Rigid cast Events	Rigid cast Total	removable splint Events	removable splint Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Karami 2012	66	73	58	64	100.0%	1.00 [0.89, 1.11]
Total (95% CI)		**73**		**64**	**100.0%**	**1.00 [0.89, 1.11]**
Total events	66		58			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.04 (P = 0.97)

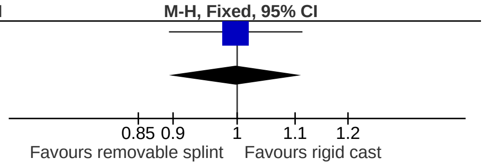


Figure 77: Adverse events – skin problems

Study or Subgroup	Rigid cast Events	Rigid cast Total	removable splint Events	removable splint Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Karami 2012	0	73	11	64	100.0%	0.10 [0.03, 0.34]
Total (95% CI)		**73**		**64**	**100.0%**	**0.10 [0.03, 0.34]**
Total events	0		11			

Heterogeneity: Not applicable
Test for overall effect: Z = 3.68 (P = 0.0002)

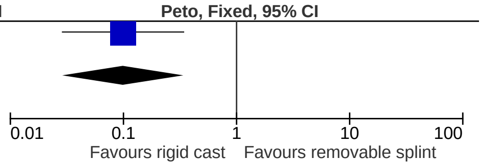


Figure 78: Adverse events oedema

Study or Subgroup	Rigid cast Events	Rigid cast Total	removable splint Events	removable splint Total	Weight	Risk Difference M-H, Fixed, 95% CI
Karami 2012	5	73	0	64	100.0%	0.07 [0.01, 0.13]
Total (95% CI)		**73**		**64**	**100.0%**	**0.07 [0.01, 0.13]**
Total events	5		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 2.12 (P = 0.03)

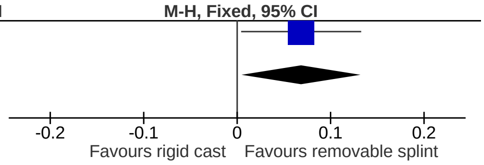


Figure 79: Proportion at 2-4 weeks who would choose to continue with same form of immobilisation in future

Study or Subgroup	Rigid cast Events	Rigid cast Total	removable splint Events	removable splint Total	Weight	Risk Ratio M-H, Random, 95% CI
Oakley 2008	30	42	31	42	37.8%	0.97 [0.74, 1.26]
Plint 2006	5	23	20	21	25.3%	0.23 [0.10, 0.50]
Williams 2013	25	51	36	43	36.9%	0.59 [0.43, 0.80]
Total (95% CI)		**116**		**106**	**100.0%**	**0.56 [0.29, 1.06]**
Total events	60		87			

Heterogeneity: Tau² = 0.27; Chi² = 16.79, df = 2 (P = 0.0002); I² = 88%
Test for overall effect: Z = 1.78 (P = 0.08)

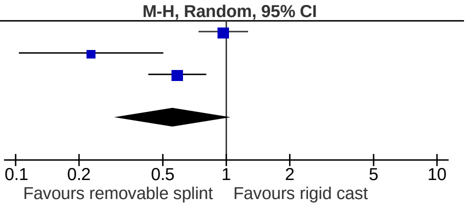


Figure 80: proportion at 2 weeks resuming normal activities

Study or Subgroup	Rigid cast Events	Rigid cast Total	removable splint Events	removable splint Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Oakley 2008	40	42	28	42	100.0%	1.43 [1.14, 1.79]
Total (95% CI)		**42**		**42**	**100.0%**	**1.43 [1.14, 1.79]**
Total events	40		28			

Heterogeneity: Not applicable
Test for overall effect: Z = 3.12 (P = 0.002)

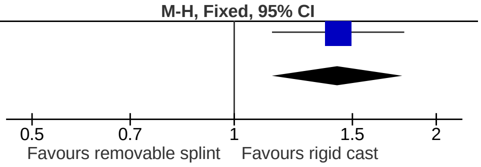


Figure 81: proportion at 2 weeks requiring re-immobilisation

Study or Subgroup	Rigid cast Events	Rigid cast Total	removable splint Events	removable splint Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Oakley 2008	3	42	6	42	100.0%	0.50 [0.13, 1.87]
Total (95% CI)		**42**		**42**	**100.0%**	**0.50 [0.13, 1.87]**
Total events	3		6			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.03 (P = 0.30)

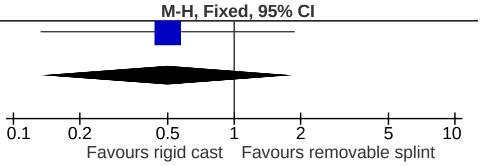
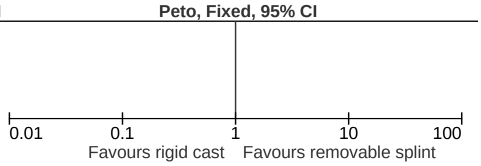


Figure 82: Adverse events – re-fractures

Study or Subgroup	Rigid cast Events	Rigid cast Total	removable splint Events	removable splint Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Plint 2006	0	45	0	42		Not estimable
Total (95% CI)		**45**		**42**		**Not estimable**
Total events	0		0			

Heterogeneity: Not applicable
Test for overall effect: Not applicable



J.3.2.2 Rigid cast versus soft cast

Figure 83: parental problems with casts at 3 weeks

Study or Subgroup	Rigid cast Events	Rigid cast Total	Soft cast Events	Soft cast Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Khan 2007	5	48	1	69	100.0%	7.19 [0.87, 59.59]
Total (95% CI)		**48**		**69**	**100.0%**	**7.19 [0.87, 59.59]**
Total events	5		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.83 (P = 0.07)

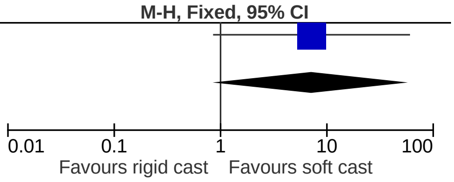


Figure 84: proportion of parents at 3 weeks who would choose to continue the same intervention in the future

Study or Subgroup	Rigid cast Events	Rigid cast Total	Soft cast Events	Soft cast Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Khan 2007	3	48	68	69	100.0%	0.06 [0.02, 0.19]
Total (95% CI)		**48**		**69**	**100.0%**	**0.06 [0.02, 0.19]**
Total events	3		68			

Heterogeneity: Not applicable
Test for overall effect: Z = 4.93 (P < 0.00001)

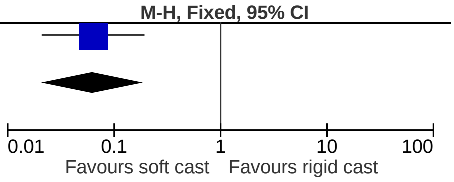
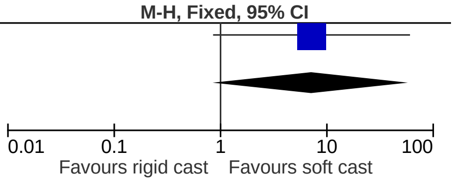


Figure 85: cast complications at 3 weeks

Study or Subgroup	Rigid cast Events	Rigid cast Total	Soft cast Events	Soft cast Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Khan 2007	5	48	1	69	100.0%	7.19 [0.87, 59.59]
Total (95% CI)		**48**		**69**	**100.0%**	**7.19 [0.87, 59.59]**
Total events	5		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.83 (P = 0.07)



J.3.2.3 Rigid cast versus bandages

Figure 86: existence of pain at 4 weeks

Study or Subgroup	rigid cast Events	rigid cast Total	bandaging Events	bandaging Total	Weight	Risk Ratio M-H, Fixed, 95% CI
West 2005	15	21	4	18	100.0%	3.21 [1.30, 7.95]
Total (95% CI)		**21**		**18**	**100.0%**	**3.21 [1.30, 7.95]**
Total events	15		4			

Heterogeneity: Not applicable
Test for overall effect: Z = 2.53 (P = 0.01)

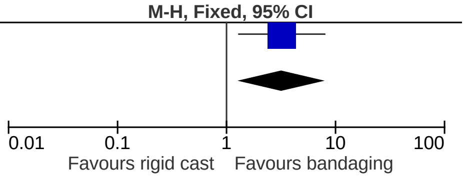


Figure 87: existence of pain for 2 or more days at 4 weeks

Study or Subgroup	rigid cast Events	rigid cast Total	bandaging Events	bandaging Total	Weight	Risk Ratio M-H, Fixed, 95% CI
West 2005	15	21	1	18	100.0%	12.86 [1.88, 88.04]
Total (95% CI)		**21**		**18**	**100.0%**	**12.86 [1.88, 88.04]**
Total events	15		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 2.60 (P = 0.009)

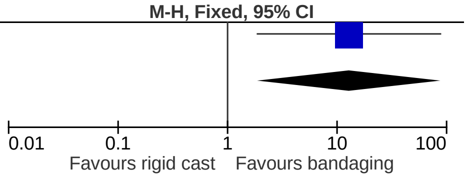


Figure 88: proportion of patients with discomfort during the treatment period

Study or Subgroup	rigid cast Events	rigid cast Total	bandaging Events	bandaging Total	Weight	Risk Ratio M-H, Fixed, 95% CI
West 2005	12	21	1	18	100.0%	10.29 [1.48, 71.61]
Total (95% CI)		**21**		**18**	**100.0%**	**10.29 [1.48, 71.61]**
Total events	12		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 2.35 (P = 0.02)

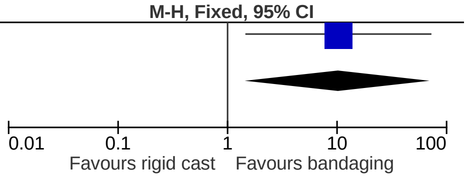
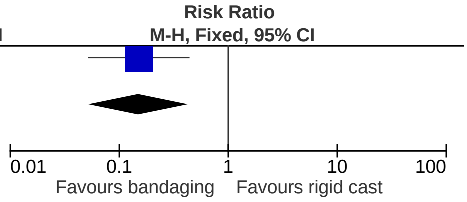


Figure 89: proportion of patients finding treatment convenient at 4 weeks

Study or Subgroup	rigid cast Events	rigid cast Total	bandaging Events	bandaging Total	Weight	Risk Ratio M-H, Fixed, 95% CI
West 2005	3	21	17	18	100.0%	0.15 [0.05, 0.43]
Total (95% CI)		**21**		**18**	**100.0%**	**0.15 [0.05, 0.43]**
Total events	3		17			

Heterogeneity: Not applicable
Test for overall effect: Z = 3.51 (P = 0.0004)



J.3.3 Referral for on-going management from the emergency department

J.3.3.1 Referral pathway decision makers MDT

No intervention after first attendance at fracture clinic (unnecessary attendance)

Figure 90: Consultant versus SHO

Study or Subgroup	Consultant Events	Consultant Total	SHO Events	SHO Total	Risk Ratio M-H, Fixed, 95% CI
EAST 2014	1	6	1	16	2.67 [0.20, 36.20]

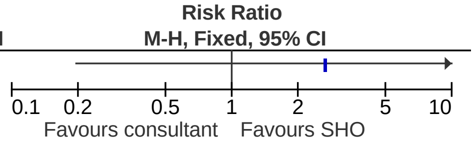


Figure 91: Consultant versus clinical nurse specialist

Study or Subgroup	Consultant Events	Consultant Total	Clinical nurse specialist Events	Clinical nurse specialist Total	Risk Ratio M-H, Fixed, 95% CI
EAST 2014	1	6	4	10	0.42 [0.06, 2.91]

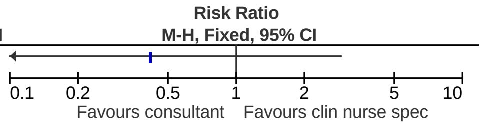


Figure 92: Consultant versus registrar

Study or Subgroup	Consultant Events	Consultant Total	Registrar Events	Registrar Total	Risk Ratio M-H, Fixed, 95% CI
EAST 2014	1	6	10	56	0.93 [0.14, 6.09]

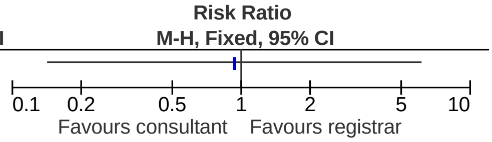


Figure 93: SHO versus clinical nurse specialist

Study or Subgroup	SHO Events	SHO Total	Clinical nurse specialist Events	Clinical nurse specialist Total	Risk Ratio M-H, Fixed, 95% CI
EAST 2014	1	16	4	10	0.16 [0.02, 1.21]

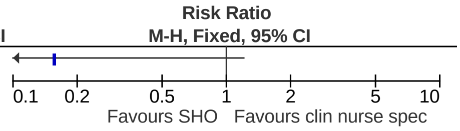


Figure 94: Registrar versus SHO

Study or Subgroup	Registrar Events	Registrar Total	SHO Events	SHO Total	Risk Ratio M-H, Fixed, 95% CI
EAST 2014	10	56	1	16	2.86 [0.39, 20.68]

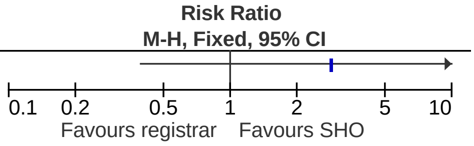
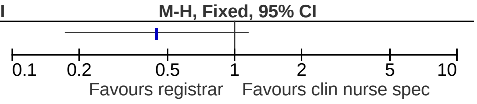


Figure 95: Registrar versus clinical nurse specialist

Study or Subgroup	Registrar Events	Registrar Total	Clinical nurse specialist Events	Clinical nurse specialist Total	Risk Ratio M-H, Fixed, 95% CI
EAST 2014	10	56	4	10	0.45 [0.17, 1.15]



Number of referrals to specialist clinics

Figure 96: Consultant versus senior doctor

Study or Subgroup	Consultant Events	Consultant Total	Senior doctor Events	Senior doctor Total	Risk Ratio M-H, Fixed, 95% CI
Snaith 2014	15	42	73	200	0.98 [0.63, 1.53]

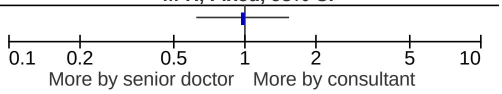


Figure 97: Consultant versus junior doctor

Study or Subgroup	Consultant Events	Consultant Total	Junior doctor Events	Junior doctor Total	Risk Ratio M-H, Fixed, 95% CI
Snaith 2014	15	42	24	70	1.04 [0.62, 1.75]

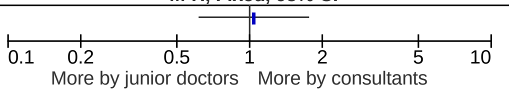


Figure 98: Consultant versus ENP

Study or Subgroup	Consultant Events	Consultant Total	ENP Events	ENP Total	Risk Ratio M-H, Fixed, 95% CI
Snaith 2014	15	42	103	234	0.81 [0.53, 1.25]

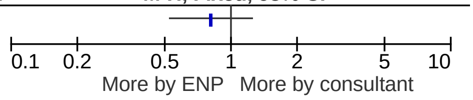


Figure 99: Senior doctor versus junior doctor

Study or Subgroup	Senior doctor Events	Senior doctor Total	Junior doctor Events	Junior doctor Total	Risk Ratio M-H, Fixed, 95% CI
Snaith 2014	73	200	24	70	1.06 [0.73, 1.54]

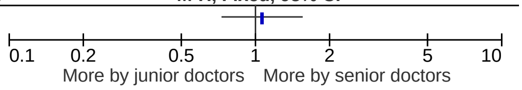


Figure 100: Senior doctor versus ENP

Study or Subgroup	Senior doctor Events	Senior doctor Total	ENP Events	ENP Total	Risk Ratio M-H, Fixed, 95% CI
Snaith 2014	73	200	103	234	0.83 [0.66, 1.05]

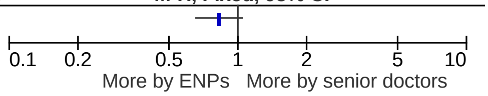
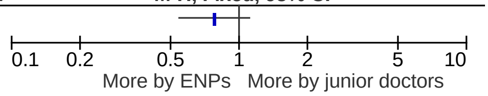


Figure 101: Junior doctor versus ENP

Study or Subgroup	Junior doctor Events	Junior doctor Total	ENP Events	ENP Total	Risk Ratio M-H, Fixed, 95% CI
Snaith 2014	24	70	103	234	0.78 [0.55, 1.11]



J.4 On-going management

J.4.1 Timing of surgery – ankle fractures

J.4.1.1 Surgery <24 hours versus surgery >24 hours

Figure 102: Inpatient length of stay

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Fixed, 95% CI
1.1.1 < 24 hours vs 2-7 days								
James 2001	9.6	5.01	47	14	5.01	40	40.8%	-4.40 [-6.51, -2.29]
Manoukian 2013	4.61	6.93	57	8.1	6.43	41	25.6%	-3.49 [-6.16, -0.82]
Singh 2005	7.1	6.28	22	10.6	6.28	40	17.0%	-3.50 [-6.77, -0.23]
Westacott 2010	3.7	4.4	38	7.2	8.8	33	16.6%	-3.50 [-6.81, -0.19]
Subtotal (95% CI)			**164**			**154**	**100.0%**	**-3.86 [-5.21, -2.52]**
Heterogeneity: Chi² = 0.42, df = 3 (P = 0.94); I² = 0%								
Test for overall effect: Z = 5.62 (P < 0.00001)								
1.1.3 < 24 hours vs 8-13 days								
Hoiness 2000	7.2	4.1	67	19.6	10.3	17	100.0%	-12.40 [-17.39, -7.41]
Subtotal (95% CI)			**67**			**17**	**100.0%**	**-12.40 [-17.39, -7.41]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 4.87 (P < 0.00001)								

Test for subgroup differences: Chi² = 10.46, df = 1 (P = 0.001), I² = 90.4%

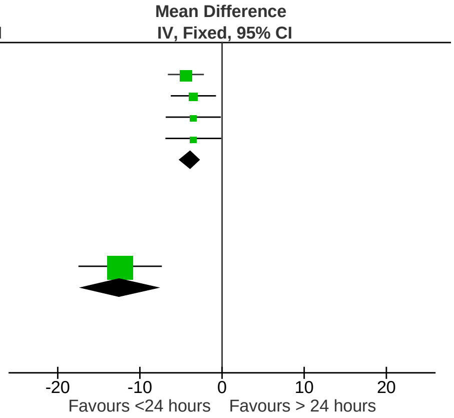


Figure 103: Infection

Study or Subgroup	< 24 hours Events	< 24 hours Total	> 24 hours Events	> 24 hours Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
1.2.1 < 24 hours vs 2-7 days						
Breederveld 1988	3	72	2	20	39.2%	0.33 [0.04, 2.86]
Singh 2005	0	22	6	40	60.8%	0.18 [0.03, 1.06]
Subtotal (95% CI)		**94**		**60**	**100.0%**	**0.23 [0.06, 0.90]**
Total events	3		8			
Heterogeneity: Chi² = 0.16, df = 1 (P = 0.69); I² = 0%						
Test for overall effect: Z = 2.11 (P = 0.03)						
1.2.3 < 24 hours vs 8-13 days						
Hoiness 2000	2	67	3	17	100.0%	0.08 [0.01, 0.70]
Subtotal (95% CI)		**67**		**17**	**100.0%**	**0.08 [0.01, 0.70]**
Total events	2		3			
Heterogeneity: Not applicable						
Test for overall effect: Z = 2.27 (P = 0.02)						
1.2.4 < 24 hours vs > 24 hours						
Schepers 2013	0	60	16	145	100.0%	0.22 [0.07, 0.67]
Subtotal (95% CI)		**60**		**145**	**100.0%**	**0.22 [0.07, 0.67]**
Total events	0		16			
Heterogeneity: Not applicable						
Test for overall effect: Z = 2.67 (P = 0.008)						

Test for subgroup differences: Chi² = 0.79, df = 2 (P = 0.67), I² = 0%

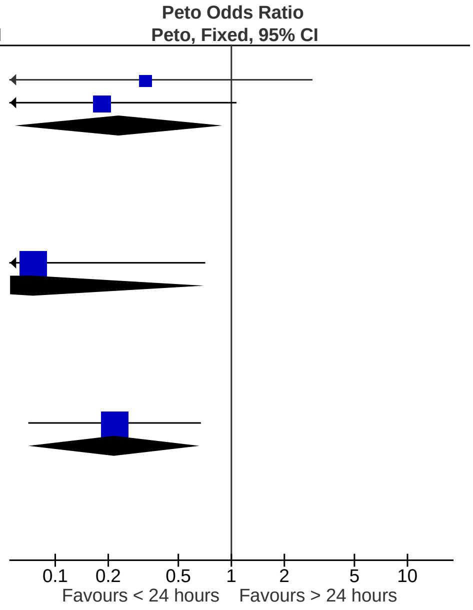
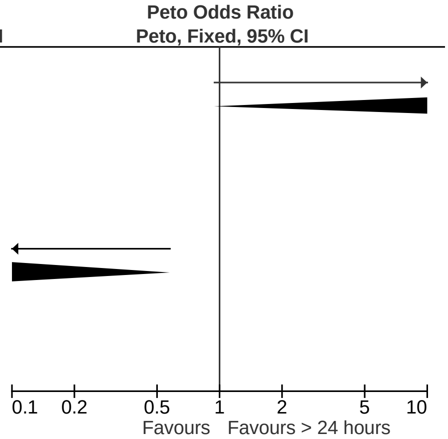


Figure 104: Wound breakdown

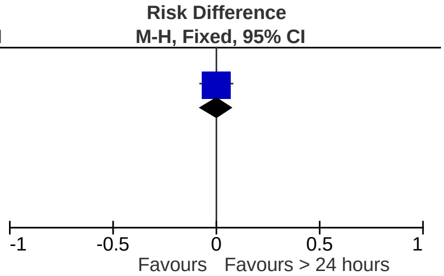
Study or Subgroup	< 24 hours Events	< 24 hours Total	> 24 hours Events	> 24 hours Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
1.3.1 < 24 hours vs 2-7 days						
Singh 2005	2	22	0	40	100.0%	17.55 [0.95, 325.63]
Subtotal (95% CI)		**22**		**40**	**100.0%**	**17.55 [0.95, 325.63]**
Total events	2		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.92 (P = 0.05)						
1.3.2 < 24 hours vs 8-13 days						
Hoiness 2000	3	67	4	17	100.0%	0.09 [0.01, 0.58]
Subtotal (95% CI)		**67**		**17**	**100.0%**	**0.09 [0.01, 0.58]**
Total events	3		4			
Heterogeneity: Not applicable						
Test for overall effect: Z = 2.52 (P = 0.01)						



Test for subgroup differences: Chi² = 8.95, df = 1 (P = 0.003), I² = 88.8%

Figure 105: VTE

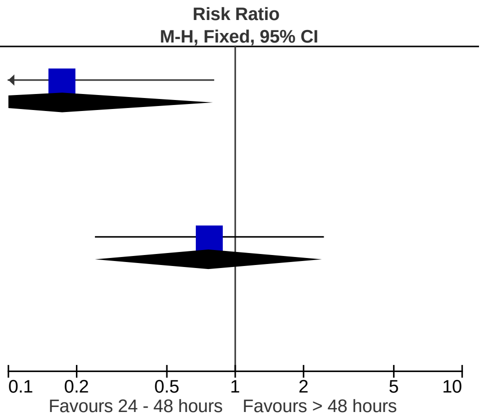
Study or Subgroup	< 24 hours Events	< 24 hours Total	> 24 hours Events	> 24 hours Total	Weight	Risk Difference M-H, Fixed, 95% CI
1.4.2 < 24 hours vs 8-13 days						
Hoiness 2000	0	67	0	17	100.0%	0.00 [-0.08, 0.08]
Subtotal (95% CI)		**67**		**17**	**100.0%**	**0.00 [-0.08, 0.08]**
Total events	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.00 (P = 1.00)						



J.4.1.2 Surgery within 24–48 hours versus surgery >48 hours

Figure 106: Infection

Study or Subgroup	24 - 48 hours Events	24 - 48 hours Total	> 48 hours Events	> 48 hours Total	Weight	Risk Ratio M-H, Fixed, 95% CI
2.2.1 24-48 hours vs 8 - 13 days						
Saithna 2009	2	56	6	29	100.0%	0.17 [0.04, 0.80]
Subtotal (95% CI)		**56**		**29**	**100.0%**	**0.17 [0.04, 0.80]**
Total events	2		6			
Heterogeneity: Not applicable						
Test for overall effect: Z = 2.24 (P = 0.03)						
2.2.2 24-48 hours vs > 14 days						
Konrath 1995	5	105	6	97	100.0%	0.77 [0.24, 2.44]
Subtotal (95% CI)		**105**		**97**	**100.0%**	**0.77 [0.24, 2.44]**
Total events	5		6			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.44 (P = 0.66)						



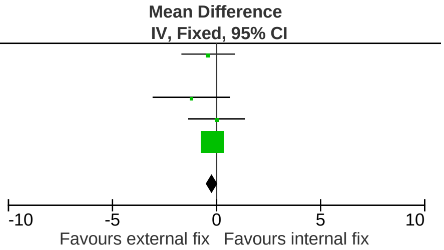
J.4.2 Definitive treatment - distal radial fractures

J.4.2.1 External fixation versus internal fixation in adults

Figure 107: Pain (at 1–2 years)

Study or Subgroup	External fixation Mean	External fixation SD	External fixation Total	Internal fixation Mean	Internal fixation SD	Internal fixation Total	Weight	Mean Difference IV, Fixed, 95% CI
Egol 2008	2.1	2.7	38	2.5	2.9	39	5.4%	-0.40 [-1.65, 0.85]
Gradl 2013	0.1	0.1	44	0	0	44		Not estimable
Grewal 2005	1	3.4	30	2.21	3.4	24	2.5%	-1.21 [-3.03, 0.61]
Wei 2009	1.8	1.3	17	1.8	1.8	9	4.8%	0.00 [-1.33, 1.33]
Williksen 2013	0.1	0.81	54	0.3	0.81	50	87.2%	-0.20 [-0.51, 0.11]
Total (95% CI)			**183**			**166**	**100.0%**	**-0.23 [-0.52, 0.06]**

Heterogeneity: Chi² = 1.33, df = 3 (P = 0.72); I² = 0%
Test for overall effect: Z = 1.53 (P = 0.13)



Note: Sample size was estimated or Wei 2009, based on overall attrition rate. Standard deviations were calculated for Grewal 2005 and Williksen 2013.

Figure 6: Hand and wrist function (at 1 year)

Study or Subgroup	External fixation Mean	External fixation SD	External fixation Total	Internal fixation Mean	Internal fixation SD	Internal fixation Total	Weight	Std. Mean Difference IV, Random, 95% CI
Abramo 2009	14	13	24	8.7	8.9	26	13.3%	0.47 [-0.09, 1.03]
Egol 2008	17.2	33.7	44	13	30.9	44	15.5%	0.13 [-0.29, 0.55]
Gradl 2013	1.18	0.3	44	1.4	0.35	44	15.3%	-0.67 [-1.10, -0.24]
Roh 2015	79	14	38	81	15	36	14.9%	-0.14 [-0.59, 0.32]
Wei 2009	18	14	22	4	5	12	10.6%	1.17 [0.40, 1.93]
Wilcke 2011	15	16.07	30	11	14.1	33	14.3%	0.26 [-0.23, 0.76]
Williksen 2013	15	14.8	54	10	14.8	50	16.0%	0.34 [-0.05, 0.72]
Total (95% CI)			**256**			**245**	**100.0%**	**0.17 [-0.19, 0.54]**

Heterogeneity: Tau² = 0.18; Chi² = 24.36, df = 6 (P = 0.0004); I² = 75%
Test for overall effect: Z = 0.93 (P = 0.35)

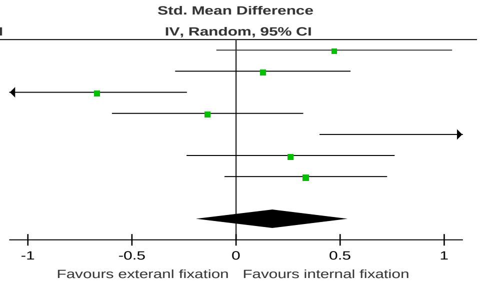


Figure 108: Hand and wrist function (at 6weeks – 2 years; fair/poor)

Study or Subgroup	External fixation Events	External fixation Total	Internal fixation Events	Internal fixation Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Jeudy 2012	28	39	17	36	43.1%	1.52 [1.02, 2.26]
Kapoor 2000	4	18	7	19	16.6%	0.60 [0.21, 1.72]
Leung 2008	3	49	2	54	4.6%	1.65 [0.29, 9.48]
Shukla 2014	9	62	13	48	35.7%	0.54 [0.25, 1.15]
Total (95% CI)		**168**		**157**	**100.0%**	**1.02 [0.73, 1.43]**
Total events	44		39			

Heterogeneity: Chi² = 7.85, df = 3 (P = 0.05); I² = 62%
Test for overall effect: Z = 0.13 (P = 0.89)

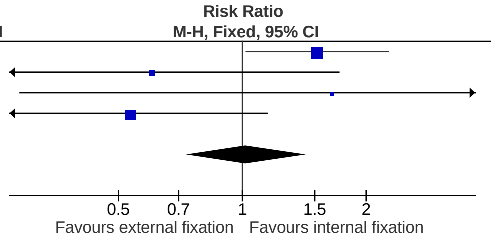


Figure 109: Pin site infection (at 6 weeks–2 years)

Study or Subgroup	External fixation Events	External fixation Total	Internal fixation Events	Internal fixation Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Abramo 2009	1	24	0	26	2.6%	8.03 [0.16, 406.02]
Egol 2008	2	38	0	39	5.1%	7.79 [0.48, 126.95]
Grewal 2005	2	30	0	24	5.0%	6.26 [0.37, 104.63]
Grewal 2011	8	24	0	26	17.6%	11.37 [2.54, 50.84]
Kapoor 2000	1	28	1	29	5.0%	1.04 [0.06, 17.00]
Leung 2008	5	49	0	54	12.3%	8.92 [1.49, 53.43]
Mcqueen 1996	7	30	1	30	18.1%	5.48 [1.25, 24.00]
Roh 2015	3	38	1	36	9.9%	2.68 [0.36, 19.87]
Wilcke 2011	4	30	0	33	9.8%	9.09 [1.22, 67.91]
Williksen 2013	6	59	0	52	14.7%	7.18 [1.39, 37.05]
Xu 2009	0	14	0	16		Not estimable
Total (95% CI)		**364**		**365**	**100.0%**	**6.41 [3.42, 12.02]**
Total events	39		3			

Heterogeneity: Chi² = 3.26, df = 9 (P = 0.95); I² = 0%
Test for overall effect: Z = 5.80 (P < 0.00001)

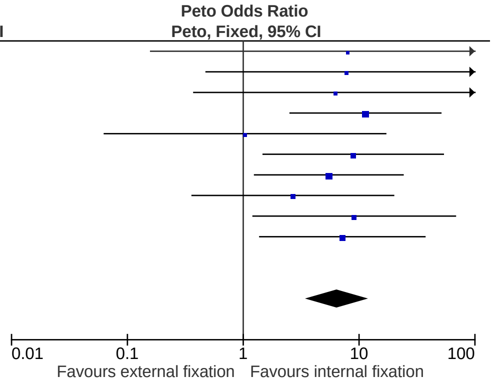


Figure 110: Post traumatic osteoarthritis (at 2–7 years)

Study or Subgroup	External fixation Events	External fixation Total	Internal fixation Events	Internal fixation Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Abramo 2009	4	24	2	24	5.8%	2.00 [0.40, 9.91]
Leung 2008	40	49	30	54	83.3%	1.47 [1.12, 1.93]
Xu 2009	4	14	4	16	10.9%	1.14 [0.35, 3.74]
Total (95% CI)		**87**		**94**	**100.0%**	**1.46 [1.11, 1.93]**
Total events	48		36			

Heterogeneity: Chi² = 0.31, df = 2 (P = 0.85); I² = 0%
Test for overall effect: Z = 2.70 (P = 0.007)

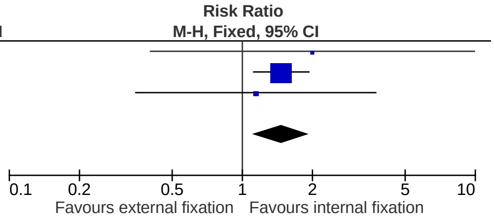


Figure 111: Complex regional pain syndrome (at 1-2 years)

Study or Subgroup	External fixation Events	External fixation Total	Internal fixation Events	Internal fixation Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Abramo 2009	2	24	1	26	5.1%	2.17 [0.21, 22.39]
Grewal 2005	2	30	3	24	17.7%	0.53 [0.10, 2.94]
Grewal 2011	1	24	0	26	2.5%	3.24 [0.14, 75.91]
Jeudy 2012	12	39	7	36	38.6%	1.58 [0.70, 3.57]
Kapoor 2000	1	28	0	29	2.6%	3.10 [0.13, 73.12]
Leung 2008	1	49	0	54	2.5%	3.30 [0.14, 79.16]
Mcqueen 1996	4	30	1	30	5.3%	4.00 [0.47, 33.73]
Roh 2015	1	38	1	36	5.4%	0.95 [0.06, 14.59]
Shukla 2014	0	62	1	48	8.9%	0.26 [0.01, 6.23]
Williksen 2013	4	59	2	52	11.3%	1.76 [0.34, 9.23]
Xu 2009	0	14	0	16		Not estimable
Total (95% CI)		**397**		**377**	**100.0%**	**1.55 [0.90, 2.66]**
Total events	28		16			

Heterogeneity: Chi² = 4.32, df = 9 (P = 0.89); I² = 0%
Test for overall effect: Z = 1.58 (P = 0.11)

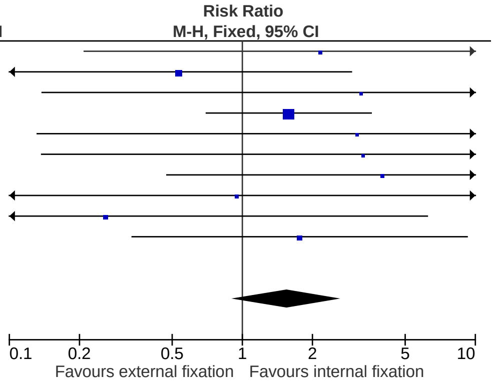


Figure 112: Need for further surgery (at 1–7 years)

Study or Subgroup	External fixation Events	External fixation Total	Internal fixation Events	Internal fixation Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Abramo 2009	5	24	1	26	11.0%	5.42 [0.68, 43.10]
Egol 2008	2	38	5	39	56.4%	0.41 [0.08, 1.99]
Wilcke 2011	2	30	3	33	32.6%	0.73 [0.13, 4.09]
Total (95% CI)		**92**		**98**	**100.0%**	**1.07 [0.44, 2.58]**
Total events	9		9			

Heterogeneity: Chi² = 3.95, df = 2 (P = 0.14); I² = 49%
Test for overall effect: Z = 0.14 (P = 0.89)

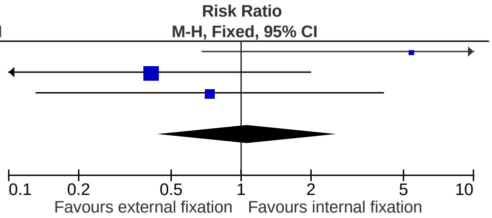
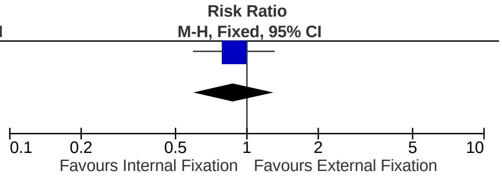


Figure 113: Return to normal activity

Study or Subgroup	External fixation Events	External fixation Total	Internal fixation Events	Internal fixation Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Jeudy 2012	21	39	22	36	100.0%	0.88 [0.60, 1.30]
Total (95% CI)		**39**		**36**	**100.0%**	**0.88 [0.60, 1.30]**
Total events	21		22			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.64 (P = 0.53)



J.4.2.2 External fixation versus plaster cast/splint in adults

Figure 114: Quality of life (at 3 months)

Study or Subgroup	External fixation Mean	External fixation SD	External fixation Total	Plaster cast/splint Mean	Plaster cast/splint SD	Plaster cast/splint Total	Weight	Mean Difference IV, Fixed, 95% CI
Moroni 2004	67.1	13.2	20	66.2	13.1	20	100.0%	0.90 [-7.25, 9.05]
Total (95% CI)			**20**			**20**	**100.0%**	**0.90 [-7.25, 9.05]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.22 (P = 0.83)

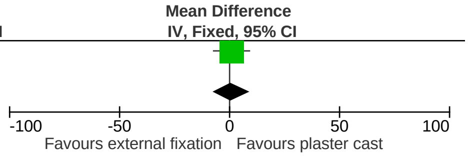


Figure 115: Pain (at 2 years)

Study or Subgroup	External fixation Mean	External fixation SD	External fixation Total	Plaster cast/splint Mean	Plaster cast/splint SD	Plaster cast/splint Total	Weight	Mean Difference IV, Fixed, 95% CI
Kreder 2006	0.5	0.9	54	0.1	1.1	59	100.0%	0.40 [0.03, 0.77]
Total (95% CI)			**54**			**59**	**100.0%**	**0.40 [0.03, 0.77]**

Heterogeneity: Not applicable
Test for overall effect: Z = 2.12 (P = 0.03)

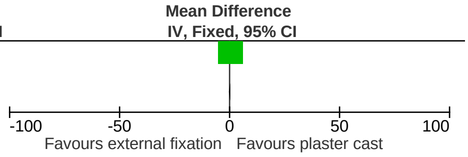


Figure 116: Pain (at 3 months – 7 years)

Study or Subgroup	External fixation Events	External fixation Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Hegeman 2004	2	15	3	17	7.2%	0.76 [0.15, 3.93]
Ur 2012	17	30	28	30	71.3%	0.61 [0.44, 0.84]
Young 2003	6	36	10	49	21.6%	0.82 [0.33, 2.04]
Total (95% CI)		**81**		**96**	**100.0%**	**0.66 [0.47, 0.93]**
Total events	25		41			

Heterogeneity: Chi² = 0.50, df = 2 (P = 0.78); I² = 0%
Test for overall effect: Z = 2.39 (P = 0.02)

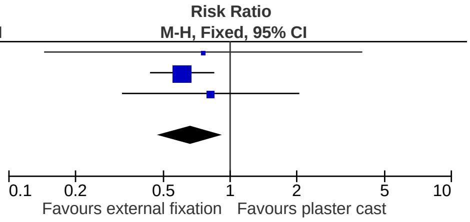


Figure 117: Hand and wrist function (at 6 weeks – 7 years; poor/fair)

Study or Subgroup	External fixation Events	External fixation Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Abbaszadegan 1990	3	22	7	19	9.0%	0.37 [0.11, 1.24]
Foldhazy 2010	13	22	19	29	19.7%	0.90 [0.58, 1.40]
Hegeman 2004	2	15	3	17	3.4%	0.76 [0.15, 3.93]
Howard 1989	6	25	7	25	8.4%	0.86 [0.34, 2.19]
Ismatullah 2012	4	15	8	15	9.6%	0.50 [0.19, 1.31]
Jenkins 1988	15	59	9	41	12.7%	1.16 [0.56, 2.39]
Kapoor 2000	4	18	13	23	13.7%	0.39 [0.15, 1.00]
Merchan 1992	7	35	15	35	18.0%	0.47 [0.22, 1.00]
Roumen 1991	9	21	3	22	3.5%	3.14 [0.98, 10.04]
Young 2003	2	36	2	49	2.0%	1.36 [0.20, 9.21]
Total (95% CI)		**268**		**275**	**100.0%**	**0.78 [0.60, 1.02]**
Total events	65		86			

Heterogeneity: Chi² = 13.54, df = 9 (P = 0.14); I² = 34%
Test for overall effect: Z = 1.83 (P = 0.07)

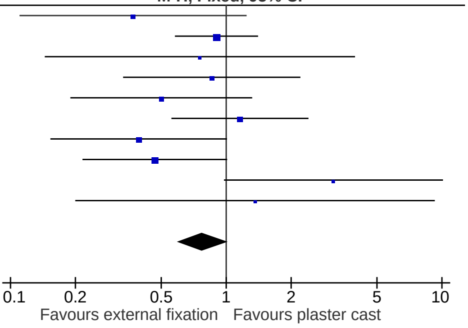


Figure 118: Pin site infection (at 6 weeks – 2 years)

Study or Subgroup	External fixation Events	External fixation Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Abbaszadegan 1990	3	23	0	24	11.9%	8.47 [0.84, 85.71]
Howard 1989	2	25	0	25	8.1%	7.70 [0.47, 126.75]
Ismatullah 2012	2	15	0	15	8.0%	7.94 [0.47, 133.26]
Kapoor 2000	1	28	0	33	4.1%	8.83 [0.17, 451.12]
Kreder 2006	6	43	1	36	26.6%	3.92 [0.83, 18.44]
Mcqueen 1996	7	30	1	30	29.2%	5.48 [1.25, 24.00]
Ur 2012	3	30	0	30	12.0%	7.93 [0.79, 79.26]
Total (95% CI)		**194**		**193**	**100.0%**	**5.96 [2.68, 13.25]**
Total events	24		2			

Heterogeneity: Chi² = 0.55, df = 6 (P = 1.00); I² = 0%
Test for overall effect: Z = 4.38 (P < 0.0001)

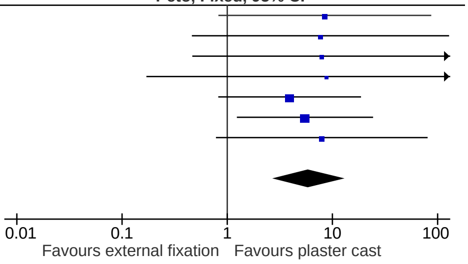


Figure 119: Post traumatic osteoarthritis (at 1 year)

Study or Subgroup	External fixation Events	External fixation Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Foldhazy 2010	6	28	8	31	100.0%	0.83 [0.33, 2.10]
Total (95% CI)		**28**		**31**	**100.0%**	**0.83 [0.33, 2.10]**
Total events	6		8			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.39 (P = 0.69)

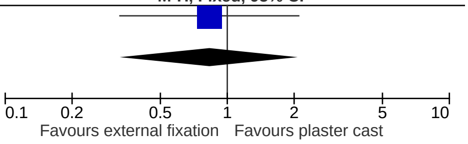


Figure 120: Complex regional pain syndrome (at 6 months)

Study or Subgroup	External fixation Events	External fixation Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Foldhazy 2010	2	28	2	31	11.5%	1.11 [0.17, 7.34]
Hegeman 2004	1	15	0	17	2.9%	3.38 [0.15, 77.12]
Howard 1989	0	25	0	25		Not estimable
Ismatullah 2012	1	15	3	15	18.2%	0.33 [0.04, 2.85]
Kapoor 2000	1	28	0	33	2.8%	3.52 [0.15, 83.07]
Kreder 2006	1	43	2	36	13.2%	0.42 [0.04, 4.43]
Mcqueen 1996	4	30	1	30	6.1%	4.00 [0.47, 33.73]
Merchan 1992	0	35	2	35	15.2%	0.20 [0.01, 4.02]
Roumen 1991	4	21	2	22	11.9%	2.10 [0.43, 10.26]
Ur 2012	2	30	3	30	18.2%	0.67 [0.12, 3.71]
Total (95% CI)		**270**		**274**	**100.0%**	**1.08 [0.57, 2.06]**
Total events	16		15			

Heterogeneity: Chi² = 6.45, df = 8 (P = 0.60); I² = 0%
Test for overall effect: Z = 0.24 (P = 0.81)

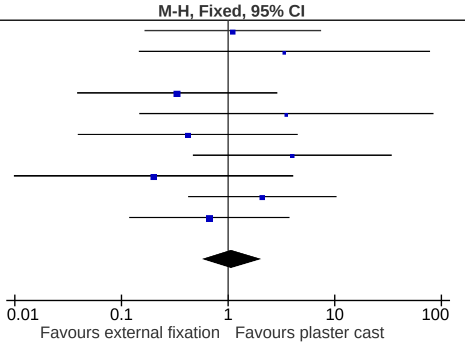
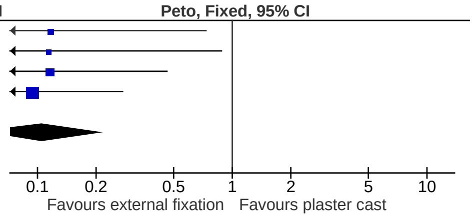


Figure 121: Need for further surgery (at 8 weeks–6 months)

Study or Subgroup	External fixation Events	External fixation Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Abbaszadegan 1990	0	23	5	24	15.3%	0.12 [0.02, 0.73]
Moroni 2004	0	20	4	20	12.4%	0.11 [0.01, 0.88]
Pring 1988	0	36	9	39	26.9%	0.12 [0.03, 0.46]
Ur 2012	2	30	18	30	45.5%	0.09 [0.03, 0.27]
Total (95% CI)		**109**		**113**	**100.0%**	**0.11 [0.05, 0.22]**
Total events	2		36			

Heterogeneity: Chi² = 0.08, df = 3 (P = 0.99); I² = 0%
Test for overall effect: Z = 6.14 (P < 0.00001)

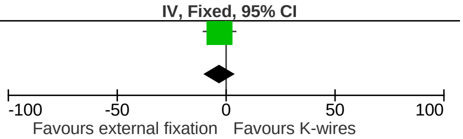


J.4.2.3 External fixation versus percutaneous wiring in adults

Figure 122: Quality of life (at 1 year)

Study or Subgroup	External fixation Mean	External fixation SD	External fixation Total	K-wires Mean	K-wires SD	K-wires Total	Weight	Mean Difference IV, Fixed, 95% CI
Harley 2004	45	11	17	48	11	17	100.0%	-3.00 [-10.39, 4.39]
Total (95% CI)			**17**			**17**	**100.0%**	**-3.00 [-10.39, 4.39]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.80 (P = 0.43)



Note: Sample size for Harley 2004 was estimated from overall attrition rate

Figure 123: Pain (at 2 years)

Study or Subgroup	External fixation Mean	External fixation SD	External fixation Total	K-wires Mean	K-wires SD	K-wires Total	Weight	Mean Difference IV, Fixed, 95% CI
Belloti 2010	1.4	1.5	46	1.2	1.4	45	100.0%	0.20 [-0.40, 0.80]
Total (95% CI)			**46**			**45**	**100.0%**	**0.20 [-0.40, 0.80]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.66 (P = 0.51)

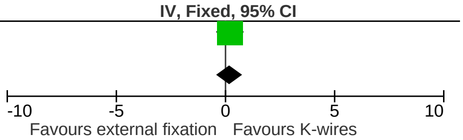
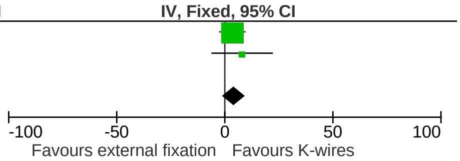


Figure 124: Hand and wrist function (at 1–2 years)

Study or Subgroup	External fixation Mean	External fixation SD	External fixation Total	K-wires Mean	K-wires SD	K-wires Total	Weight	Mean Difference IV, Fixed, 95% CI
Belloti 2010	12.9	15.2	46	9.4	12.9	45	85.2%	3.50 [-2.29, 9.29]
Harley 2004	23	23	17	15	18	17	14.8%	8.00 [-5.88, 21.88]
Total (95% CI)			**63**			**62**	**100.0%**	**4.17 [-1.18, 9.51]**

Heterogeneity: Chi² = 0.34, df = 1 (P = 0.56); I² = 0%
Test for overall effect: Z = 1.53 (P = 0.13)



Note: Sample size for Harley 2004 was estimated from overall attrition rate

Figure 125: Hand and wrist function (at 6 months–2 years; poor/fair)

Study or Subgroup	External fixation Events	External fixation Total	K-wires Events	K-wires Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Hutchinson 1995	1	26	2	26	34.1%	0.50 [0.05, 5.18]
Ludvigsen 1997	5	29	4	31	65.9%	1.34 [0.40, 4.50]
Total (95% CI)		**55**		**57**	**100.0%**	**1.05 [0.37, 3.02]**
Total events	6		6			

Heterogeneity: Chi² = 0.54, df = 1 (P = 0.46); I² = 0%
Test for overall effect: Z = 0.09 (P = 0.93)

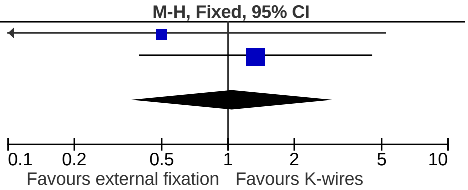
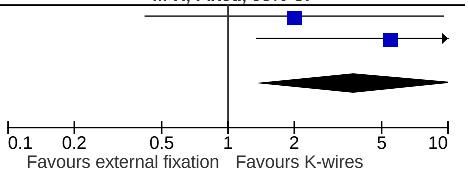


Figure 126: Infection (at 1 year)

Study or Subgroup	External fixation Events	External fixation Total	K-wires Events	K-wires Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Harley 2004	4	17	2	17	50.0%	2.00 [0.42, 9.50]
Hutchinson 1995	11	26	2	26	50.0%	5.50 [1.35, 22.42]
Total (95% CI)		**43**		**43**	**100.0%**	**3.75 [1.35, 10.44]**
Total events	15		4			

Heterogeneity: Chi² = 0.91, df = 1 (P = 0.34); I² = 0%
Test for overall effect: Z = 2.53 (P = 0.01)

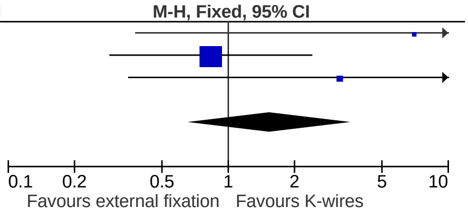


Note: Sample size for Harley 2004 was estimated from overall attrition rate

Figure 127: Complex regional pain syndrome (at 1 year)

Study or Subgroup	External fixation Events	External fixation Total	K-wires Events	K-wires Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Harley 2004	3	25	0	25	6.7%	7.00 [0.38, 128.87]
Hutchinson 1995	5	26	6	26	80.4%	0.83 [0.29, 2.39]
Ludvigsen 1997	3	29	1	31	12.9%	3.21 [0.35, 29.11]
Total (95% CI)		**80**		**82**	**100.0%**	**1.55 [0.66, 3.64]**
Total events	11		7			

Heterogeneity: Chi² = 2.78, df = 2 (P = 0.25); I² = 28%
Test for overall effect: Z = 1.01 (P = 0.31)



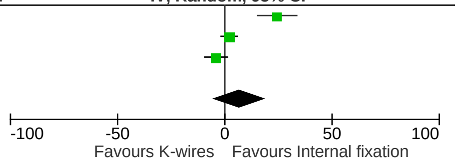
Note: Sample size for Harley 2004 was estimated from overall attrition rate

J.4.2.4 Internal fixation versus percutaneous wiring in adults

Figure 128: Quality of life (at 1 year)

Study or Subgroup	Internal fixation Mean	Internal fixation SD	Internal fixation Total	K-wires Mean	K-wires SD	K-wires Total	Weight	Mean Difference IV, Random, 95% CI
Bahari-Kashani 2012	66.5	27.4	57	42.1	22.3	57	30.3%	24.40 [15.23, 33.57]
Costa 2014	85	19	194	83	19	204	35.4%	2.00 [-1.73, 5.73]
Karantana 2013	77	18	64	81	12	66	34.3%	-4.00 [-9.28, 1.28]
Total (95% CI)			**315**			**327**	**100.0%**	**6.73 [-5.38, 18.84]**

Heterogeneity: Tau² = 104.10; Chi² = 27.80, df = 2 (P < 0.00001); I² = 93%
Test for overall effect: Z = 1.09 (P = 0.28)



Note: Analysis conducted using random effects model

Figure 129: Pain (at 1 year)

Study or Subgroup	Internal fixation Mean	Internal fixation SD	Internal fixation Total	K-wires Mean	K-wires SD	K-wires Total	Weight	Mean Difference IV, Fixed, 95% CI
Bahari-Kashani 2012	62.8	14.1	57	54.3	7.7	57	100.0%	8.50 [4.33, 12.67]
Total (95% CI)			**57**			**57**	**100.0%**	**8.50 [4.33, 12.67]**

Heterogeneity: Not applicable
Test for overall effect: Z = 3.99 (P < 0.0001)

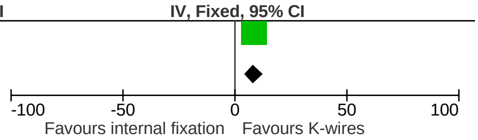


Figure 130: Pain (at 1 year)

Study or Subgroup	Internal fixation Events	Internal fixation Total	K-wires Events	K-wires Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Karantana 2013	3	66	3	64	100.0%	0.97 [0.20, 4.63]
Total (95% CI)		**66**		**64**	**100.0%**	**0.97 [0.20, 4.63]**
Total events	3		3			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.04 (P = 0.97)

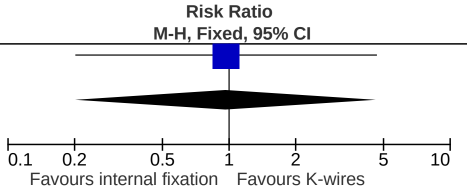


Figure 131: Return to normal activities (at 1 year)

Study or Subgroup	Internal fixation Mean	Internal fixation SD	Internal fixation Total	K-wires Mean	K-wires SD	K-wires Total	Weight	Mean Difference IV, Fixed, 95% CI
Rozental 2009	17	21	21	26	27	21	100.0%	-9.00 [-23.63, 5.63]
Total (95% CI)			**21**			**21**	**100.0%**	**-9.00 [-23.63, 5.63]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.21 (P = 0.23)

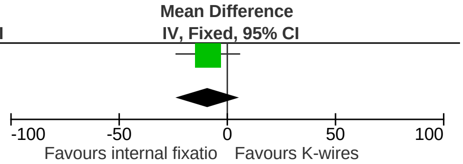
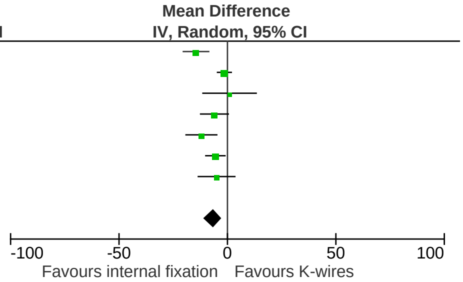


Figure 132: Hand and wrist function (at 6 months–1 year)

Study or Subgroup	Internal fixation Mean	Internal fixation SD	Internal fixation Total	K-wires Mean	K-wires SD	K-wires Total	Weight	Mean Difference IV, Random, 95% CI
Bahari-Kashani 2012	24.8	19.5	57	39.3	11.3	57	15.4%	-14.50 [-20.35, -8.65]
Costa 2014	13.9	17.1	204	15.3	15.8	211	19.8%	-1.40 [-4.57, 1.77]
Hollevoet 2011	14	16	15	13	20	18	7.4%	1.00 [-11.29, 13.29]
Karantana 2013	21	17	66	27	20	64	14.5%	-6.00 [-12.39, 0.39]
Marcheix 2010	10	14	50	22	22	53	13.4%	-12.00 [-19.08, -4.92]
McFadyen 2011	15.89	8.44	27	21.45	8.44	29	17.8%	-5.56 [-9.98, -1.14]
Rozental 2009	4	8	21	9	18	21	11.5%	-5.00 [-13.42, 3.42]
Total (95% CI)			**440**			**453**	**100.0%**	**-6.49 [-10.59, -2.40]**

Heterogeneity: $Tau^2 = 19.42$; $Chi^2 = 19.82$, df = 6 (P = 0.003); $I^2 = 70\%$
Test for overall effect: Z = 3.11 (P = 0.002)



Note: Analysis conducted using random effects model

Figure 133: Pin site infection (at 1 year)

Study or Subgroup	Internal fixation Events	Internal fixation Total	K-wires Events	K-wires Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Bahari-Kashani 2012	0	57	1	57	5.3%	0.14 [0.00, 6.82]
Hollevoet 2011	1	16	3	15	19.2%	0.31 [0.04, 2.42]
Karantana 2013	2	66	5	64	35.6%	0.39 [0.09, 1.80]
McFadyen 2011	0	27	5	29	24.7%	0.12 [0.02, 0.77]
Rozental 2009	0	21	3	21	15.2%	0.12 [0.01, 1.24]
Total (95% CI)		**187**		**186**	**100.0%**	**0.22 [0.09, 0.55]**
Total events	3		17			

Heterogeneity: $Chi^2 = 1.34$, df = 4 (P = 0.85); $I^2 = 0\%$
Test for overall effect: Z = 3.25 (P = 0.001)

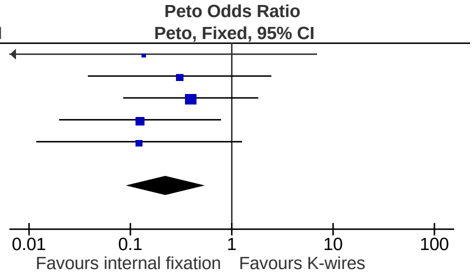


Figure 134: Complex regional pain syndrome (at 6 months)

Study or Subgroup	Internal fixation Events	Internal fixation Total	K-wires Events	K-wires Total	Weight	Risk Difference M-H, Fixed, 95% CI
McFadyen 2011	0	27	0	29	100.0%	0.00 [-0.07, 0.07]
Total (95% CI)		**27**		**29**	**100.0%**	**0.00 [-0.07, 0.07]**
Total events	0		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.00 (P = 1.00)

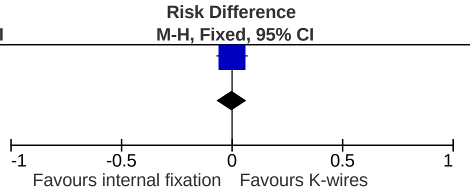
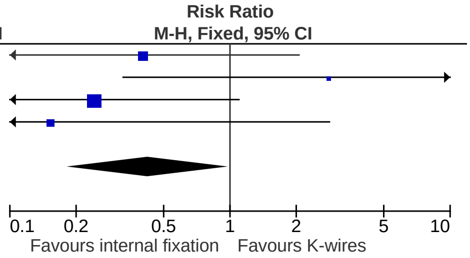


Figure 135: Need for further surgery (at 1 year)

Study or Subgroup	Internal fixation Events	Internal fixation Total	K-wires Events	K-wires Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Costa 2014	2	228	5	230	28.4%	0.40 [0.08, 2.06]
Hollevoet 2011	3	16	1	15	5.9%	2.81 [0.33, 24.16]
Karantana 2013	2	66	8	64	46.4%	0.24 [0.05, 1.10]
McFadyen 2011	0	27	3	29	19.3%	0.15 [0.01, 2.83]
Total (95% CI)		**337**		**338**	**100.0%**	**0.42 [0.18, 0.98]**
Total events	7		17			

Heterogeneity: Chi² = 3.97, df = 3 (P = 0.26); I² = 24%
Test for overall effect: Z = 2.01 (P = 0.04)



J.4.2.5 Internal fixation versus plaster cast/splint in adults

Figure 136: Quality of life (EQ5D utility at 12 months)

Study or Subgroup	Internal fixation Mean	Internal fixation SD	Internal fixation Total	Plaster cast/splint Mean	Plaster cast/splint SD	Plaster cast/splint Total	Weight	Mean Difference IV, Fixed, 95% CI
Bartl 2014	0.89	0.21	68	0.89	0.18	81	100.0%	0.00 [-0.06, 0.06]
Total (95% CI)			**68**			**81**	**100.0%**	**0.00 [-0.06, 0.06]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.00 (P = 1.00)

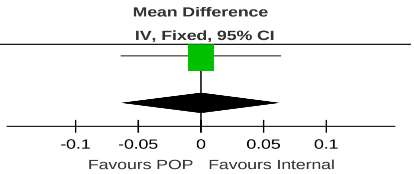


Figure 137: Quality of life (SF36 physical at 12 months)

Study or Subgroup	Internal fixation Mean	Internal fixation SD	Internal fixation Total	Plaster cast/splint Mean	Plaster cast/splint SD	Plaster cast/splint Total	Weight	Mean Difference IV, Fixed, 95% CI
Bartl 2014	48.6	10.4	68	45.3	11.3	81	100.0%	3.30 [-0.19, 6.79]
Total (95% CI)			**68**			**81**	**100.0%**	**3.30 [-0.19, 6.79]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.85 (P = 0.06)

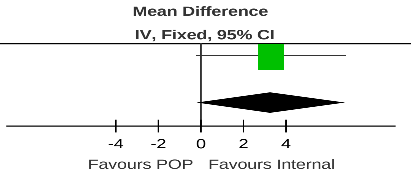


Figure 138: Quality of life (SF36 mental at 12 months)

Study or Subgroup	Internal fixation Mean	Internal fixation SD	Internal fixation Total	Plaster cast/splint Mean	Plaster cast/splint SD	Plaster cast/splint Total	Weight	Mean Difference IV, Fixed, 95% CI
Bartl 2014	53.8	7.6	68	53.6	9.1	81	100.0%	0.20 [-2.48, 2.88]
Total (95% CI)			**68**			**81**	**100.0%**	**0.20 [-2.48, 2.88]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.15 (P = 0.88)

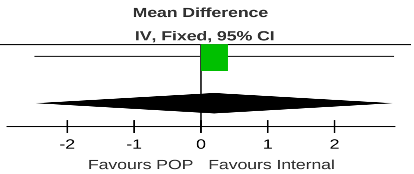


Figure 139: Pain (at 12 weeks)

Study or Subgroup	Internal fixation Mean	Internal fixation SD	Internal fixation Total	Plaster cast/splint Mean	Plaster cast/splint SD	Plaster cast/splint Total	Weight	Mean Difference IV, Fixed, 95% CI
Arora 2011	0.2	0.7	36	0.3	0.8	37	100.0%	-0.10 [-0.44, 0.24]
Total (95% CI)			**36**			**37**	**100.0%**	**-0.10 [-0.44, 0.24]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.57 (P = 0.57)

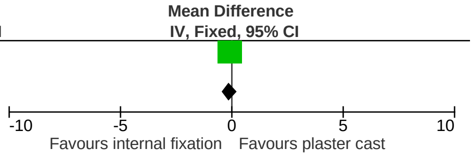


Figure 140: Hand and wrist function (at 1 year)

Study or Subgroup	Internal fixation Mean	SD	Total	Plaster cast/splint Mean	SD	Total	Weight	Std. Mean Difference IV, Fixed, 95% CI
Arora 2011	12.8	23.2	36	14.6	22.8	37	33.2%	-0.08 [-0.54, 0.38]
Bartl 2014	14	16.1	68	19	21.3	81	66.8%	-0.26 [-0.58, 0.06]
Total (95% CI)			**104**			**118**	**100.0%**	**-0.20 [-0.46, 0.06]**

Heterogeneity: Chi² = 0.41, df = 1 (P = 0.52); I² = 0%
Test for overall effect: Z = 1.48 (P = 0.14)

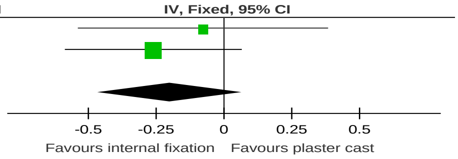


Figure 141: Hand and wrist function (at 6–7 weeks; poor/fair)

Study or Subgroup	Internal fixation Events	Total	Plaster cast/splint Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Kapoor 2000	7	19	13	23	100.0%	0.65 [0.33, 1.30]
Total (95% CI)		**19**		**23**	**100.0%**	**0.65 [0.33, 1.30]**
Total events	7		13			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.22 (P = 0.22)

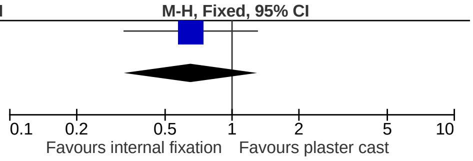


Figure 142: Pin site infection (at 6 weeks–1 year)

Study or Subgroup	Internal fixation Events	Total	Plaster cast/splint Events	Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Kapoor 2000	1	29	0	33	49.9%	8.48 [0.17, 430.97]
Mcqueen 1996	1	30	0	30	50.1%	7.39 [0.15, 372.38]
Total (95% CI)		**59**		**63**	**100.0%**	**7.92 [0.49, 126.92]**
Total events	2		0			

Heterogeneity: Chi² = 0.00, df = 1 (P = 0.96); I² = 0%
Test for overall effect: Z = 1.46 (P = 0.14)

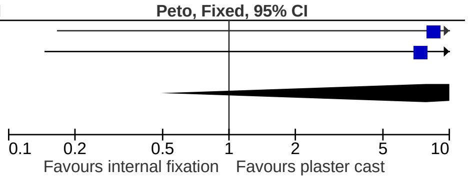
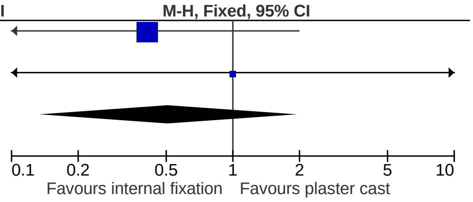


Figure 143: Complex regional pain syndrome (at 1 year)

Study or Subgroup	Internal fixation Events	Total	Plaster cast/splint Events	Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Arora 2011	2	36	5	37	83.1%	0.41 [0.09, 1.98]
Kapoor 2000	0	29	0	33		Not estimable
Mcqueen 1996	1	30	1	30	16.9%	1.00 [0.07, 15.26]
Total (95% CI)		**95**		**100**	**100.0%**	**0.51 [0.13, 1.95]**
Total events	3		6			

Heterogeneity: Chi² = 0.31, df = 1 (P = 0.58); I² = 0%
Test for overall effect: Z = 0.98 (P = 0.32)

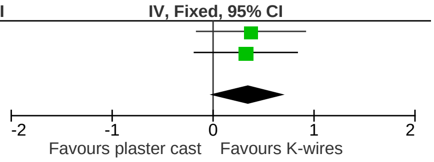


J.4.2.6 K-wires versus plaster cast/splint in adults

Figure 144: Quality of life (at 1 year)

Study or Subgroup	K-wires Mean	SD	Total	Plaster cast/splint Mean	SD	Total	Weight	Std. Mean Difference IV, Fixed, 95% CI
Azzopardi 2005	42.2	9.7	27	38.2	11.2	27	47.2%	0.38 [-0.16, 0.91]
Wong 2010	3.7	0.7	30	3.5	0.5	30	52.8%	0.32 [-0.19, 0.83]
Total (95% CI)			**57**			**57**	**100.0%**	**0.35 [-0.02, 0.72]**

Heterogeneity: Chi² = 0.02, df = 1 (P = 0.89); I² = 0%
Test for overall effect: Z = 1.85 (P = 0.06)



Note: *Azzopardi 2005 assessed the physical component of the SF-36. Scale and calculation of final quality of life score in Wong 2010 unclear.*

Figure 145: Pain (at 1 year)

Study or Subgroup	K-wires Mean	K-wires SD	K-wires Total	Plaster cast/splint Mean	Plaster cast/splint SD	Plaster cast/splint Total	Weight	Mean Difference IV, Fixed, 95% CI
Azzopardi 2005	0.7	1.3	27	1.2	1.6	27	100.0%	-0.50 [-1.28, 0.28]
Total (95% CI)			**27**			**27**	**100.0%**	**-0.50 [-1.28, 0.28]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.26 (P = 0.21)

Mean Difference IV, Fixed, 95% CI

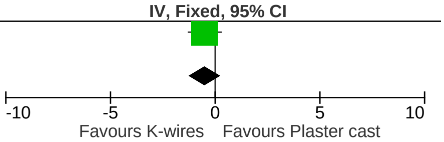


Figure 146: Return to normal activities (at 1 year)

Study or Subgroup	K-wires Mean	K-wires SD	K-wires Total	Plaster cast/splint Mean	Plaster cast/splint SD	Plaster cast/splint Total	Weight	Mean Difference IV, Fixed, 95% CI
Azzopardi 2005	9.7	2.2	27	9.4	2.5	27	100.0%	0.30 [-0.96, 1.56]
Total (95% CI)			**27**			**27**	**100.0%**	**0.30 [-0.96, 1.56]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.47 (P = 0.64)

Mean Difference IV, Fixed, 95% CI

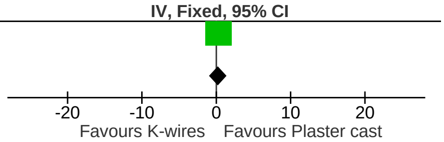


Figure 147: Hand and wrist function (at 1 year; change score)

Study or Subgroup	K-wires Mean	K-wires SD	K-wires Total	Plaster cast/splint Mean	Plaster cast/splint SD	Plaster cast/splint Total	Weight	Mean Difference IV, Fixed, 95% CI
Stoffelen 1998	19	37.4	48	34	37.4	50	100.0%	-15.00 [-29.81, -0.19]
Total (95% CI)			**48**			**50**	**100.0%**	**-15.00 [-29.81, -0.19]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.98 (P = 0.05)

Mean Difference IV, Fixed, 95% CI

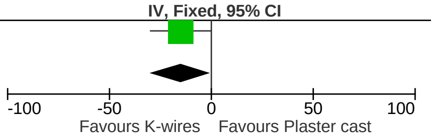


Figure 148: Hand and wrist function (at 1 year; final value)

Study or Subgroup	K-wires Mean	K-wires SD	K-wires Total	Plaster cast/splint Mean	Plaster cast/splint SD	Plaster cast/splint Total	Weight	Mean Difference IV, Fixed, 95% CI
Wong 2010	17.8	6.2	30	19.5	7.5	30	100.0%	-1.70 [-5.18, 1.78]
Total (95% CI)			**30**			**30**	**100.0%**	**-1.70 [-5.18, 1.78]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.96 (P = 0.34)

Mean Difference IV, Fixed, 95% CI

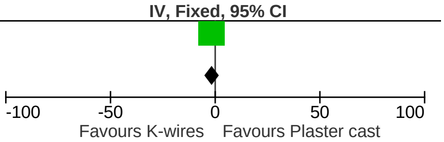


Figure 149: Hand and wrist function (at 7 weeks–6 months; fair/poor)

Study or Subgroup	K-wires Events	K-wires Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Gupta 1999	2	25	6	25	23.8%	0.33 [0.07, 1.50]
Rodriguez-Merchan 1997	2	20	9	20	35.7%	0.22 [0.05, 0.90]
Shankar 1992	4	23	10	22	40.5%	0.38 [0.14, 1.04]
Total (95% CI)		**68**		**67**	**100.0%**	**0.31 [0.15, 0.64]**
Total events	8		25			

Heterogeneity: Chi² = 0.39, df = 2 (P = 0.82); I² = 0%
Test for overall effect: Z = 3.17 (P = 0.002)

Risk Ratio M-H, Fixed, 95% CI

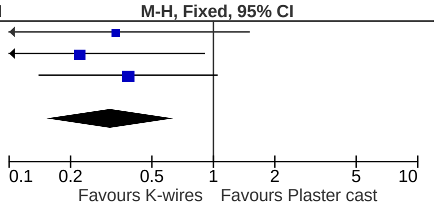


Figure 150: Pin site infection (at 7 weeks–1 year)

Study or Subgroup	K-wires Events	K-wires Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Azzopardi 2005	1	27	0	27	19.9%	3.00 [0.13, 70.53]
Mardani 2011	15	99	0	99	19.9%	31.00 [1.88, 511.05]
Rodriguez-Merchan 1997	2	20	0	20	19.9%	5.00 [0.26, 98.00]
Shankar 1992	1	23	0	22	20.3%	2.88 [0.12, 67.03]
Wong 2010	1	30	0	30	19.9%	3.00 [0.13, 70.83]
Total (95% CI)		**199**		**198**	**100.0%**	**8.95 [2.46, 32.62]**
Total events	20		0			

Heterogeneity: Chi² = 2.32, df = 4 (P = 0.68); I² = 0%
Test for overall effect: Z = 3.32 (P = 0.0009)

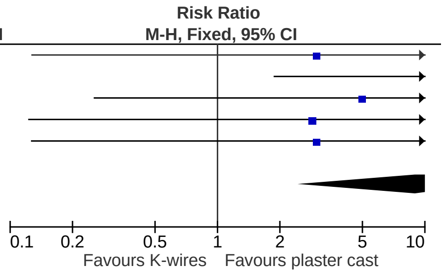


Figure 151: Complex regional pain syndrome (at 7 weeks–1 year)

Study or Subgroup	K-wires Events	K-wires Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Rodriguez-Merchan 1997	1	20	1	20	49.4%	1.00 [0.06, 16.58]
Shankar 1992	0	23	1	22	25.3%	0.13 [0.00, 6.52]
Wong 2010	0	30	1	30	25.3%	0.14 [0.00, 6.82]
Total (95% CI)		**73**		**72**	**100.0%**	**0.36 [0.05, 2.58]**
Total events	1		3			

Heterogeneity: Chi² = 1.01, df = 2 (P = 0.60); I² = 0%
Test for overall effect: Z = 1.02 (P = 0.31)

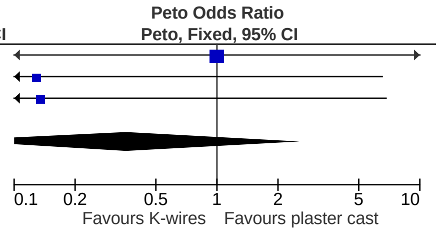
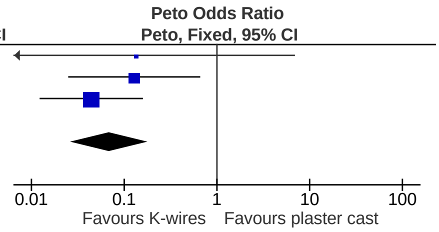


Figure 152: Need for further surgery (at 1 week–1 year)

Study or Subgroup	K-wires Events	K-wires Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Azzopardi 2005	0	27	1	27	6.1%	0.14 [0.00, 6.82]
Mardani 2011	0	99	6	99	35.5%	0.13 [0.03, 0.65]
Rodriguez-Merchan 1997	0	20	15	20	58.4%	0.04 [0.01, 0.16]
Total (95% CI)		**146**		**146**	**100.0%**	**0.07 [0.03, 0.18]**
Total events	0		22			

Heterogeneity: Chi² = 1.16, df = 2 (P = 0.56); I² = 0%
Test for overall effect: Z = 5.42 (P < 0.00001)



J.4.2.7 Percutaneous wiring versus plaster cast/splint in children

Figure 153: Hand and wrist function (at 6 months)

Study or Subgroup	K-wires Mean	K-wires SD	K-wires Total	Plaster cast/splint Mean	Plaster cast/splint SD	Plaster cast/splint Total	Weight	Mean Difference IV, Fixed, 95% CI
Colaris 2013	41.9	0.4	60	41.5	1.6	63	100.0%	0.40 [-0.01, 0.81]
Total (95% CI)			**60**			**63**	**100.0%**	**0.40 [-0.01, 0.81]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.92 (P = 0.05)

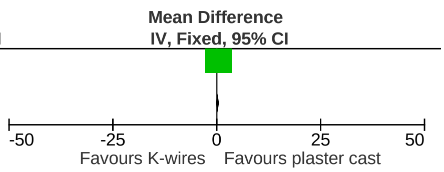


Figure 154: Pin site infection (at 1–6 months)

Study or Subgroup	K-wires Events	K-wires Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Colaris 2013	2	60	0	63	50.6%	7.90 [0.49, 127.87]
Miller 2005	2	16	0	18	49.4%	8.95 [0.53, 150.07]
Total (95% CI)		**76**		**81**	**100.0%**	**8.40 [1.16, 60.92]**
Total events	4		0			

Heterogeneity: Chi² = 0.00, df = 1 (P = 0.95); I² = 0%
Test for overall effect: Z = 2.11 (P = 0.04)

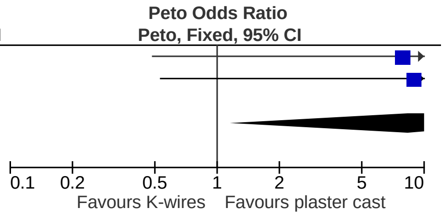
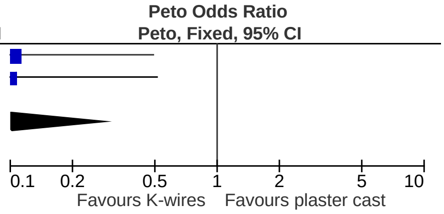


Figure 155: Need for further surgery (at 1–3 months)

Study or Subgroup	K-wires Events	K-wires Total	Plaster cast/splint Events	Plaster cast/splint Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Mclauchlan 2002	0	35	7	33	52.7%	0.10 [0.02, 0.49]
Miller 2005	0	16	7	18	47.3%	0.10 [0.02, 0.51]
Total (95% CI)		**51**		**51**	**100.0%**	**0.10 [0.03, 0.31]**
Total events	0		14			

Heterogeneity: Chi² = 0.00, df = 1 (P = 0.97); I² = 0%
Test for overall effect: Z = 3.97 (P < 0.0001)



J.4.3 Definitive treatment - humerus fractures

J.4.3.1 Hemiarthroplasty versus Conservative

Figure 156: Mortality at 1–2 years

Study or Subgroup	Hemiarthroplasty Events	Hemiarthroplasty Total	Conservative Events	Conservative Total	Weight	Risk Ratio M-H, Random, 95% CI
Boons 2012	0	24	1	24	22.7%	0.33 [0.01, 7.80]
Olerud 2011	3	27	2	28	77.3%	1.56 [0.28, 8.59]
Total (95% CI)		**51**		**52**	**100.0%**	**1.10 [0.24, 4.93]**
Total events	3		3			

Heterogeneity: Tau² = 0.00; Chi² = 0.72, df = 1 (P = 0.40); I² = 0%
Test for overall effect: Z = 0.12 (P = 0.90)

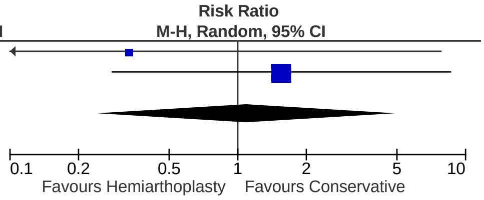


Figure 157: Health related quality of life (EQ-5D) at 2 years

Study or Subgroup	Hemiarthroplasty Mean	Hemiarthroplasty SD	Hemiarthroplasty Total	Conservative Mean	Conservative SD	Conservative Total	Weight	Mean Difference IV, Fixed, 95% CI
Olerud 2011	0.81	0.12	24	0.65	0.27	25	100.0%	0.16 [0.04, 0.28]
Total (95% CI)			**24**			**25**	**100.0%**	**0.16 [0.04, 0.28]**

Heterogeneity: Not applicable
Test for overall effect: Z = 2.70 (P = 0.007)

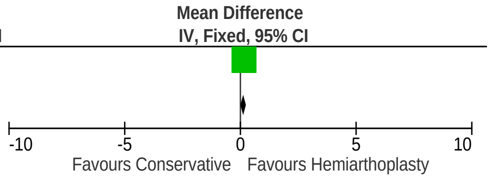


Figure 158: Constant score at 1–2 years

Study or Subgroup	Hemiarthroplasty Mean	Hemiarthroplasty SD	Hemiarthroplasty Total	Conservative Mean	Conservative SD	Conservative Total	Weight	Mean Difference IV, Fixed, 95% CI
Boons 2012	64	15.8	23	60	17.6	24	54.7%	4.00 [-5.55, 13.55]
Olerud 2011	48.3	16.4	24	49.6	20.5	24	45.3%	-1.30 [-11.80, 9.20]
Total (95% CI)			**47**			**48**	**100.0%**	**1.60 [-5.47, 8.67]**

Heterogeneity: Chi² = 0.54, df = 1 (P = 0.46); I² = 0%
Test for overall effect: Z = 0.44 (P = 0.66)

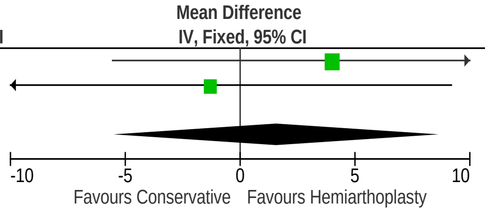


Figure 159: DASH score at 2 years

Study or Subgroup	Hemiarthroplasty Mean	Hemiarthroplasty SD	Hemiarthroplasty Total	Conservative Mean	Conservative SD	Conservative Total	Weight	Mean Difference IV, Fixed, 95% CI
Olerud 2011	30.2	18.3	24	36.9	21.3	24	100.0%	-6.70 [-17.93, 4.53]
Total (95% CI)			**24**			**24**	**100.0%**	**-6.70 [-17.93, 4.53]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.17 (P = 0.24)

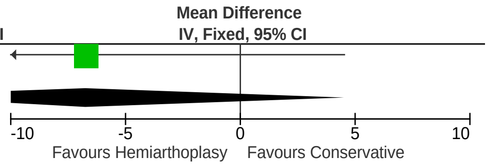


Figure 160: Need for further operative treatment at 1–2 years

Study or Subgroup	Hemiarthroplasty Events	Hemiarthroplasty Total	Conservative Events	Conservative Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Boons 2012	1	25	1	25	50.5%	1.00 [0.07, 15.12]
Olerud 2011	3	27	1	28	49.5%	3.11 [0.34, 28.09]
Total (95% CI)		**52**		**53**	**100.0%**	**2.05 [0.39, 10.66]**
Total events	4		2			

Heterogeneity: Chi² = 0.41, df = 1 (P = 0.52); I² = 0%
Test for overall effect: Z = 0.85 (P = 0.40)

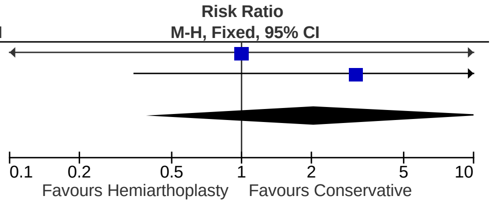
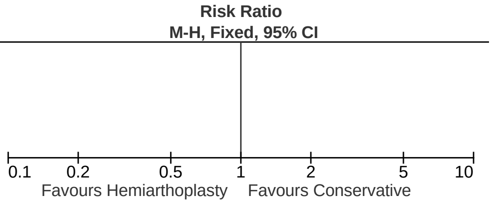


Figure 161: Infection at 2 years

Study or Subgroup	Hemiarthroplasty Events	Hemiarthroplasty Total	Conservative Events	Conservative Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Boons 2012	0	23	0	24		Not estimable
Olerud 2011	0	27	0	28		Not estimable
Total (95% CI)		**50**		**52**		**Not estimable**
Total events	0		0			
Heterogeneity: Not applicable						
Test for overall effect: Not applicable						



J.4.3.2 Hemiarthroplasty versus Open Reduction

Figure 162: Mortality at 2 years

Study or Subgroup	Hemiarthroplasty Events	Hemiarthroplasty Total	Open Reduction Events	Open Reduction Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Cai 2012	1	16	0	12	100.0%	5.75 [0.11, 302.04]
Total (95% CI)		**16**		**12**	**100.0%**	**5.75 [0.11, 302.04]**
Total events	1		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.87 (P = 0.39)						

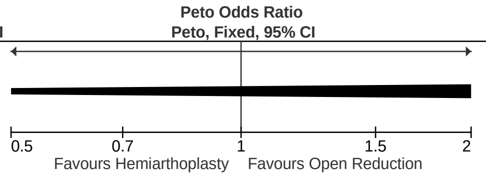


Figure 163: Health related quality of life (EQ-5D) at 2 years

Study or Subgroup	Hemiarthroplasty Mean	Hemiarthroplasty SD	Hemiarthroplasty Total	Open Reduction Mean	Open Reduction SD	Open Reduction Total	Weight	Mean Difference IV, Fixed, 95% CI
Cai 2012	0.81	0.17	15	0.74	0.26	12	100.0%	0.07 [-0.10, 0.24]
Total (95% CI)			**15**			**12**	**100.0%**	**0.07 [-0.10, 0.24]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.81 (P = 0.42)								

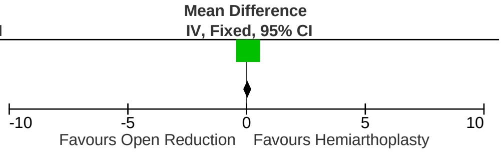
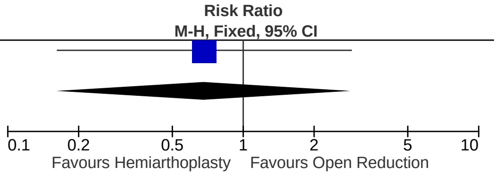


Figure 164: Need for further operative treatment at 2 years

Study or Subgroup	Hemiarthroplasty Events	Hemiarthroplasty Total	Open Reduction Events	Open Reduction Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Cai 2012	3	19	3	13	100.0%	0.68 [0.16, 2.88]
Total (95% CI)		**19**		**13**	**100.0%**	**0.68 [0.16, 2.88]**
Total events	3		3			
Heterogeneity: Not applicable						
Test for overall effect: Z = 0.52 (P = 0.60)						



J.4.3.3 Open Reduction versus Conservative

Figure 165: Mortality at 1 year

Study or Subgroup	Open reduction Events	Open reduction Total	Conservative Events	Conservative Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Fjalestad 2012	2	25	0	25	100.0%	7.70 [0.47, 126.75]
Total (95% CI)		**25**		**25**	**100.0%**	**7.70 [0.47, 126.75]**
Total events	2		0			
Heterogeneity: Not applicable						
Test for overall effect: Z = 1.43 (P = 0.15)						

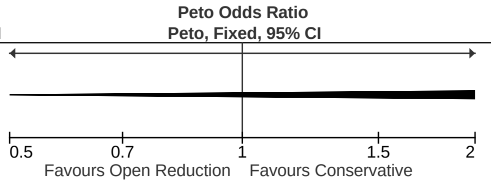


Figure 166: Health related quality of life

<Click here and insert picture with the Graphic tools on the Toolbar Ribbon>

Study or Subgroup	Experimental Mean	Experimental SD	Experimental Total	Control Mean	Control SD	Control Total	Weight	Mean Difference IV, Fixed, 95% CI
Fjalestad 2014a	0.849	0.1047	23	0.825	0.1047	25	100.0%	0.02 [-0.04, 0.08]
Total (95% CI)			**23**			**25**	**100.0%**	**0.02 [-0.04, 0.08]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.79 (P = 0.43)

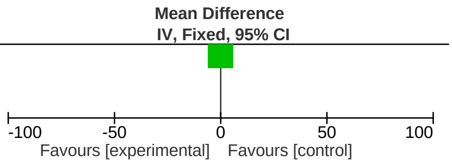


Figure 167: Constant Score at 2–4 years

Study or Subgroup	Open Reduction Mean	Open Reduction SD	Open Reduction Total	Conservative Mean	Conservative SD	Conservative Total	Weight	Mean Difference IV, Fixed, 95% CI
Fjalestad 2014a	75.1	22.2	23	77.1	22.5302	25	54.4%	-2.00 [-14.66, 10.66]
Zyto 1997	60	19	14	65	19	15	45.6%	-5.00 [-18.84, 8.84]
Total (95% CI)			**37**			**40**	**100.0%**	**-3.37 [-12.71, 5.97]**

Heterogeneity: Chi² = 0.10, df = 1 (P = 0.75); I² = 0%
Test for overall effect: Z = 0.71 (P = 0.48)

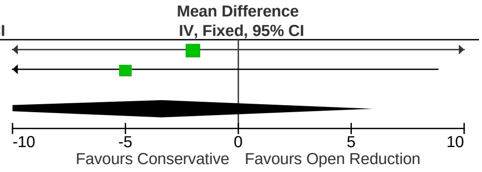


Figure 168: Infection at 4 years

Study or Subgroup	Open Reduction Events	Open Reduction Total	Conservative Events	Conservative Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Zyto 1997	2	14	0	15	100.0%	8.57 [0.51, 144.39]
Total (95% CI)		**14**		**15**	**100.0%**	**8.57 [0.51, 144.39]**
Total events	2		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.49 (P = 0.14)

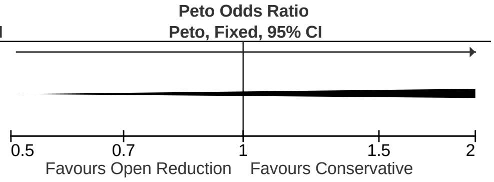


Figure 169: Avascular necrosis at 2 years

Study or Subgroup	Open Reduction Events	Open Reduction Total	Conservative Events	Conservative Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Fjalestad 2014a	12	23	15	25	100.0%	0.87 [0.52, 1.44]
Total (95% CI)		**23**		**25**	**100.0%**	**0.87 [0.52, 1.44]**
Total events	12		15			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.54 (P = 0.59)

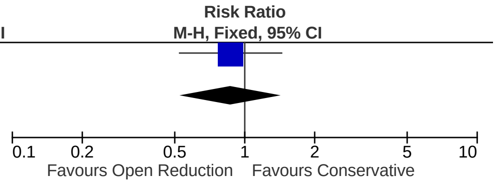


Figure 170: Need for further operative treatment at 2 years

Study or Subgroup	Open Reduction Events	Open Reduction Total	Conservative Events	Conservative Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Fjalestad 2012	4	23	1	25	100.0%	4.35 [0.52, 36.11]
Total (95% CI)		**23**		**25**	**100.0%**	**4.35 [0.52, 36.11]**
Total events	4		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.36 (P = 0.17)

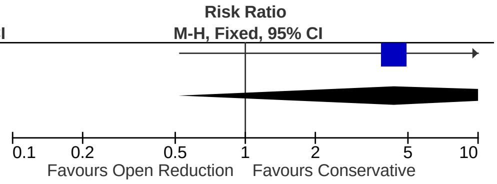
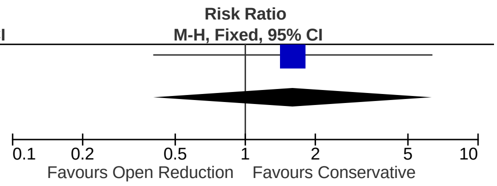


Figure 171: Nerve damage at 1 year

Study or Subgroup	Open Reduction Events	Open Reduction Total	Conservative Events	Conservative Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Fjalestad 2012	4	20	3	24	100.0%	1.60 [0.40, 6.32]
Total (95% CI)		**20**		**24**	**100.0%**	**1.60 [0.40, 6.32]**
Total events	4		3			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.67 (P = 0.50)



J.4.3.4 Reverse shoulder replacement versus Hemiarthroplasty

Figure 172: Mortality at 1 year

Study or Subgroup	Hemiarthroplasty Events	Hemiarthroplasty Total	Reverse Shoulder Events	Reverse Shoulder Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Sebastia-Forcada 2014	1	31	0	31	100.0%	7.39 [0.15, 372.38]
Total (95% CI)		**31**		**31**	**100.0%**	**7.39 [0.15, 372.38]**
Total events	1		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.00 (P = 0.32)

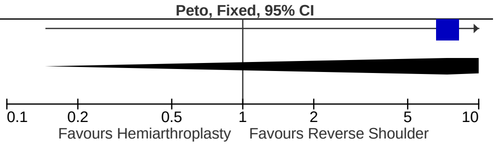


Figure 173: Constant score at 2 years

Study or Subgroup	Hemiarthroplasty Mean	Hemiarthroplasty SD	Hemiarthroplasty Total	Reverse Shoulder Mean	Reverse Shoulder SD	Reverse Shoulder Total	Weight	Mean Difference IV, Fixed, 95% CI
Sebastia-Forcada 2014	40	18.15	30	56.1	18.15	31	100.0%	-16.10 [-25.21, -6.99]
Total (95% CI)			**30**			**31**	**100.0%**	**-16.10 [-25.21, -6.99]**

Heterogeneity: Not applicable
Test for overall effect: Z = 3.46 (P = 0.0005)

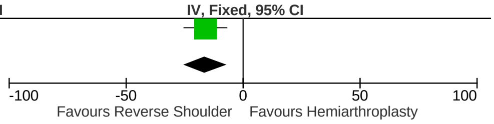


Figure 174: QuickDASH at 2 years

Study or Subgroup	Hemiarthroplasty Mean	Hemiarthroplasty SD	Hemiarthroplasty Total	Reverse Shoulder Mean	Reverse Shoulder SD	Reverse Shoulder Total	Weight	Mean Difference IV, Fixed, 95% CI
Sebastia-Forcada 2014	24.4	7.78	30	17.5	7.78	31	100.0%	6.90 [2.99, 10.81]
Total (95% CI)			**30**			**31**	**100.0%**	**6.90 [2.99, 10.81]**

Heterogeneity: Not applicable
Test for overall effect: Z = 3.46 (P = 0.0005)

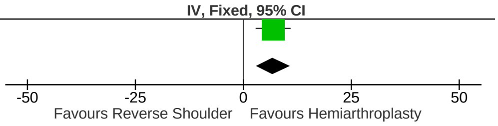


Figure 175: Infection at 2 years

Study or Subgroup	Hemiarthroplasty Events	Hemiarthroplasty Total	Reverse Shoulder Events	Reverse Shoulder Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Sebastia-Forcada 2014	1	30	1	31	100.0%	1.03 [0.07, 15.78]
Total (95% CI)		**30**		**31**	**100.0%**	**1.03 [0.07, 15.78]**
Total events	1		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.02 (P = 0.98)

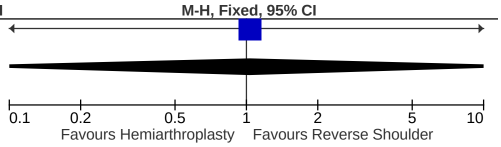
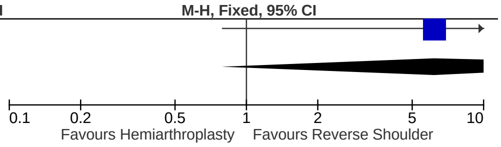


Figure 176: Need for further operative treatment

Study or Subgroup	Hemiarthroplasty Events	Hemiarthroplasty Total	Reverse Shoulder Events	Reverse Shoulder Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Sebastia-Forcada 2014	6	30	1	31	100.0%	6.20 [0.79, 48.48]
Total (95% CI)		**30**		**31**	**100.0%**	**6.20 [0.79, 48.48]**
Total events	6		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.74 (P = 0.08)



J.4.3.5 Surgical (Combined) versus Conservative

Figure 177: Mortality at 1–2 Years

Study or Subgroup	Surgical Events	Surgical Total	Conservative Events	Conservative Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Boons 2012	0	24	1	24	16.7%	0.33 [0.01, 7.80]
Fjalestad 2014a	2	25	0	25	5.6%	5.00 [0.25, 99.16]
Handoll 2015	9	125	5	125	55.8%	1.80 [0.62, 5.22]
Olerud 2011	3	27	2	28	21.9%	1.56 [0.28, 8.59]
Total (95% CI)		**201**		**202**	**100.0%**	**1.68 [0.75, 3.75]**
Total events	14		8			

Heterogeneity: Chi² = 1.55, df = 3 (P = 0.67); I² = 0%
Test for overall effect: Z = 1.26 (P = 0.21)

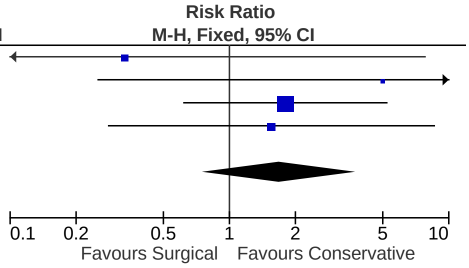


Figure 178: Health related quality of life (EQ-5D) at 2 years

Study or Subgroup	Surgical Mean	Surgical SD	Surgical Total	Conservative Mean	Conservative SD	Conservative Total	Weight	Mean Difference IV, Fixed, 95% CI
Fjalestad 2014a	0.849	0.1047	23	0.825	0.1047	25	55.7%	0.02 [-0.04, 0.08]
Handoll 2015	0.67	0.3	109	0.69	0.31	109	29.8%	-0.02 [-0.10, 0.06]
Olerud 2011	0.81	0.12	24	0.65	0.27	25	14.5%	0.16 [0.04, 0.28]
Total (95% CI)			**156**			**159**	**100.0%**	**0.03 [-0.01, 0.07]**

Heterogeneity: Chi² = 6.31, df = 2 (P = 0.04); I² = 68%
Test for overall effect: Z = 1.35 (P = 0.18)

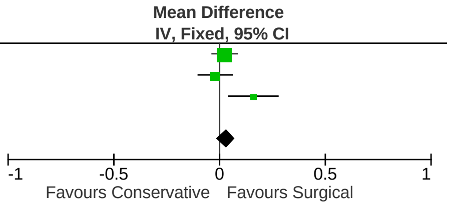


Figure 179: Health related quality of life (SF-12 components) at 2 years

Study or Subgroup	Surgical Mean	Surgical SD	Surgical Total	Conservative Mean	Conservative SD	Conservative Total	Weight	Mean Difference IV, Fixed, 95% CI
5.3.1 SF-12 physical component								
Handoll 2015	45.68	12.7591	111	44.2	12.6131	115	100.0%	1.48 [-1.83, 4.79]
Subtotal (95% CI)			**111**			**115**	**100.0%**	**1.48 [-1.83, 4.79]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.88 (P = 0.38)								
5.3.2 SF-12 mental component								
Handoll 2015	49.3	12.387	111	50.69	12.3966	115	100.0%	-1.39 [-4.62, 1.84]
Subtotal (95% CI)			**111**			**115**	**100.0%**	**-1.39 [-4.62, 1.84]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 0.84 (P = 0.40)								

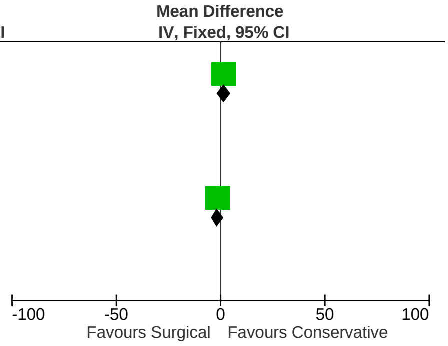


Figure 180: Oxford Shoulder Score at 2 years

Study or Subgroup	Surgical Mean	Surgical SD	Surgical Total	Conservative Mean	Conservative SD	Conservative Total	Weight	Mean Difference IV, Fixed, 95% CI
Handoll 2015	40.11	6.5	114	40.4	9.88	117	100.0%	-0.29 [-2.44, 1.86]
Total (95% CI)			**114**			**117**	**100.0%**	**-0.29 [-2.44, 1.86]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.26 (P = 0.79)

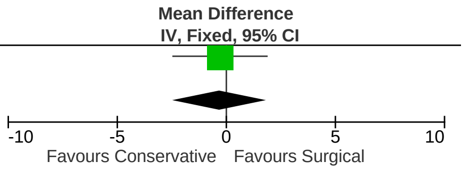


Figure 181: Constant Score up to 4 years

Study or Subgroup	Surgical Mean	Surgical SD	Surgical Total	Conservative Mean	Conservative SD	Conservative Total	Weight	Mean Difference IV, Fixed, 95% CI
Boons 2012	64	15.8	23	60	17.6	24	34.8%	4.00 [-5.55, 13.55]
Fjalestad 2014a	75.1	22.2	23	77.1	22.5302	25	19.8%	-2.00 [-14.66, 10.66]
Olerud 2011	48.3	16.4	24	49.6	20.5	24	28.8%	-1.30 [-11.80, 9.20]
Zyto 1997	60	19	14	65	19	15	16.6%	-5.00 [-18.84, 8.84]
Total (95% CI)			**84**			**88**	**100.0%**	**-0.21 [-5.84, 5.43]**

Heterogeneity: Chi² = 1.32, df = 3 (P = 0.72); I² = 0%
Test for overall effect: Z = 0.07 (P = 0.94)

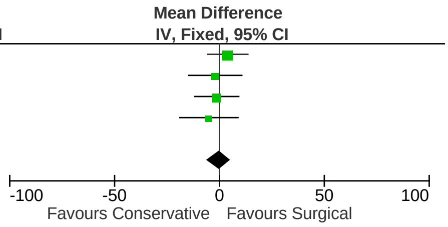


Figure 182: Infection up to 4 years

Study or Subgroup	Surgical Events	Surgical Total	Conservative Events	Conservative Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Boons 2012	0	23	0	24		Not estimable
Handoll 2015	2	125	0	125	50.8%	7.45 [0.46, 119.76]
Olerud 2011	0	27	0	28		Not estimable
Zyto 1997	2	14	0	15	49.2%	8.57 [0.51, 144.39]
Total (95% CI)		**189**		**192**	**100.0%**	**7.98 [1.10, 57.81]**
Total events	4		0			

Heterogeneity: Chi² = 0.00, df = 1 (P = 0.94); I² = 0%
Test for overall effect: Z = 2.06 (P = 0.04)

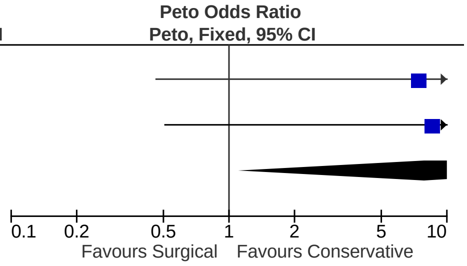


Figure 183: Avascular necrosis

Study or Subgroup	Surgical Events	Surgical Total	Conservative Events	Conservative Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Fjalestad 2014a	12	23	15	25	93.5%	0.87 [0.52, 1.44]
Handoll 2015	4	125	1	125	6.5%	4.00 [0.45, 35.29]
Total (95% CI)		**148**		**150**	**100.0%**	**1.07 [0.65, 1.78]**
Total events	16		16			

Heterogeneity: Chi² = 2.07, df = 1 (P = 0.15); I² = 52%
Test for overall effect: Z = 0.27 (P = 0.78)

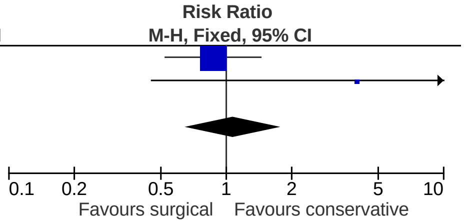


Figure 184: Nerve damage

Study or Subgroup	Surgical Events	Surgical Total	Conservative Events	Conservative Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Fjalestad 2014a	4	20	3	24	75.0%	1.73 [0.35, 8.60]
Handoll 2015	2	125	0	125	25.0%	7.45 [0.46, 119.76]
Total (95% CI)		**145**		**149**	**100.0%**	**2.49 [0.62, 9.99]**
Total events	6		3			

Heterogeneity: Chi² = 0.80, df = 1 (P = 0.37); I² = 0%
Test for overall effect: Z = 1.29 (P = 0.20)

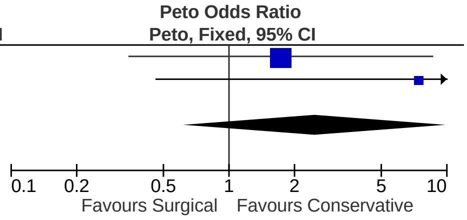
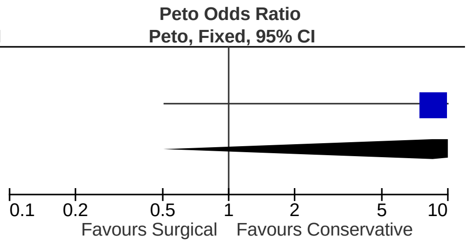


Figure 185: Need for further Operation

Study or Subgroup	Surgical Events	Surgical Total	Conservative Events	Conservative Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Boons 2012	0	23	0	24		Not estimable
Olerud 2011	0	27	0	28		Not estimable
Zyto 1997	2	14	0	15	100.0%	8.57 [0.51, 144.39]
Total (95% CI)		**64**		**67**	**100.0%**	**8.57 [0.51, 144.39]**
Total events	2		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.49 (P = 0.14)



J.4.4 Definitive treatment - paediatric femoral fractures

J.4.4.1 Spica versus elastic intramedullary nail (EIN)

Figure 186: Length of hospital stay (days)

Study or Subgroup	Spica Mean	Spica SD	Spica Total	EIN Mean	EIN SD	EIN Total	Weight	Mean Difference IV, Random, 95% CI
Hsu 2009	6	2.5	25	17	8.5	26	33.0%	-11.00 [-14.41, -7.59]
Ruhullah 2014	3.32	1.4	24	6.56	2.75	25	33.7%	-3.24 [-4.45, -2.03]
Shemshaki 2011	20.5	5.8	23	6.9	2.9	23	33.3%	13.60 [10.95, 16.25]
Total (95% CI)			**72**			**74**	**100.0%**	**-0.19 [-12.32, 11.94]**

Heterogeneity: $Tau^2 = 113.21$; $Chi^2 = 162.29$, $df = 2$ ($P < 0.00001$); $I^2 = 99\%$
Test for overall effect: $Z = 0.03$ ($P = 0.98$)

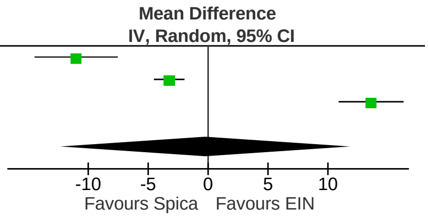


Figure 187: Return to school (weeks)

Study or Subgroup	Spica Mean	Spica SD	Spica Total	EIN Mean	EIN SD	EIN Total	Weight	Mean Difference IV, Random, 95% CI
Ruhullah 2014	15.6	2.98	24	8.82	1.7	25	50.2%	6.78 [5.41, 8.15]
Shemshaki 2011	9.18	2.8	23	4.5	1.91	23	49.8%	4.68 [3.29, 6.07]
Total (95% CI)			**47**			**48**	**100.0%**	**5.73 [3.68, 7.79]**

Heterogeneity: $Tau^2 = 1.71$; $Chi^2 = 4.48$, $df = 1$ ($P = 0.03$); $I^2 = 78\%$
Test for overall effect: $Z = 5.46$ ($P < 0.00001$)

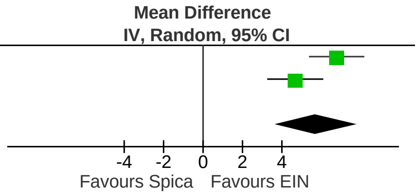


Figure 188: Return to independent ambulation (days)

Study or Subgroup	Spica Mean	Spica SD	Spica Total	EIN Mean	EIN SD	EIN Total	Weight	Mean Difference IV, Random, 95% CI
Ruhullah 2014	74.7	4.32	24	46.2	9.03	25	51.5%	28.50 [24.56, 32.44]
Shemshaki 2011	80	10.1	23	35.2	13.2	23	48.5%	44.80 [38.01, 51.59]
Total (95% CI)			**47**			**48**	**100.0%**	**36.41 [20.44, 52.37]**

Heterogeneity: $Tau^2 = 124.82$; $Chi^2 = 16.55$, $df = 1$ ($P < 0.0001$); $I^2 = 94\%$
Test for overall effect: $Z = 4.47$ ($P < 0.00001$)

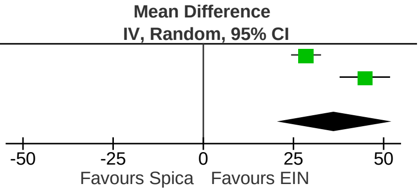


Figure 189: Return to normal activities (weeks)

Study or Subgroup	Spica Mean	Spica SD	Spica Total	EIN Mean	EIN SD	EIN Total	Weight	Mean Difference IV, Fixed, 95% CI
Ruhullah 2014	12.08	4.51	24	8.76	2.27	25	100.0%	3.32 [1.31, 5.33]
Total (95% CI)			**24**			**25**	**100.0%**	**3.32 [1.31, 5.33]**

Heterogeneity: Not applicable
Test for overall effect: $Z = 3.23$ ($P = 0.001$)

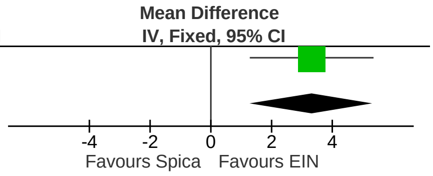


Figure 190: Further treatment

Study or Subgroup	Spica Events	Spica Total	EIN Events	EIN Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Ruhullah 2014	1	24	3	25	100.0%	0.35 [0.04, 3.11]
Total (95% CI)		**24**		**25**	**100.0%**	**0.35 [0.04, 3.11]**
Total events	1		3			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.95 (P = 0.34)

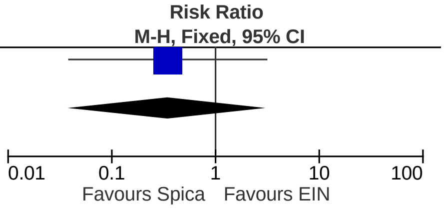


Figure 191: Flynn grading classed as 'excellent'

Study or Subgroup	Spica Events	Spica Total	EIN Events	EIN Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Ruhullah 2014	4	24	19	25	100.0%	0.22 [0.09, 0.55]
Total (95% CI)		**24**		**25**	**100.0%**	**0.22 [0.09, 0.55]**
Total events	4		19			

Heterogeneity: Not applicable
Test for overall effect: Z = 3.23 (P = 0.001)

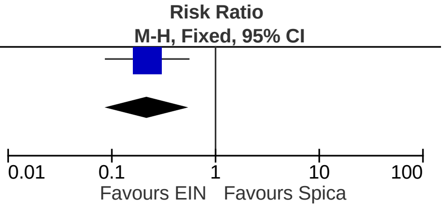


Figure 192: Malunion

Study or Subgroup	Spica Events	Spica Total	EIN Events	EIN Total	Weight	Risk Ratio M-H, Random, 95% CI
Ruhullah 2014	4	24	1	25	54.4%	4.17 [0.50, 34.66]
Shemshaki 2011	0	23	3	23	45.6%	0.14 [0.01, 2.62]
Total (95% CI)		**47**		**48**	**100.0%**	**0.90 [0.03, 24.99]**
Total events	4		4			

Heterogeneity: $Tau^2 = 4.13$; $Chi^2 = 3.45$, df = 1 (P = 0.06); $I^2 = 71\%$
Test for overall effect: Z = 0.06 (P = 0.95)

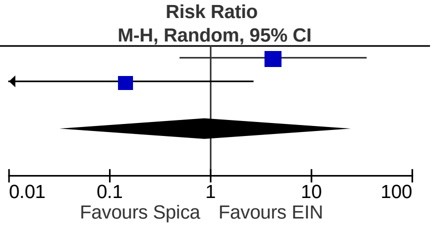


Figure 193: Avascular necrosis

Study or Subgroup	Spica Events	Spica Total	EIN Events	EIN Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Ruhullah 2014	0	24	1	25	100.0%	0.14 [0.00, 7.10]
Total (95% CI)		**24**		**25**	**100.0%**	**0.14 [0.00, 7.10]**
Total events	0		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.98 (P = 0.33)

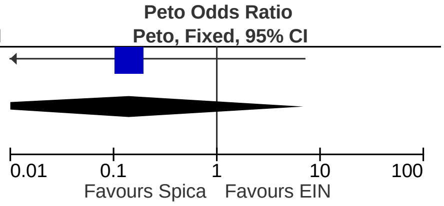


Figure 194: Parental satisfaction – 'good or excellent'

Study or Subgroup	Spica Events	Spica Total	EIN Events	EIN Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Shemshaki 2011	17	23	23	23	100.0%	0.74 [0.58, 0.96]
Total (95% CI)		**23**		**23**	**100.0%**	**0.74 [0.58, 0.96]**
Total events	17		23			

Heterogeneity: Not applicable
Test for overall effect: Z = 2.30 (P = 0.02)

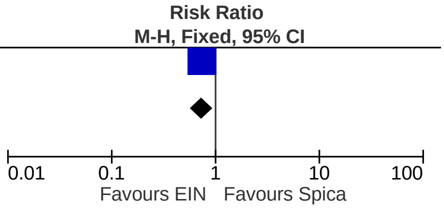
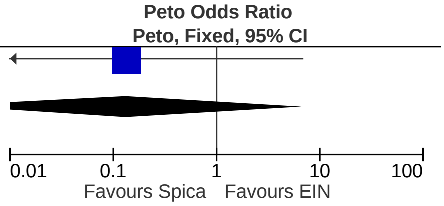


Figure 195: Nerve injury

Study or Subgroup	Spica Events	Spica Total	EIN Events	EIN Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Shemshaki 2011	0	23	1	23	100.0%	0.14 [0.00, 6.82]
Total (95% CI)		**23**		**23**	**100.0%**	**0.14 [0.00, 6.82]**
Total events	0		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.00 (P = 0.32)



J.4.4.2 Spica versus Ext fixation

Figure 196: Malunion

Study or Subgroup	Spica Events	Spica Total	Ext fix Events	Ext fix Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Wright 2005	25	56	7	45	100.0%	2.87 [1.37, 6.02]
Total (95% CI)		**56**		**45**	**100.0%**	**2.87 [1.37, 6.02]**
Total events	25		7			

Heterogeneity: Not applicable
Test for overall effect: Z = 2.79 (P = 0.005)

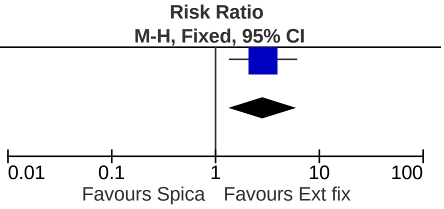


Figure 197: Rand child health status (higher worse)

Study or Subgroup	Spica Mean	Spica SD	Spica Total	Ext fix Mean	Ext fix SD	Ext fix Total	Weight	Mean Difference IV, Fixed, 95% CI
Wright 2005	68	7.38	56	69	7.38	45	100.0%	-1.00 [-3.90, 1.90]
Total (95% CI)			**56**			**45**	**100.0%**	**-1.00 [-3.90, 1.90]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.68 (P = 0.50)

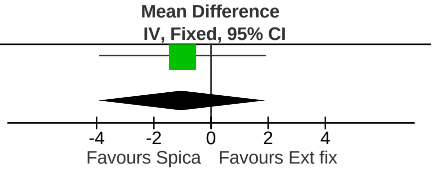
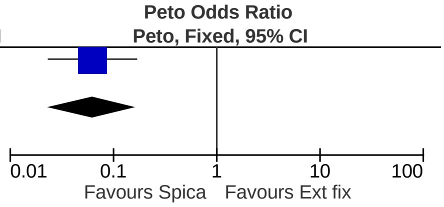


Figure 198: Adverse events requiring further treatment

Study or Subgroup	Spica Events	Spica Total	Ext fix Events	Ext fix Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Wright 2005	0	56	20	45	100.0%	0.06 [0.02, 0.17]
Total (95% CI)		**56**		**45**	**100.0%**	**0.06 [0.02, 0.17]**
Total events	0		20			

Heterogeneity: Not applicable
Test for overall effect: Z = 5.54 (P < 0.00001)



J.4.4.3 Ext fixation versus EIN

Figure 199: Parental satisfaction – numbers who would choose same treatment again

Study or Subgroup	Ext fix Events	Ext fix Total	EIN Events	EIN Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Bar-on 1997	8	10	10	10	100.0%	0.81 [0.57, 1.14]
Total (95% CI)		**10**		**10**	**100.0%**	**0.81 [0.57, 1.14]**
Total events	8		10			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.20 (P = 0.23)

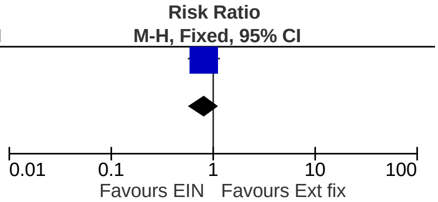


Figure 200: Number of follow-up revisions

Study or Subgroup	Ext fix Events	Ext fix Total	EIN Events	EIN Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Bar-on 1997	2	10	1	10	100.0%	2.00 [0.21, 18.69]
Total (95% CI)		**10**		**10**	**100.0%**	**2.00 [0.21, 18.69]**
Total events	2		1			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.61 (P = 0.54)

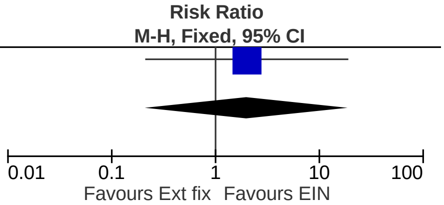


Figure 201: foot drop

Study or Subgroup	Bryant's Mean	Bryant's SD	Bryant's Total	Pavlik's Mean	Pavlik's SD	Pavlik's Total	Weight	Mean Difference IV, Fixed, 95% CI
Wang 2014	17.8	11.5	17	1.4	11.5	21	100.0%	16.40 [9.05, 23.75]
Total (95% CI)			**17**			**21**	**100.0%**	**16.40 [9.05, 23.75]**

Heterogeneity: Not applicable
Test for overall effect: Z = 4.37 (P < 0.0001)

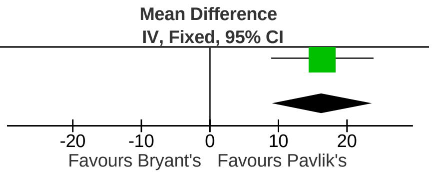
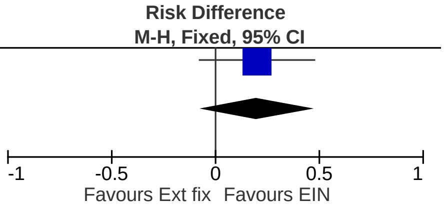


Figure 202: limb length discrepancy

Study or Subgroup	Ext fix Events	Ext fix Total	EIN Events	EIN Total	Weight	Risk Difference M-H, Fixed, 95% CI
Bar-on 1997	2	10	0	10	100.0%	0.20 [-0.08, 0.48]
Total (95% CI)		**10**		**10**	**100.0%**	**0.20 [-0.08, 0.48]**
Total events	2		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.42 (P = 0.16)



J.4.4.4 Bryant's traction versus Pavlik's harness

Figure 203: length of hospital stay (days)

Study or Subgroup	Bryant's Mean	Bryant's SD	Bryant's Total	Pavlik's Mean	Pavlik's SD	Pavlik's Total	Weight	Mean Difference IV, Fixed, 95% CI
Wang 2014	17.8	11.5	17	1.4	11.5	21	100.0%	16.40 [9.05, 23.75]
Total (95% CI)			**17**			**21**	**100.0%**	**16.40 [9.05, 23.75]**

Heterogeneity: Not applicable
Test for overall effect: Z = 4.37 (P < 0.0001)

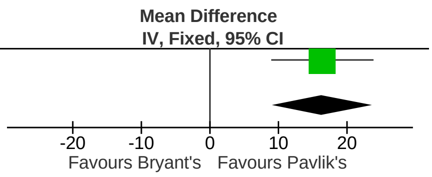


Figure 204: leg length discrepancy (mm)

Study or Subgroup	Bryant's Mean	Bryant's SD	Bryant's Total	Pavlik's Mean	Pavlik's SD	Pavlik's Total	Weight	Mean Difference IV, Fixed, 95% CI
Wang 2014	8	12.12	17	7.6	12.12	21	100.0%	0.40 [-7.35, 8.15]
Total (95% CI)			**17**			**21**	**100.0%**	**0.40 [-7.35, 8.15]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.10 (P = 0.92)

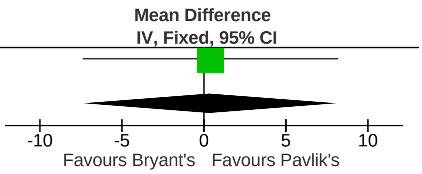
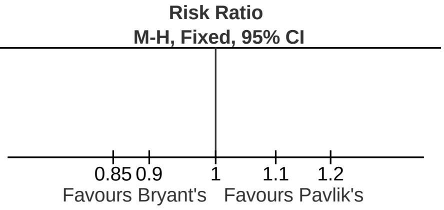


Figure 205: malunion

Study or Subgroup	Bryant's Events	Bryant's Total	Pavlik's Events	Pavlik's Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Wang 2014	0	17	0	21		Not estimable
Total (95% CI)		**17**		**21**		**Not estimable**
Total events	0		0			

Heterogeneity: Not applicable
Test for overall effect: Not applicable



J.4.4.5 SIN versus plating

Figure 206: Flynn grading of excellent

Study or Subgroup	SIN Events	SIN Total	Plate Events	Plate Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Park 2012	13	22	12	23	100.0%	1.13 [0.67, 1.91]
Total (95% CI)		**22**		**23**	**100.0%**	**1.13 [0.67, 1.91]**
Total events	13		12			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.47 (P = 0.64)

Risk Ratio
M-H, Fixed, 95% CI

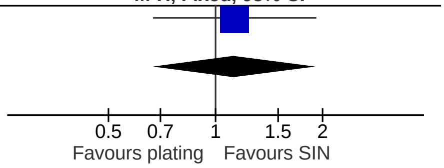


Figure 207: Return to ambulation without limping

Study or Subgroup	SIN Events	SIN Total	Plate Events	Plate Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Park 2012	21	21	22	22	100.0%	1.00 [0.92, 1.09]
Total (95% CI)		**21**		**22**	**100.0%**	**1.00 [0.92, 1.09]**
Total events	21		22			

Heterogeneity: Not applicable
Test for overall effect: Z = 0.00 (P = 1.00)

Risk Ratio
M-H, Fixed, 95% CI

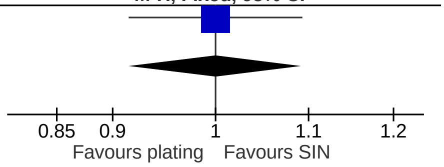


Figure 208: need for re-operation

Study or Subgroup	SIN Events	SIN Total	Plate Events	Plate Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Park 2012	2	21	0	22	100.0%	8.15 [0.49, 134.79]
Total (95% CI)		**21**		**22**	**100.0%**	**8.15 [0.49, 134.79]**
Total events	2		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.47 (P = 0.14)

Peto Odds Ratio
Peto, Fixed, 95% CI

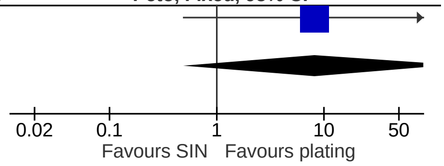


Figure 209: leg length discrepancy > 1cm

Study or Subgroup	SIN Events	SIN Total	Plate Events	Plate Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Park 2012	0	21	0	22		Not estimable
Total (95% CI)		**21**		**22**		**Not estimable**
Total events	0		0			

Heterogeneity: Not applicable
Test for overall effect: Not applicable

Peto Odds Ratio
Peto, Fixed, 95% CI

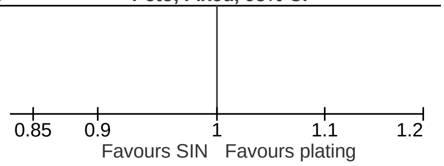
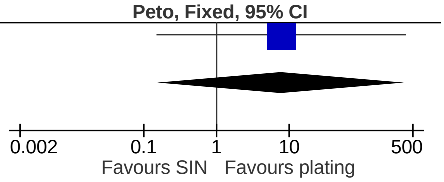


Figure 210: Non union

Study or Subgroup	SIN Events	SIN Total	Plate Events	Plate Total	Weight	Peto Odds Ratio Peto, Fixed, 95% CI
Park 2012	1	21	0	22	100.0%	7.75 [0.15, 390.96]
Total (95% CI)		**21**		**22**	**100.0%**	**7.75 [0.15, 390.96]**
Total events	1		0			

Heterogeneity: Not applicable
Test for overall effect: Z = 1.02 (P = 0.31)

Peto Odds Ratio
Peto, Fixed, 95% CI



J.4.5 Post operative mobilisation – ankle fractures

J.4.5.1 Immediate unrestricted weight bearing versus delayed unrestricted weight bearing

Figure 211: Ankle score at 9 weeks

Study or Subgroup	Immediate WB Mean	Immediate WB SD	Immediate WB Total	Delayed WB Mean	Delayed WB SD	Delayed WB Total	Weight	Mean Difference IV, Fixed, 95% CI
Finsen 1989	8.8	5.9	20	11.6	4.6	19	100.0%	-2.80 [-6.11, 0.51]
Total (95% CI)			**20**			**19**	**100.0%**	**-2.80 [-6.11, 0.51]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.66 (P = 0.10)

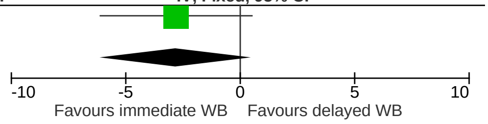


Figure 212: Ankle score at 18 weeks

Study or Subgroup	Immediate WB Mean	Immediate WB SD	Immediate WB Total	Delayed WB Mean	Delayed WB SD	Delayed WB Total	Weight	Mean Difference IV, Fixed, 95% CI
Finsen 1989	5.4	4.3	20	5.3	4.3	19	100.0%	0.10 [-2.60, 2.80]
Total (95% CI)			**20**			**19**	**100.0%**	**0.10 [-2.60, 2.80]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.07 (P = 0.94)

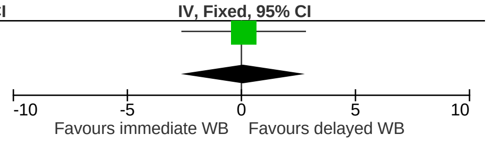


Figure 213: Ankle score at 36 weeks

Study or Subgroup	Immediate WB Mean	Immediate WB SD	Immediate WB Total	Delayed WB Mean	Delayed WB SD	Delayed WB Total	Weight	Mean Difference IV, Fixed, 95% CI
Finsen 1989	3.3	3.5	20	2.2	1.9	19	100.0%	1.10 [-0.66, 2.86]
Total (95% CI)			**20**			**19**	**100.0%**	**1.10 [-0.66, 2.86]**

Heterogeneity: Not applicable
Test for overall effect: Z = 1.23 (P = 0.22)

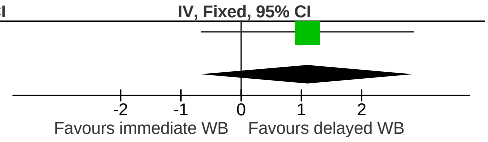


Figure 214: Ankle score at 52 weeks

Study or Subgroup	Immediate WB Mean	Immediate WB SD	Immediate WB Total	Delayed WB Mean	Delayed WB SD	Delayed WB Total	Weight	Mean Difference IV, Fixed, 95% CI
Finsen 1989	1.9	2.6	20	1.8	2.7	19	100.0%	0.10 [-1.57, 1.77]
Total (95% CI)			**20**			**19**	**100.0%**	**0.10 [-1.57, 1.77]**

Heterogeneity: Not applicable
Test for overall effect: Z = 0.12 (P = 0.91)

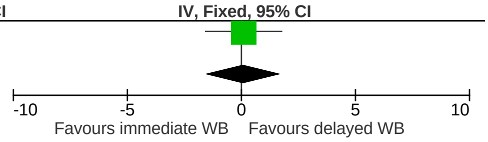


Figure 215: Displacement/re-dislocation

Study or Subgroup	Immediate WB Events	Immediate WB Total	Delayed WB Events	Delayed WB Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Ahl 1986	0	22	2	22	49.9%	0.20 [0.01, 3.94]
Ahl 1987	1	25	0	26	9.8%	3.12 [0.13, 73.06]
Ahl 1988	0	26	0	25		Not estimable
Ahl 1989	1	47	2	46	40.3%	0.49 [0.05, 5.21]
Ahl 1993	0	19	0	21		Not estimable
Van laarhoven 1996	0	41	0	40		Not estimable
Total (95% CI)		**180**		**180**	**100.0%**	**0.60 [0.15, 2.45]**
Total events	2		4			

Heterogeneity: Chi² = 1.60, df = 2 (P = 0.45); I² = 0%
Test for overall effect: Z = 0.71 (P = 0.48)

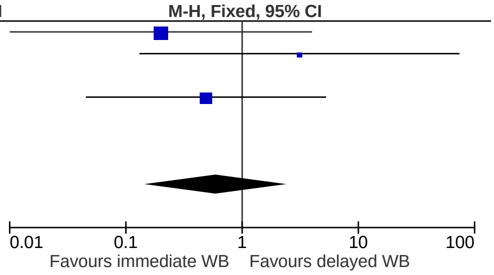
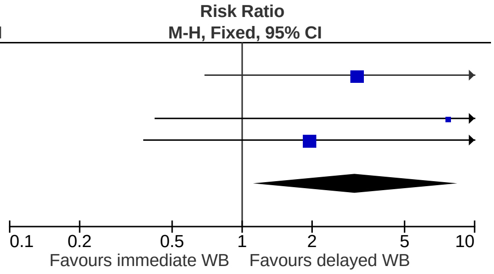


Figure 216: Wound infection

Study or Subgroup	Immediate WB Events	Immediate WB Total	Delayed WB Events	Delayed WB Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Ahl 1986	0	22	0	22		Not estimable
Ahl 1987	6	25	2	26	43.9%	3.12 [0.69, 14.03]
Ahl 1988	0	26	0	25		Not estimable
Ahl 1993	3	19	0	21	10.7%	7.70 [0.42, 140.03]
Van laarhoven 1996	4	41	2	40	45.4%	1.95 [0.38, 10.06]
Total (95% CI)		**133**		**134**	**100.0%**	**3.08 [1.11, 8.51]**
Total events	13		4			

Heterogeneity: Chi² = 0.68, df = 2 (P = 0.71); I² = 0%
Test for overall effect: Z = 2.17 (P = 0.03)



Appendix K: Excluded clinical studies

K.1 Initial pain management and immobilisation

K.1.1 Initial pharmacological pain management

Table 1: Studies excluded from the clinical review

Study	Reason for exclusion
Adolphson 1993[4]	Not initial pain management
Baharuddin 2014[34]	Majority non-fracture
Barrington 1980[40]	Not initial pain management
Borland 2011[69]	Dose comparision
Bounes 2010[71]	Pre-hospital study
Burton 1998[97]	Non- fracture population (Lacerations)
Davis 1988[138]	Not initial pain management
Derakhshanfar 2014[144]	Abstract
Derakhshanfar 2014[143]	Abstract
Devellis 1998[146]	Non-randomised study; pre-hospital population
Drendel 2009[158]	Not initial pain management (following ED discharge).
Duda 1987[160]	Study not in English
Evans 2005[165]	Compares mechanism of analgesic delivery.
Farahmand 2014[170]	Less than 50% fracture population.
Farsi 2013[171]	Dose comparision
Graudins 2013[204]	Study protocol
Graudins 2015[205]	Study protocol
Hamdan 2012[214]	Abstract
Hansen 2012[223]	Systematic review - Non-trauma population
Hoogewijs 2000[238]	Non-fracture population
Indelicato 1986[250]	Non-trauma population
Jadon 2014[251]	Femur/Nerve blocks
Kendall 2001[267]	Incorrect interventions. Morphine delivered intramuscular
Kidd 2009[271]	Biochemical study. No applicable outcomes.
Lacey 1984[294]	Non-fracture population
Le may 2013[301]	Non- fracture population
Leman 2003[310]	Non=fracture population (<20%)
Lemay 2010[311]	Abstract
Majidi 2015[332]	Incorrect interventions
Man 2004[336]	Abstract
Mcilwain 1988[348]	Non-fracture population (Musculoskeletal)
Melnychuck 2012[354]	Abstract
Migita 2006[356]	Use of pharmacological agents in reductions/sedation
Moustafa 2014[368]	Abstract
Ortiz 2010[401]	Study does not report outcomes applicable to study protocol.. High level

Study	Reason for exclusion
	of bias (flawed methodology)
Petrack 1997[415]	Retrospective chart review
Ponce-monter 2012[423]	Incorrect interventions. Considers the effect of Vitamin D addition to Diclofenac
Rainer 2000[431]	Cost-effectiveness study - No outcomes applicable to protocol.
Ridderikhof 2013[438]	Study protocol
Sleet 1980[466]	Majority non-fracture
Stableforth 1977[478]	Soft tissue injury
Staunstrup 1999[480]	Elective surgery group (Non fracture)
Suresh 2014[491]	Femur/Nerve blocks
Tsertsvadze 2013[511]	Systematic review of long-term fracture management.
Vergnion 2001[522]	Pre-hospital
Wilson 1997[539]	Incorrect interventions. Intramuscular Morphine (Incorrect Comparision)
Woo 2005[541]	Non-fracture population (<10%)
Yost 2008[551]	Exclude study abstract (Included under Borland 2007)
Younge 1999[553]	Incorrect interventions. Intramuscular morphine

K.1.2 Paediatric nerve blocks femoral fractures

Table 2: Studies excluded from the clinical review

Study	Reason for exclusion
Amiri 2012[19]	Incorrect age group
Barker 2008[39]	Incorrect age group. Not guideline population. Non-femoral.
Beaudoin 2013[47]	Incorrect age group
Bech 2009[48]	Incorrect age group
Bech 2011[49]	Conference Abstract
Cao 2008[102]	Not in English
Coad 1991[121]	Not initial pain management - Post operative analgesia.
Derakhshanfar 2014[143]	Incorrect interventions
Drendel 2009[158]	Incorrect interventions
Durrani 2013[161]	Incorrect age group
Fletcher 2003[180]	Incorrect age group
Ghimire 2012[195]	Conference Abstract
Haddad 1995[212]	Incorrect age group
Iamaroon 2010[247]	Incorrect age group
Kidd 2009[271]	Incorrect interventions
Majeed 2013[331]	Conference Abstract
Mittal 2014[361]	Review article
Mosaffa 2009[367]	Conference Abstract
Mutty 2007[373]	Incorrect age group
Mutty 2008[374]	Review article.
Newman 2013[386]	Incorrect age group

Study	Reason for exclusion
Paul 2013[410]	Conference Abstract
Paul 2013[411]	Conference Abstract
Sahota 2014[447]	Trial protocol
Samuel 2013[450]	Conference Abstract
Schiferer 2007[453]	Incorrect age group
Stanhope 2010[479]	Abstract only
Stewart 2007[482]	Incorrect interventions. Study investigated continuous versus single injection block of the femur
Szucs 2014[494]	Incorrect age group
Van leeuwen 2000[517]	Incorrect age group
Woo 2005[541]	Incorrect interventions
Yost 2008[551]	Incorrect interventions
Younge 2001[552]	Incorrect interventions
Yun 2009[556]	Incorrect age group

K.2 Acute stage assessment and diagnostic imaging

K.2.1 Selecting patients for imaging - clinical prediction rules for knee fractures

Table 3: Studies excluded from the clinical review

Reference	Reason for exclusion
Bachmann 2004[30]	Out-dated systematic review – reference list checked
Bauer 1995[45]	Validation study. Bauer criteria decided on the basis of which combination of criteria gave optimal accuracy – this will have led to the play of chance contributing to accuracy of Bauer criteria to a greater extent than would be expected
Cohen 1998[123]	Assessed single diagnostic test criteria, which were non-validated
Crossley 2004[129]	Review of a single paper
Kec 2003[266]	In terms of sensitivity, the gold standard was the physician interpretation of the rule (this study was examining the diagnostic accuracy of the tool when performed by triage nurses). This is an inappropriate gold standard and this question is not aimed at examining the accuracy of the tools between different personnel
Matteucci 2003[345]	No diagnostic accuracy data
Moore 2005[365]	Assessed single criteria from the Ottawa scale, which were non-validated
Nagpal 2007[377]	Non RCT and no diagnostic accuracy data
Nichol 1999[388]	Non RCT comparison study; no diagnostic data
Nugent 2004[395]	Review – references checked
Perry 2006[412]	Review – references checked
Stevermer 1996[481]	Review of a single article
Stiell 2007[489]	Review – reference list checked
Stiell 1995[488]	Derivation study with no validation in another sample
Tandeter 1999[496]	Review – reference list checked

Reference	Reason for exclusion
Tigges 2001[505]	Non RCT comparison study; no diagnostic data
Vijayasankar 2009[525]	Review – reference list checked
Weber 1995[534]	Derivation study with no validation in another sample
Yao 2012[547]	Review – reference list checked

K.2.2 Selecting patients for imaging - clinical prediction rules for ankle fractures

Table 4: Studies excluded from the clinical review

Reference	Reason for exclusion
Allerston 2000 [15]	Not relevant to protocol question
Anis,1995 [23]	Non-randomised study
Auleley 1998 [27]	Diagnostic accuracy study
Auleley 1997 [28]	Cluster randomised and only 5 clusters. Also there was no coercion to use the Ottawa in the hospitals randomised to Ottawa
Bachmann 2003 [31]	Diagnostic accuracy study
Bachmann 2003 [32]	Diagnostic accuracy study
Bessen 2009 [55]	Diagnostic accuracy study
Boutis 2013 [72]	Diagnostic accuracy study
Boutis 2001 [73]	Non-randomised study
Broomhead 2003 [84]	Diagnostic accuracy study
Can 2008 [100]	Diagnostic accuracy study
Canagasabey 2011[101]	Imaging study, not clinical prediction rules study
Chan 2010 [108]	Diagnostic accuracy study
Clark 2003 [119]	Diagnostic accuracy study
Dayan 2004 [139]	Diagnostic accuracy study
Diehr 1988 [150]	Diagnostic accuracy study
Dissmann 2006 [151]	Diagnostic accuracy study
Dowling 2009 [157]	Diagnostic accuracy systematic review
Fiesseler 2004 [174]	Non-randomised study
Goksel 2009 [197]	Diagnostic accuracy study
Gwilym 2003 [211]	Non-randomised study
Heyworth 2003 [231]	Opinion narrative
Hopkins 2010 [239]	Non-randomised study and not relevant to protocol
Karpas 2002 [263]	Diagnostic accuracy study
Kerr 1994[270]	Diagnostic accuracy study
Keogh 1998 [269]	Diagnostic accuracy study
Klassen 1993 [276]	Not restricted to ankle.
Lau 2013 [299]	Non-randomised study
Leddy 2002 [303]	Non-randomised study
Leddy 1998 [302]	Diagnostic accuracy study
Leisey 2004 [309]	Diagnostic accuracy study
Libetta, 1999 [317]	Diagnostic accuracy study

Reference	Reason for exclusion
Lucchesi 1995 [327]	Diagnostic accuracy study
Mann, 1998 [337]	Diagnostic accuracy study
Marinelli 2011 [340]	Diagnostic accuracy study
Marinelli 2007 [341]	Diagnostic accuracy study
Markert 1998 [342]	Diagnostic accuracy study
McBride 1997 [346]	Diagnostic accuracy study
Milne 1996 [359]	Diagnostic accuracy study
Morris 2013 [366]	Non-randomised study
Myers 2005 [376]	Diagnostic accuracy study
Negahban 2010 [384]	Not an ankle fracture prediction tool study
Northrup 2005 [392]	Non-systematic review
Northrup 2005 [391]	Non-systematic review
Nugent 2004 [394]	Diagnostic accuracy study
Papacostas 2001 [405]	Diagnostic accuracy study
Parron 2008 [406]	Diagnostic accuracy study
Perry 2006 [412]	Non-systematic review
Perry 1999 [413]	Diagnostic accuracy study
Pigman 1994[417]	Diagnostic accuracy study
Pijnenburg 2002 [419]	Diagnostic accuracy study
Plint 1999 [420]	Diagnostic accuracy study
Pope 2002 [425]	Diagnostic accuracy study
Rajasekaran 2006 [433]	Not appropriate to protocol
Rodrigues 2011 [441]	Non-English language
Rosin 1999 [442]	Diagnostic accuracy study
Salt 1997 [449]	Diagnostic accuracy study
Shetty 2013 [460]	validation study
Singh-Ranger 1999 [465]	Diagnostic accuracy study
Smith 2011 [470]	Non-randomised study
Sorensen 2012 [476]	Non-randomised study
Springer 2000 [477]	Diagnostic accuracy study
Stiell 1995 [484]	Non-randomised study
Stiell 1996 [483]	Background review
Stiell 1993 [485]	Developmental and diagnostic accuracy study
Stiell 1992 [486]	Developmental study
Stiell 1994 [487]	Non-randomised study
Tay 1999 [498]	Diagnostic accuracy study
Tollefson 2012 [506]	Diagnostic accuracy study
Tsui 2011 [512]	Non-systematic review
van der Wees 2012 [514]van der Wees P,	Validity study
Van Der Wees 2011 [515]	Non-randomised study
Verbeek 1997 [521]	Not relevant to protocol
Verma 1997 [523]	Diagnostic accuracy study

Reference	Reason for exclusion
Wang 2013 [531]	Diagnostic accuracy study
Wynn-Thomas 2002 [544]	Diagnostic accuracy study
Yazdani 2006 [548]	Diagnostic accuracy study
Yuen 2001 [554]	Diagnostic accuracy study
Yuen 2001 [555]	Diagnostic accuracy study

K.2.3 Imaging of scaphoid

Table 5: Studies excluded from the clinical review

Study	Reason for exclusion
Amrami 2005[20]	Study is not relevant to review question or unclear PICO
Dorsay 2001[156]	Systematic review is not relevant to review question or unclear PICO
Geijer 2013[194]	Systematic review is not relevant to review question or unclear PICO
Gooding 2014[201]	Incorrect study design (historical cohort study)
Hansen 2009[224]	Incorrect study design (cohort study)
Hiscox 2013[232]	Inappropriate comparison (bone scintigraphy versus. delayed X-ray)
Kitsis 1998[275]	Incorrect study design (case series)
Mallee 2012[335]	Incorrect study design (Cochrane review protocol)
Raby 2001[430]	Incorrect study design (historical cohort study)
Raja 2013[432]	Study is not relevant to review question or unclear PICO
Yin 2010[549]	Systematic review is not relevant to review question or unclear PICO
Yin 2012[550]	Systematic review is not relevant to review question or unclear PICO

Table 6: Studies excluded from the clinical review (diagnostic accuracy)

Reference	Reason for exclusion
Beeres 2008a[51]	Inappropriate comparison (used combination methods as the gold standard, not MRI alone)
Bhat 2004[58]	Incorrect population (scaphoid fracture visible on initial X-ray)
Breederveld 2004[79]	Inappropriate comparison (used combination methods as the gold standard, not MRI alone)
Breitenseher 1997[80]	Inappropriate comparison (did not use MRI as gold standard)
Bretlau 1999[81]	Inappropriate comparison (did not use MRI as gold standard)
Buijze 2011[94]	Inappropriate comparison (used combination methods as the gold standard, not MRI alone)
Buijze 2012[93]	Incorrect population (patients with a definitive diagnosis of scaphoid fracture)
Calderon 2007[98]	Incorrect study design (non-systematic review)
Cerezal 2000[106]	Incorrect population (patients with non-union of scaphoid fracture >6-months post-injury)
Cook 1997[124]	Inappropriate comparison (did not use MRI as gold standard)
Cruickshank 2007[130]	Inappropriate comparison (did not use MRI as gold standard)
Dias 1990[148]	Incorrect study design (no reference standard)
Duckworth 2011[159]	Incorrect study design (non-systematic review)

Reference	Reason for exclusion
Fowler 1998[183]	Inappropriate comparison (used combination methods as the gold standard, not MRI alone)
Gabler 2001[191]	Inappropriate comparison (did not use MRI as gold standard)
Gaebler 1996[192]	Inappropriate comparison (did not use MRI as gold standard)
Groves 2005[209]	Incorrect study design (no reference standard)
Jenkins 2008[258]	Incorrect study design (no reference standard)
Kitsis 1998[275]	Incorrect study design (case series)
Kumar 2005[291]	Incorrect study design (case series)
Kusunoli 1992[293]	Incorrect study design (case series)
Low 2005[324]	Inappropriate comparison (delayed X-ray taken 10-50 days post-injury; mean = 34.5 days)
Lozano-Calderon 2006[325]	Inappropriate comparison (did not use MRI as gold standard)
Mallee 2011[334]	Inappropriate comparison (did not use MRI as gold standard)
Mallee 2012[335]	Incorrect study design (Cochrane review protocol)
Memarsadeghi 2006[355]	Inappropriate comparison (did not use MRI as gold standard)
Moller 2004[363]	Inappropriate comparison (did not use MRI as gold standard)
Munk 1995[369]	Incorrect study design (case series)
Nguyen 2008[387]	Incorrect study design (case series)
Rhemrev 2010[436]	Inappropriate comparison (did not use MRI as gold standard)
Temple 2005[499]	Incorrect population (cadavers)
Thorpe 1996[501]	Inappropriate comparison (did not use MRI as gold standard)
Tiel-van Buul 1993[503]	Inappropriate comparison (did not use MRI as gold standard)
Tiel-Van Buul 1996[504]	Inappropriate comparison (did not use MRI as gold standard)
Trigg 2007[509]	Incorrect study design (survey)

K.2.4 Hot reporting

Table 7: Studies excluded from the clinical review

Reference	Reason for exclusion
Benger 2003[54]	Incorrect study design (diagnostic accuracy)
Brealey 2005[78]	Intervention does not match protocol (intervention and comparison both used cold reporting)
Dabbo 2013[134]	Incorrect study design (retrospective cohort study)
Henderson 2013A[229]	Intervention does not match protocol (intervention included management of soft tissue injuries)
Lamb 2014[297]	Incorrect study design (retrospective cohort study)
Snaith 2014[471]	No relevant outcomes

K.3 Management and treatment plan in the emergency department

K.3.1 Timing of reduction and imaging guidance- distal radius fractures

Table 8: Studies excluded from the clinical review

Reference	Reason for exclusion
Ang 2010[22]	Inappropriate comparison. Image guided rather than image

Reference	Reason for exclusion
	intensification
Auge 2000[26]	Study design: case series
Bain 1997[35]	Inappropriate comparison. Not review population
Beerekamp 2011[50]	Trial protocol
Bevan 2013[56]	Literature review
Blakeney 2009[63]	Incorrect interventions: no varied timing or image intensification
Brady 1998[75]	Conference abstract
Brahm 2011[76]	Conference abstract
Chartier 2012[110]	Literature review
Chinnock 2011[112]	Inappropriate comparison. Image guided rather than image intensification
Handoll helen 2003[217]	Systematic review is not relevant to review question or unclear PICO
Kodama 2014[277]	Non-randomised study does not account for key confounder (anaesthetic type)
Mcmillan 1996[350]	Conference abstract
Mikkelsen 1991[357]	Incorrect intervention: not closed reduction
Montazeri 2014[364]	Non-comparative study
Ruch 2004[444]	Incorrect intervention: arthroscopic reduction
Sadeghifar 2014[445]	Not English language
Tai-chang 2002[495]	Incorrect study design: case series
Varitimidis 2008[520]	Incorrect intervention: open reduction

K.3.2 Reduction anaesthesia – distal radius fractures

Table 9: Studies excluded from the clinical effectiveness review

Study	Reason for exclusion
Blyth 1995[66]	Incorrect interventions. Only IV regional anaesthesia
Brady 1998[75]	Conference abstract
Bultitude 1972[95]	Incorrect interventions. General anaesthetic
Case 1985[105]	Study design not relevant to review. Non-randomised study. Interventions covered by RCTs
Chong 2007[114]	Incorrect interventions. Only IV regional anaesthesia
Cobb 1985[122]	Conference abstract
Funk 1997[189]	Non-randomised study does not account for key confounder: age
Furia 1997[190]	Incorrect population. Radius and ankle fractures.
Handoll 2002[219]	Systematic review is not relevant to review question or unclear PICO
Hollingworth 1982[236]	Incorrect interventions. Only Bier block
Johnson 1991[259]	Study design not relevant to review. Non-comparative study
Jones 1996[260]	Incorrect interventions. Only IV regional anaesthesia. Not review population
Liles 1969[318]	Study design not relevant to review. Not a clinical trial
London 1996[322]	Inappropriate comparison. Haematoma block versus haematoma block
Myderrizi 2011[375]	Incorrect interventions. General anaesthesia

Study	Reason for exclusion
Quinton 1988[429]	Incorrect interventions. Only haematoma block
Sadeghifar 2014[445]	Not English language
Sherry 1989[459]	Incorrect interventions. Only conscious sedation
Singh 1992[464]	Unable to obtain paper

Table 10: Studies excluded from the adverse events review

Study	Exclusion reason
Weaver 2011[533]	No outcomes of interest

K.3.3 Treatment of torus fractures

Table 11: Studies excluded from the clinical review

Reference	Reason for exclusion
Abraham 2008 [2]	Withdrawn from publication as out-of-date
Bae 2012[33]	Non-systematic review article –checked for references
Davidson 2001[137]	No relevant outcomes included
Derksen 2013[145]	Included greenstick fractures with no sub-grouping for fracture type
Firmin 2009[177]	Systematic review – checked for references
Hamilton 2013[215]	Included greenstick fractures with no sub-grouping for fracture type
Howes 2008[243]	Non-systematic review article –checked for references
Kennedy 2010[268]	Systematic review - checked for references
Neal 2014[383]	Non-systematic review article –checked for references
Plint 2004[421]	Retrospective cohort study; already have RCTs for the comparison covered in this study
Pountos 2010[427]	Included greenstick fractures with no sub-grouping for fracture type
Sutherland 2011[492]	Not torus fracture population
Symons 2001[493]	Wrong intervention and comparator
Taranu 2011[497]	Non RCT; non comparative
Vernooij 2012[524]	Non RCT; already have RCTs for the comparison covered in this study
West 2004[537]	Abstract; full paper included

Reference	Reason for exclusion
Witney-Lagen 2013[540]	Non RCT; already have RCTs for the comparison covered in this study
Wright 2011[542]	Non-systematic review article –checked for references

K.3.4 Referral for ongoing management from the emergency department

Table 12: Studies excluded from the clinical review: Referral pathway decision-makers (MDT)

Study	Reason for exclusion
Bayreuther 2009[46]	Study does not extend to referral pathway decision-makers
Brandis 1998[77]	Post-referral focussed study
Brooke 2014[82]	Study takes place after the primary management plan has been formulated
Lambrecht 1998[298]	Non-comparative study
Malkin 2003[333]	Non-comparative study

Table 13: Studies excluded from the clinical review: Referral to virtual clinics versus face to face clinics

Reference	Reason for exclusion
Rouleau 2010[443]	Not relevant to review question
Bancroft 2000[38]	Not relevant to review question
Blank 2011[64]	Descriptive. No outcomes covered
Good2012[200]	GDG felt the evidence for Skype clinics was not relevant to the review question
Heath 1997[225]	Not relevant to review question
Ricci 2002[437]	Non comparative
Palombo 2003[404]	Not relevant to review question
Jayaram 2014[255]	Non comparative
Zennaro 2014[557]	No comparison to face to face clinics
Sathiyakumar 2015[451]	First post-discharge appointment was face to face in both groups; only later follow ups differed between groups.
Vardy 2014[519]	Not relevant to review question – focussed on ED performance not accuracy of achieving appropriate management plan

Table 14: Studies excluded from the clinical review: Referral destinations (Specialist clinics versus general fracture clinics)

Reference	Reason for exclusion
Rouleau 2010[443]	Not relevant to review question
Bancroft 2000[38]	Not relevant to review question
Blank 2011[64]	Descriptive. No outcomes covered

Reference	Reason for exclusion
Heath 1997[225]	Not relevant to review question
Good 2012[200]	Not relevant to this question; included in virtual clinics question
Ricci 2002[437]	Non comparative
Palombo 2003[404]	Not relevant to review question
Jayaram 2014[255]	Non comparative
Beiri 2006[52]	Not relevant to this question; included in virtual clinics question
Murray 2012[371]	Not relevant to this question; included in virtual clinics question

K.4 On-going management

K.4.1 Non-surgical management of unimalleolar ankle fractures

Table 15: Studies excluded from the clinical review

Reference	Reason for exclusion
Ahl 1986[8]	Post-surgery population
Ahl 1987[9]	Post-surgery population
Ahl 1988[11]	Post-surgery population
Ahl 1989[12]	Post-surgery population
Ahl 1993[10]	Post-surgery population
Black 2013[62]	Systematic review is not relevant to review question or unclear PICO
Cimino 1991[118]	Post-surgery population
Distasio 1994[152]	Unable to obtain paper from BL
Dogra 1999[153]	Post-surgery population
Finsen 1989[176]	Post-surgery population
Finsen 1989[175]	Post-surgery population
Fox 2005[184]	Incorrect study design
Honigmann 2007[237]	Post-surgery population
Kimmel 2012[273]	Post-surgery population
Krannitz 2007[283]	No relevant outcomes
Lee 2012[304]	Post-surgery population
Lin 2012[320]	Systematic review is not relevant to review question or unclear PICO
Mason 2010[344]	No immediate unrestricted weight bearing
Partio 1990[408]	Non-English language publication
Port 1996[426]	Does not adjust for “fracture intervention” confounder
Siddique 2005[462]	Post-surgery population
Sondenaa 1986[474]	Post-surgery population
Van laarhoven 1996[516]	Post-surgery population
Vioreanu 2007[526]	Post-surgery population

K.4.2 Timing of surgery – ankle fractures

Table 16: Studies excluded from the clinical review

Reference	Reason for exclusion
Bhandari 1999[57]	Population does not match protocol (tibial fractures)
Carragee 1991[104]	Reported insufficient data for analysis
Carragee 1993[103]	Comparison does not match protocol (a comparison of transferred and non-transferred patients with ankle fractures)
Eventov 1978[167]	Comparison does not match protocol (a comparison of surgical and conservative treatment for ankle fractures)
Fogel 1987[181]	No relevant outcomes
Hulsker 2011[245]	Not guideline condition (open fractures)
Miller 2012[358]	Incorrect study design (non-comparative study)
Pietzik 2006[416]	Reported insufficient data for analysis
Sharma 2006[457]	Incorrect study design (non-comparative study)

K.4.3 Timing of surgery – distal radius fractures

Table 17: Studies excluded from the clinical review

Reference	Reason for exclusion
Grewal 2007[208]	No timing aspects included
Chung 2007[117]	No timing aspects included, and population were people who had previously failed surgical treatment
Ward 2011[532]	No timing aspects included
Lefevre 2012[306]	Wrong population – people with malunion secondary to failed initial treatment
Kaufman 2014[265]	Open fractures
Henry 2008[230]	No timing aspects included
Handoll 2003[217]	No timing aspects included
Handoll 2007[220]	No timing aspects included

K.4.4 Definitive treatment - distal radial fractures

Table 18: Studies excluded from the clinical review

Study	Reason for exclusion
Afekenstam 1989[5]	Incorrect interventions
Anon 2011[3]	Not published
Arora 2012[24]	Incorrect study design
Atroshi 2006[25]	Inappropriate comparison
Axelrod 1991[29]	Incorrect study design
Bartl 2011[41]	Protocol only
Bruijn 1987[90]	Incorrect interventions
Chappuis 2011[109]	Incorrect interventions

Study	Reason for exclusion
Chen 2010[111]	Not English language
Chirpaz-Cerbat 2011[113]	Incorrect study design
Chung 2013[116]	Incorrect study design
Chung 2013[115]	Incorrect study design
Cooper 2008[125]	Incorrect study design
Costa 2011[126]	Protocol only
Cui 2012[132]	Inappropriate comparison
Diaz-Garcia 2011[149]	Inappropriate comparison
Esposito 2013[164]	Systematic review: study designs inappropriate
Faierman 1998[168]	Systematic review: methods are not adequate/unclear
Falk 2012[169]	Incorrect interventions
Ferris 1989[172]	Inappropriate comparison
Franck 2000[185]	Not English language
Freeman 2000[186]	Abstract only
Fritz 1999[187]	Incorrect study design
Gibbons 1994[196]	Incorrect study design
Gomez-rice 2012[199]	Incorrect study design
Gradl 2011[202]	Incorrect interventions
Gradl 2014[203]	Incorrect interventions
Gravier 2005[206]	Incorrect interventions
Hahnloser 1999[213]	Inappropriate comparison
Handoll 2003[217]	Inappropriate comparison
Handoll 2007[220]	Inappropriate comparison
Handoll 2008[216]	Inappropriate comparison
Handoll 2009[218]	Withdrawn
Handoll 2013[221]	Protocol only
Horne 1991[240]	Incorrect study design
Hossain 2006[241]	Incorrect study design
Hove 2010[242]	Inappropriate comparison
Hutchinson 2000[246]	Inappropriate comparison
Jakubietz 2008[253]	Inappropriate comparison
Jakubietz 2012[252]	Inappropriate comparison
Jenkins 1989[257]	Abstract only
Kasapinova 2014[264]	Review
Kongsholm 1981[278]	Inappropriate comparison
Kopylov 1999[281]	Incorrect interventions
Kopylov 2001[280]	Incorrect interventions
Koshimune 2005[282]	Inappropriate comparison
Kreder 2005[284]	Inappropriate comparison
Krishnan 2003[285]	Inappropriate comparison
Krukhaug 2009[287]	Inappropriate comparison
Kumbaraci 2014[292]	Non RCT
Kulshrestha 2011[289]	Inappropriate comparison

Study	Reason for exclusion
Laino 2012[296]	Incorrect study design
Li 2010[313]	Not English language
Lihai 2015[316]	Review
Ludvigsen 1996[328]	Not English language
Margaliot 2005[339]	Systematic review: study designs inappropriate
Mccann 2012[347]	Incorrect study design
Mcqueen 1998[351]	Inappropriate comparison
Meier 2012[353]	Not English language
Milutinovic 2013[360]	Incorrect study design
Modi 2010[362]	Systematic review is not relevant to review question or unclear PICO
Murray 2013[370]	Incorrect study design
Nann 1994[379]	Abstract only
Nazar 2009[382]	Incorrect study design
Neumann 1996[385]	Not English language
Osti 2012[402]	Inappropriate comparison
Paksima 2004[403]	Systematic review: study designs inappropriate
Pershad 2009[414]	Incorrect study design
Pritchett 1995[428]	Inappropriate comparison
Ring 1997[439]	Incorrect study design
Safi 2013[446]	Incorrect interventions
Schonnemann 2011[455]	Incorrect interventions
Shyamalan 2009[461]	Incorrect study design
Sommerkamp 1994[473]	Inappropriate comparison
Strohm 2004[490]	Inappropriate comparison
Trevisan 2013[508]	Systematic review: methods are not adequate/unclear
Walenkamp 2013[527]	Systematic review: study designs inappropriate
Walenkamp 2014[528]	protocol
Wang 2013[530]	Unable to gain access
Wei 2012[535]	Systematic review: study designs inappropriate
Werber 2003[536]	Inappropriate comparison
Xie 2013[545]	Systematic review: study designs inappropriate
Xun 2011[546]	Inappropriate comparison
Zettl 2009[558]	Not English language
Zyluk 2007[561]	Not English language

K.4.5 Definitive treatment - humerus fractures

Table 19: Studies excluded from the clinical review

Study	Reason for exclusion
Afridi 2002[6]	Unable to obtain study; incorrect age group
Agarwal 2004[7]	Incorrect age group; abstract only
Altay 2011[17]	Supracondylar humerus fracture

Anakwenze 2014[21]	Systematic review; no applicable outcome
Bastian 2009[42]	Non-randomised case series
Bauer 1999[44]	Not in English
Benegas 2014[53]	Humeral shaft fracture
Biberthaler 2009[59]	Abstract only
Bigorre 2009[60]	Non comparative study
Bing 2002[61]	A5 poster; not manuscript
Blonna 2014[65]	Non-comparative study
Boons 2013[67]	Abstract only
Boudard 2014[70]	Non-randomised study; comparisons not matched for age
Boyle 2013[74]	Non-randomised study; comparisons not matched for age
Brorson 2009[88]	Exclude; study protocol
Brorson 2009[86]	Narrative review
Brorson 2011[87]	Systematic review; no reported outcomes
Brorson 2011[85]	Narrative review
Brorson 2013[89]	Narrative review
Buecking 2014[92]	Compares operative approach; Deltoid split versus deltopectoral approach
Burkhart 2013[96]	Narrative review
Chalmers 2014[107]	Patients not matched for severity of fracture
Cuff 2013[131]	Patients not matched confounders
Dai 2014[136]	Systematic review is not relevant to review question or unclear PICO
Den hartog 2010[140]	Systematic review; no analysis
Den hartog 2010[141]	Study protocol
Edelmann 2011[162]	Non- English Study
Ellwein 2015[163]	Non-randomised study; distal humerus fractures
Fialka 2008[173]	Compares 2 Hemiarthroplasty techniques
Fjalestad 2010[178]	Included in economic analysis
Fjalestad 2014[179]	Study protocol
Fuchtmeier 2007[188]	Exclude; non-human biomechanical study
Gomberawalla 2013[198]	Systematic review is not relevant to review question or unclear PICO
Handoll 2009[222]	Study protocol
Hoellen 1997[233]	Not in English
Hoellen 1997[234]	Not in English
Holbein 1999[235]	Not in English
Ilchmann 1998[248]	Non-randomised study of Open reduction versus. Conservative
Kim 2012[272]	Non-comparative study
Kontakis 2008[279]	Review; no comparative studies
Kristiansen 1988[286]	Exclude; no outcomes specific to protocol
Laflamme 2008[295]	Non-comparative Study
Launonen 2012[300]	Study protocol; fits protocol, but will not be published until 2017
Lefevre-Colau 2007[307]	Compares 2 immobilisation techniques
Li 2011[314]	Shaft fracture; incorrect Population.
Li 2013[315]	Humeral shaft fractures

Lill 2012[319]	Compares novel technique for IM nailing
Liu 2011[321]	Compares separate techniques for open reduction and plating.
Lopiz 2014[323]	Compares 2 separate IM nail models
Mao 2014[338]	Systematic review; study designs inappropriate
Martetschlager 2012[343]	Study compares surgical type
Namdari 2013[378]	Systematic review is not relevant to review question or unclear PICO
Norris 2002[390]	Non-trauma population
Nouraei 2014[393]	Non-randomised study; no additional outcomes
Ockert 2010[397]	Study compared the position of mechanical screws when using plating
Ockert 2014[398]	Study compared the position of screw
Pijls 2010[418]	Compares 2 techniques of open reduction
Rangan 2006[434]	Abstract of RCT
Roderer 2011[440]	Non comparative study
Smejkal 2008[468]	Abstract only
Smejkal 2011[469]	Non-English Review
Thorsness 2014[502]	Non-randomised study; comparisons not matched for age
Trepat 2012[507]	Non-randomised study does not report confounders.
Wali 2014[529]	Humeral shaft fractures
Wild 2011[538]	Non-randomised study comparing open reduction with Hemiarthroplasty
Zuckerman 2012[560]	Abstract only

K.4.6 Definitive treatment - paediatric femoral fractures

Table 20: Studies excluded from the clinical review

Reference	Reason for exclusion
Abbott 2013[1]	Cohort study – not well matched for key confounder (fracture type) and no MVA
Agarwal 2004[7]	Most patients had forearm fractures
Akinyoola[13]	Interventions not compared in results section
Ali 2005[14]	Thomas splint not on protocol
Allison 2011[16]	Cohort study - comparisons covered by RCTs
Altay 2011[18]	Interventions not on protocol
Baldwin 2011[36]	Review- references checked
Bali 2011[37]	Femoral neck fractures
Basumallick 2002[43]	Comparison not on protocol
Buechsenschuetz 2002 [91]	Non RCT, and comparison already covered by an RCT
Cameron 1992 [99]	Not on children
Clinkscales 1997 [120]	Cohort studies - covered some of the comparators not covered by RCTs but excluded as there was no MVA. Ages appeared different between groups.
Coyte 1997 [127]	Non RCT, and comparison already covered by an RCT
Craig 2005 [128]	Review. References checked
Curtis 1995 [133]	Non protocol treatments.

Reference	Reason for exclusion
Daglar 2009 [135]	Not on children
Domb 2002 [154]	Not as per protocol – this is comparing different types of external fixation.
Even 2012[166]	Not in children
Gaid 2006[193]	Cohort study - Poor reporting of potential key confounders across groups (for example age of each group not given).
Gregory 1995[207]	This cohort study covered some of the comparators that were not covered by RCTs but there was no MVA. Groups very different at baseline for comminution and open/closed fractures.
Gupta 2007[210]	Non RCT, and comparison already covered by an RCT
Hedin 2004[226]	This cohort study covered some of the comparators not covered by RCTs but there was no MVA. Groups very different at baseline for age.
Heffernan 2015[228]	Non RCT and comparison already covered by an RCT
Hull 1997[244]	Review. References checked.
Jarvis 2006[254]	Cohort study – not well matched for key confounder (age) and no MVA. Also extremely small groups of 2-4.
Kaiser 2014[262]	Used Buck's traction as comparator – not on protocol
Kumar 2014[290]	Did not consider key confounder. Comparator not on protocol
Jencikova-Celerin 2008 [256]	Comparator was 'other fixation types'.
Lee 2007[305]	Non comparative study
Li 2013[312]	Subtrochanteric fracture
Lozman 1986[326]	Exclude – not in children
McLaren 1990 [349]	Interventions not on protocol
Mehdinasab 2008[352]	Non RCT. Comparisons in this study already covered by included RCTs
Nascimento 2013 [380]	Cohort study – comparisons covered by RCTs
Nork 1998 [389]	Non RCT and comparison covered by an RCT
Parsch 1997 [407]	Review – references checked
Podeszwa 2004 [422]	Cohort study – potentially confounding differences in a key confounder (age) with no adjustment
Poolman 2006 [424]	Review – references checked
Reis 1980 [435]	Exclude – not in children
Sahu 2012 [448]	Covered some of the comparators not covered by RCTs but excluded as there was no MVA. Ages unclear in the different groups.
Scheerder 2008 [452]	Comparing two types of Bryant traction – not as protocol
Schonk 1978 [454]	Cohort study – poor reporting of key confounders and no MVA. Interventions poorly described.
Shaikh 2012 [456]	Not available from any source
Siddiqui 2008 [463]	Treatments not on protocol
Soleimanpour 2013 [472]	Not available from any source
Song 2004 [475]	Cohort study - comparison covered by RCTs
Thomas 1981 [500]	Not in children
Ucar 2013 [513]	Interventions not on protocol
van Niekerk 1992 [518]	Adult study
Wright 2000 [543]	Review- references checked

Reference	Reason for exclusion
Zlowodzki 2007 [559]	Adult study

K.4.7 Post operative mobilisation - Distal femoral fractures

Table 21: Studies excluded from the clinical review

Reference	Reason for exclusion
Borgen 1975[68]	Non comparative study
Kubiak 2013[288]	Non-systematic review. All references checked for relevance

K.4.8 Post operative mobilisation – ankle fractures

Table 22: Studies excluded from the clinical review

Reference	Reason for exclusion
Black 2013[62]	Systematic review is not relevant to review question or unclear PICO. Incorrect interventions
Cimino 1991[118]	Incorrect study design. Incorrect interventions
Distasio 1994[152]	Unable to obtain paper from BL
Dogra 1999[153]	Incorrect interventions
Finsen 1989[175]	No relevant outcomes
Hedstrom 1994[227]	Incorrect interventions. No immediate unrestricted weight bearing
Kimmel 2012[273]	No delayed unrestricted weight bearing. Incorrect interventions
Lee 2012[304]	Not review population
Lehtonen 2003[308]	Incorrect interventions. No immediate unrestricted weight bearing
Lin 2012[320]	Systematic review is not relevant to review question or unclear PICO
Partio 1990[408]	Non-English language publication
Siddique 2005[462]	Incorrect study design. No immediate unrestricted weight bearing
Sondenaa 1986[474]	Incorrect interventions. No immediate unrestricted weight bearing
Tropp 1995[510]	Incorrect interventions. No immediate unrestricted weight bearing
Vioreanu 2007[526]	Incorrect interventions. No immediate unrestricted weight bearing

Appendix L: Excluded economic studies

L.1 Acute stage assessment and diagnostic imaging

L.1.1 Imaging of scaphoid

Table 23: Studies excluded from the economic review

Reference	Reason for exclusion
Brooks 2005[83]	This study was assessed as partially applicable with potentially serious limitations. However, the GDG judged that other available evidence was of greater applicability, methodological quality or both, and therefore this study was selectively excluded. This non-UK study has been included in the clinical review however the included study is from a UK perspective and is therefore more applicable.
Dorsay 2001[156]	This study was assessed as partially applicable with potentially serious limitations. However, the GDG judged that other available evidence was of greater applicability, methodological quality or both, and therefore this study was selectively excluded.
Gooding 2004[201]	This study was assessed as partially applicable with potentially serious limitations. However, the GDG judged that other available evidence was of greater applicability, methodological quality or both, and therefore this study was selectively excluded.
Hansen 2009[224]	This study was assessed as partially applicable with potentially serious limitations. However, the GDG judged that other available evidence was of greater applicability, methodological quality or both, and therefore this study was selectively excluded.
Jenkins 2008[258]	This study was assessed as partially applicable with potentially serious limitations. This study was excluded in the clinical review and so was also excluded here.
Murthy 2013[372]	This study was assessed as partially applicable with potentially serious limitations. However, the GDG judged that other available evidence was of greater applicability, methodological quality or both, and therefore this study was selectively excluded.

L.2 On-going management

L.2.1 Definitive treatment of distal radial fractures

able 24: Studies excluded from the economic review

Reference	Reason for exclusion
Shauver 2011[458]	This study was assessed as partially applicable with very serious limitations. Not all adverse events were considered and quality of life estimates conflicted with those in the clinical review. Complication rates were also different.

L.2.2 Definitive treatment of humerus fractures

Table 25: Studies excluded from the economic review

Reference	Reason for exclusion
Fjalestad 2010[178]	This study was assessed as partially applicable with very serious limitations. This study has also been excluded from the clinical review. There are large baseline differences in quality of life and there are inaccuracies in the reporting of some of the data.

L.2.3 Definitive treatment - paediatric femoral fractures

Table 26: Studies excluded from the economic review

Reference	Reason for exclusion
Buechsenschuetz 2002[91]	This study was assessed as partially applicable with potentially serious limitations. This study was excluded in the clinical review and so was also excluded here.
Hedin 2004 [226]	This study was assessed as partially applicable with potentially serious limitations. This study was excluded in the clinical review and so was also excluded here.
Scheerder 2008 [452]	This study was assessed as not applicable as the comparators were not relevant. It was therefore excluded.

Appendix M: Cost-effectiveness analysis: Imaging of suspected scaphoid fractures

M.1 Introduction

Many patients present to an Emergency Department (ED) with a wrist injury whose symptoms indicate a possible fracture to the scaphoid. The majority of these patients, however, are not expected to have a fracture. Accurate diagnosis of this type of fracture is important, as the consequence of a missed fracture that results in non-union, can lead to arthritic changes that cause a detrimental effect to the quality of life of the patient. The most frequent method of diagnosis currently is to use plain film X-ray images; the sensitivity of which is not regarded to be high enough for an ED clinician to confidently discharge a patient when a fracture is not clearly identified. Therefore, a patient with normal findings on X-ray images will be brought back to hospital for an appointment at the fracture clinic to assess the injury further. More accurate imaging could allow many of these patients to be discharged, therefore reducing the burden of excessive hospital attendances. There is, of course, an increased cost to performing more accurate diagnostic imaging such as CT and MRI and so the trade-off between the initial cost of imaging and the downstream costs of further clinic attendances needs to be assessed. More accurate imaging could also prevent reduced health outcomes due to delayed treatment following incorrect diagnosis.

An original economic analysis was prioritised to answer the following question: What is the clinically and cost effective imaging strategy for patients presenting at ED with a clinically suspected scaphoid fracture?

(Please see appendix C for related review protocol).

Published economic evidence in evaluating these trade-offs is limited. The evidence found in the economic literature search assessed MRI after an indeterminate X-ray compared to follow-up X-rays and did not consider any health effects[409]. One study[258] also looked at CT scans but also did not include any health effects and the reference standard used to inform the diagnostic accuracy data was delayed X-rays and not MRI as stated in our protocol.

This question was prioritised for original economic analysis due to the lack of applicable economic evidence of sufficient quality for all strategies in this question. The outcome of the question could have a large economic impact on current practice due to the difference in cost of the imaging modalities, as well as the high incidence of suspected scaphoid fractures but low prevalence of true fractures. Here we present a cost-utility analysis on the optimal imaging strategy for patients with a suspected scaphoid fracture.

M.2 Methods

M.2.1 Model overview

M.2.1.1 Comparators

The strategies assessed in the model are:

1. X-ray then follow-up

   A plain film X-ray examination is performed on the day of presentation at ED and if the results are indeterminate, the patient's wrist will be immobilised and they are sent home. An appointment at the fracture clinic is arranged around 10 days later for further assessment and X-rays. Further appointments may be required if a fracture still cannot be identified but symptoms remain.

2. X-ray then CT

   A plain film X-ray examination is performed on the day of presentation at ED and if the results are indeterminate, the wrist is immobilised and the patient sent home. The patient returns to hospital shortly after for a CT scan, and a definitive diagnosis is then made.

3. X-ray then MRI

   A plain film X-ray examination is performed on the day of presentation at ED and if the results are indeterminate, the wrist will be immobilised and the patient sent home. The patient returns to hospital shortly after for a MRI scan, and a definitive diagnosis is then made.

4. Immediate CT

   A CT scan is performed on the day of presentation at ED and a definitive diagnosis is made.

5. Immediate MRI

   An MRI scan is performed on the day of presentation at ED and a definitive diagnosis is made.

M.2.1.2 Population

Adults and children who attend ED with an injury suspected to be an isolated scaphoid fracture.

M.2.1.3 Time horizon, perspective and discount rates

A lifetime horizon was used and a UK NHS and PSS perspective. The analysis followed the standard assumptions of the reference case including discounting at 3.5% for health effects, and an incremental analysis conducted. No costs were modelled beyond the first year and therefore discounting was only applicable to health effects.

M.2.2 Approach to modelling

The model was developed using Microsoft Excel 2010. It assesses the impact of the different diagnostic accuracies of each imaging modality on both healthcare costs and health effects (QALYs). It looks at treatments following correct diagnoses and incorrect diagnoses, for patients who have fractures and for those who do not. Health effects were incorporated into the model by means of a long term reduction in quality of life due to delayed treatment following an incorrect diagnosis of a fracture.

M.2.2.1 Model structure

The model is a decision tree with four stages: true fracture status; displacement status; diagnostic result; treatment. The model structures for the different strategies are shown below.

Figure 217: Initial X-ray model structure

This part of the model is relevant only to the strategies where people who attend the ED with a suspected scaphoid fracture are given an initial X-ray (strategies 1, 2 and 3). People who have a positive X-ray image will be immobilised in plaster cast or will have surgical fixation performed. Those who have a negative X-ray in this initial stage will then go through the next stage of the strategy. The next stages are outlined in Figure 218 and Figure 219 below. The results of each stage are combined to give the results of the overall strategy.

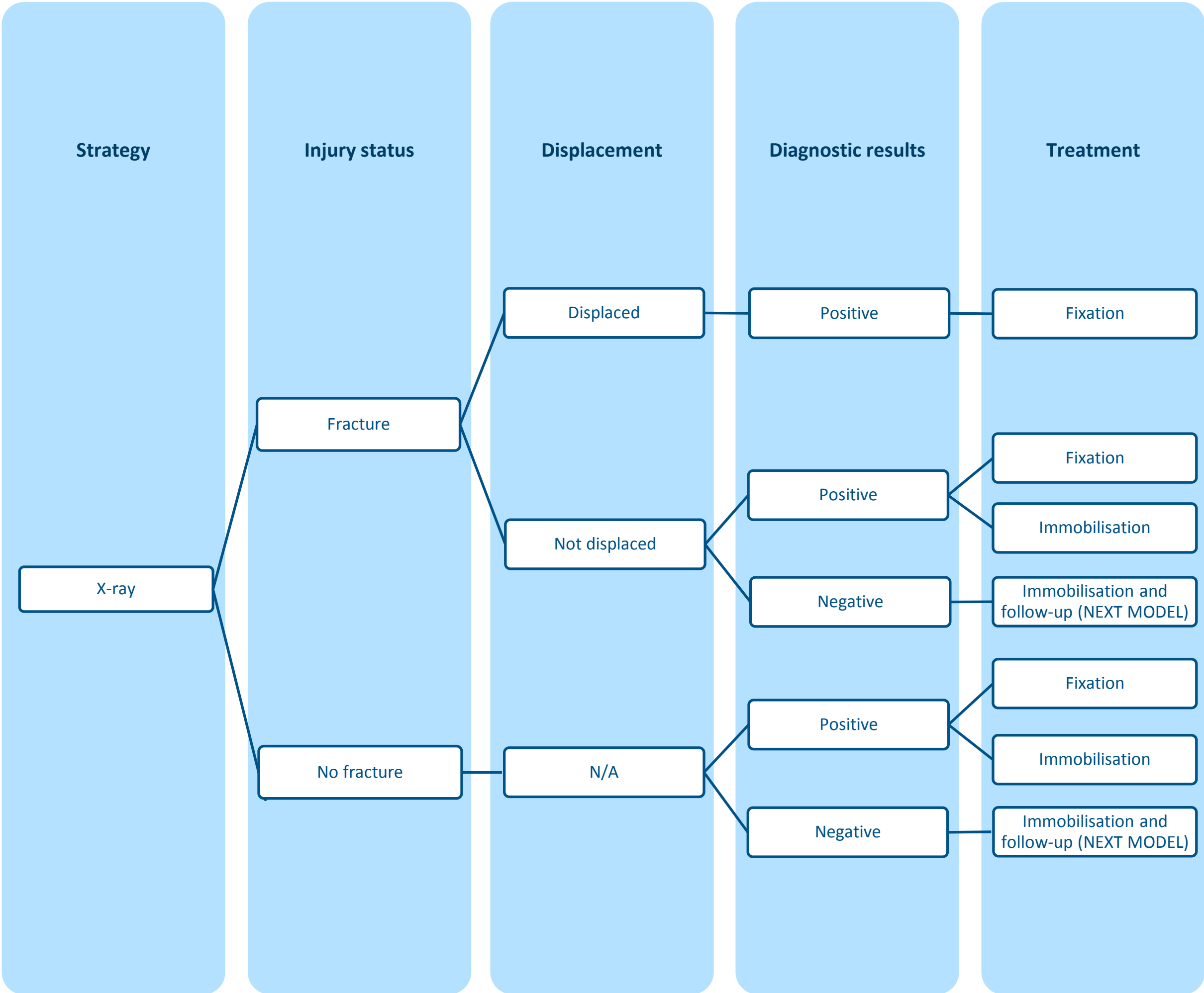


Figure 218: X-ray follow-up model structure

This is the second stage of the follow-up X-ray strategy, so the population entering this model are those who have had a negative or 'indeterminate' X-ray. The key differences between these are in the treatment stages as after a false negative follow-up X-ray the patient is assumed to have been missed but may present later and require salvage surgery. Also, the prevalence of fracture is reduced as the majority of them will be identified at the initial X-ray stage.

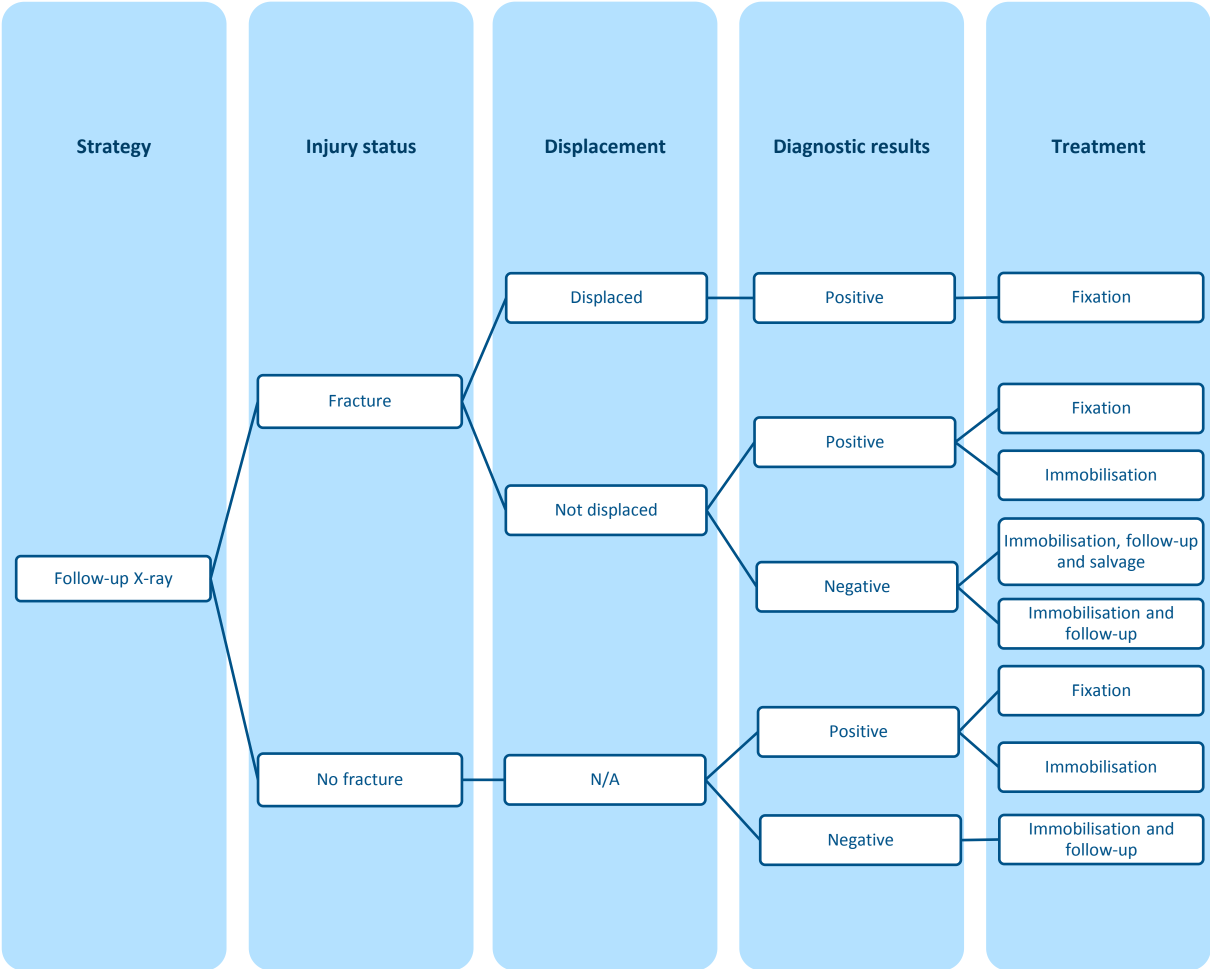
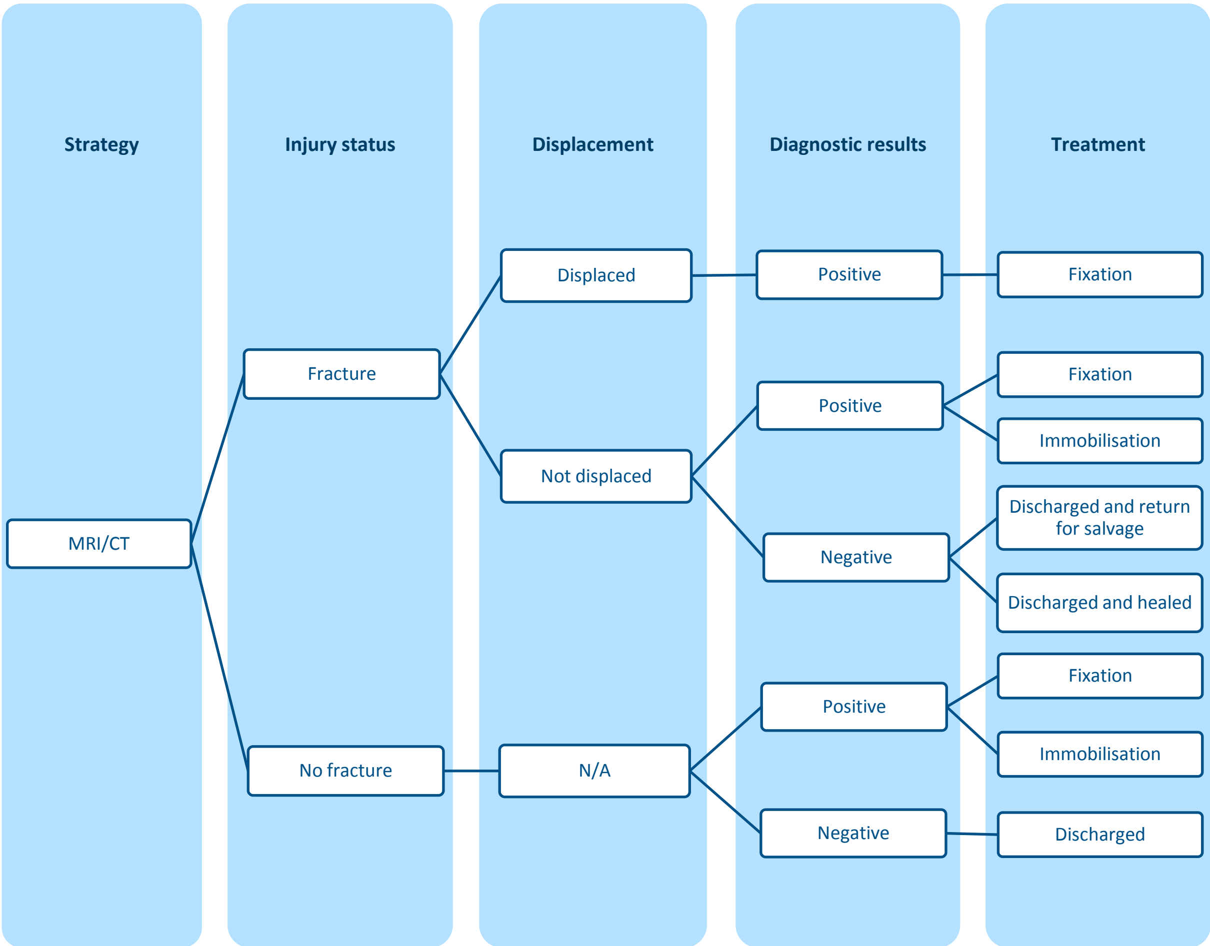


Figure 219: MRI/CT model structure

This structure is for the immediate MRI or CT strategies as well as the strategies where these modalities are used as a follow-up to an initial negative X-ray.



The population is divided at each step in the tree to apply the relevant costs and health effects to different subsets of the population. The first step splits the population by the presence or absence of a fracture. This is the expected proportional split of the population, based on prevalence study data, before any diagnostic examination has been performed.

The second step only applies to those with a fracture, as it separates those with a displaced fracture from those with a non-displaced. This step is included to allow for different diagnostic accuracies to be applied and different treatment strategies after diagnosis. In the base case analysis, all patients with a displaced fracture were assumed to be identified on all imaging modalities and were also assumed to require fixation.

The third step splits each branch by the results of the image, i.e. positive or negative. For the strategies that have an initial X-ray, a negative result is considered to be 'indeterminate' due to its low sensitivity. These patients will go through the steps of the tree again and a mean number of follow up attendances will be applied to those whose image is still negative. Note that the prevalence of fracture will have changed in those patients with an initial negative or 'indeterminate' X-ray. The prevalence in this group of patients is determined by the initial prevalence as well as the results of imaging. All fractures in this group are assumed to be non-displaced due to the assumption that all displaced fractures will be identified on the initial images.

At the final step, each branch is split by treatment type. This is described below, by imaging modality and diagnosis:

Initial X-ray

- True positive diagnosis: Surgical fixation or cast immobilisation.
- False negative diagnosis: Patients are immobilised and go through the decision tree of the next imaging modality.
- True negative diagnosis: Patients are immobilised and go through the decision tree of the next imaging modality.
- False positive diagnosis: Patients are immobilised (a sensitivity analysis explores the potential for surgery as a management plan).

Follow-up X-ray

- True positive diagnosis: As for initial X-ray.
- False negative diagnosis: Patients are followed up but some fractures heal naturally and others require a return to hospital for surgery. This surgery is 'salvage surgery'; a more expensive procedure than fixation that is required due to the arthritic changes that occur from delayed treatment of non-union.
- True negative diagnosis: Patients are followed up a fixed number of times and immobilised as a precaution.
- False positive diagnosis: As for initial X-ray.

MRI/CT (immediate or after initial X-ray)

- True positive diagnosis: Surgical fixation or cast immobilisation.
- False negative diagnosis: Patients are discharged. Some patients, whose fracture does not heal naturally, return for re-imaging and surgery. This surgery is 'salvage surgery'; a more expensive procedure than fixation that is required due to the arthritic changes that occur from delayed treatment of non-union.
- True negative diagnosis: Patients are discharged.
- False positive diagnosis: Patients are immobilised (a sensitivity analysis explores the potential for surgery as a management plan). The model allows for false positive diagnoses to potentially have surgery or immobilisation but the probability of this is zero for the base case analysis.

M.2.2.2 Key assumptions

- People indicated for surgery will have a CT scan for planning purposes. This cost is included in the model because an additional CT will not be required if CT is used as the diagnostic modality.
- People whose fracture was missed after a CT and returned to hospital with an indication for salvage surgery received an MRI scan to assess the injury further. People whose injury was

missed after an MRI and returned to hospital with an indication for salvage surgery received a CT scan to assess the injury further.

- A fracture that is still not identified on a follow-up X-ray is assumed to remain unidentified at any subsequent follow-up visits.
- Those with an identified fracture are assumed to return to full health after one year, due to a lack of quality of life data showing the progression beyond this time point. For patients whose fracture is not identified, the quality of life detriment was assumed to be sustained for life, in order to account for the detrimental effect of delayed treatment.
- A fracture that is not identified on X-ray but is immobilised as a precaution is not considered to be a missed fracture unless it is a fracture that requires surgery. Therefore, the false negatives that are followed up in the fracture clinic and don't represent with an indication for surgery are assumed to have been treated appropriately in a plaster cast. These patients will therefore return to normal health after the first year.

M.2.2.3 Uncertainty

The model was built probabilistically to take account of the uncertainty around input parameter point estimates. A probability distribution was defined for each model input parameter where data was available or reliable assumptions could be made. When the model was run, a value for each input was randomly selected simultaneously from its respective probability distribution; mean costs and mean QALYs were calculated using these values. The model was run 10,000 times for the base case analysis and results were summarised.

The way in which distributions are defined reflects the nature of the data, so for example utilities were given a beta distribution, which is bounded by 0 and 1, reflecting that a quality of life weighting will not be outside this range. A description of the different types of distributions used for each type of input is given in Table 27. All of the variables that were made probabilistic in the model and their distributional parameters are detailed in Table 29 and in the relevant input summary tables in Section M.2.3. Probability distributions in the analysis were parameterised using error estimates from data sources or assumptions were where data sources did not exist.

Various deterministic sensitivity analyses were also undertaken to test the robustness of model assumptions. In these analyses, one or more inputs were changed and the analysis rerun to evaluate the impact on results and whether conclusions on which intervention should be recommended would change.

Table 27: Description of the type and properties of distributions used in the probabilistic sensitivity analysis

Parameter	Type of distribution	Properties of distribution
Probabilities (epidemiology, imaging accuracy estimates)	Beta	Bounded between 0 and 1. For the sensitivity and specificity, as the sample size and the number of events were specified, alpha and beta values were calculated as follows: Alpha = (number of patients ruled in if sensitivity or out if specificity) Beta = (Number of patients) − (number of patients ruled in/out)

Parameter	Type of distribution	Properties of distribution
		For epidemiology data where the number of cases was available, alpha and beta values were calculated as follows: Alpha = (number of patients with condition) Beta = (Number of patients without condition) Where data were provided only as a probability, assumptions were made about the sample size.
Costs Utilities	Gamma	Bounded at 0, positively skewed. Derived from mean and its standard error. For the costs and utilities; Alpha and Beta values were calculated as follows: Alpha = $(\text{mean}/\text{SE})^2$ Beta = SE^2/Mean

The following variables were left deterministic (that is, they were not varied in the probabilistic analysis):

- cost-effectiveness threshold (which was deemed to be fixed by NICE)
- probability that fixation surgery is performed on displaced fractures
- probability of surgery following a false positive diagnosis
- sensitivity of all tests on displaced fractures
- sensitivity of follow up X-ray
- sensitivity of MRI
- specificity of follow-up X-ray
- specificity of CT
- specificity of MRI
- mean number of follow-up visits
- general population quality of life
- duration of reduced quality of life for identified fractures
- duration of reduced quality of life for missed fractures
- mean age at time of injury
- mean age at death
- PRWE score (predicted EQ-5D score was made probabilistic)

M.2.3 Model inputs

M.2.3.1 Summary table of model inputs

Model inputs were based on clinical evidence identified in the systematic review undertaken for the guideline, supplemented by additional data sources as required. Model inputs were validated with clinical members of the GDG. A summary of the model inputs used in the base-case (primary) analysis is provided in Table 28 below. More details about sources, calculations and rationale for selection can be found in the sections following this summary table.

Table 28: Summary of base-case model inputs

Input	Data	Source
Baseline risk		
Prevalence of scaphoid fracture among those where a fracture is suspected.	16%	Geijer et al. 2013[194]
Probability that the fracture is displaced.	20%	Dias et al. 2011[147]
Probability that fixation is performed on a displaced fracture as opposed to immobilisation.	100%	GDG assumption
Probability that fixation is performed on a non-displaced fracture as opposed to immobilisation.	5%	GDG assumption
Probability of surgery for a false positive diagnosis	0%	GDG assumption
Test accuracy		
Sensitivity of all tests for displaced fractures	100%	GDG assumption
Sensitivity of initial X-ray	70%	Jørgsholm et al. 2013 [261]
Sensitivity of follow-up X-ray	70%	GDG assumption guided by Jørgsholm et al. 2013 [261]
Sensitivity of CT (immediate)	95%	Jørgsholm et al. 2013 [261]
Sensitivity of CT (after indeterminate X-ray)	88%	Ilica et al. 2011[249]
Sensitivity of MRI	100%	Reference standard
Specificity of initial X-ray	98%	Jørgsholm et al. 2013 [261]
Specificity of follow-up X-ray	95%	GDG assumption guided by Jørgsholm et al. 2013 [261]
Specificity of CT	100%	Ilica et al. 2011[249]
Specificity of MRI	100%	Reference standard
Costs		
Cost of plain film X-ray	£28	Direct access plain film, NHS Reference Costs 2012-2013[142]
Cost of CT	£85	Diagnostic imaging – outpatients (Trauma and orthopaedics), NHS Reference Costs 2012-2013[142]
Cost of MRI	£143	Diagnostic imaging – outpatients (Trauma and orthopaedics), NHS Reference Costs 2012-2013[142]
Cost of immobilisation	£10	GDG assumption. Estimated cost of plaster cast materials required.
Cost of surgical fixation	£1,373	HRG: HA54Z (Day case), NHS Reference Costs 2012-2013[142]
Cost of salvage surgery	£1,549	HRG: HA52Z (Day case), NHS Reference Costs 2012-2013[142]
Cost of initial fracture clinic attendance	£128	HRG: WF01B (Trauma and Orthopaedics), NHS Reference Costs 2012-2013[142]
Cost of follow-up fracture clinic attendance	£102	HRG: WF01A(Trauma and Orthopaedics), NHS Reference Costs 2012-2013[142]

Input	Data	Source
Cost of ED attendance	£120	HRG: WF01B (Accident and Emergency), NHS Reference Costs 2012-2013[142]
Mean number of follow-up visits	2.5	GDG assumption
Quality of life		
PRWE 1-year post scaphoid fracture	22 (Pain = 15; Function = 7)	MacDermid et al. 1998[329]
EQ-5D index at 1-year post scaphoid fracture	0.819	Mapped from PRWE score from MacDermid et al. 1998[329]
General population QoL for 30 year old	0.93	Kind et. al. 1999[274]
Duration of reduced QoL for identified fractures	1 year	GDG assumption based on restriction of available data to one year from MacDermid et al. 1998[329]
Duration of reduced QoL for missed fractures	Lifetime	GDG assumption
Others		
Mean age at time of injury	30 years	GDG assumption
Mean age at death	80 years	Interim life tables, England and Wales, 2010-2012.[399]

M.2.3.2 Summary of distributions for probabilistic analysis

Table 29: Summary of distributions and parameters

Input	Point estimate	Probability distribution	Distribution parameters
Baseline risk			
Prevalence of scaphoid fracture among those where a fracture is suspected.	0.16	Beta	α=32, β=168
Probability that the fracture is displaced.[a]	0.20	Beta	α=40, β=160
Probability that fixation is performed on a non-displaced fracture as opposed to immobilisation.[a]	0.05	Beta	α=10, β=190
Test accuracy			
Sensitivity of initial X-ray	0.70	Beta	α=87, β=38
Sensitivity of CT (immediate)	0.95	Beta	α=116, β=6
Sensitivity of CT (after indeterminate X-ray)	0.88	Beta	α=14, β=2
Specificity of initial X-ray	0.98	Beta	α=172, β=3
Costs			
Cost of plain film X-ray	£28	Gamma	α=12.5, β=2.3
Cost of CT	£85	Gamma	α=6.3, β=13.6
Cost of MRI	£143	Gamma	α=5.0, β=28.6
Cost of immobilisation	£10	Gamma	α=59.2, β=0.2
Cost of surgical fixation	£1,373	Gamma	α=11.0, β=124.3
Cost of salvage surgery	£1,549	Gamma	α=12.8, β=120.8

Input	Point estimate	Probability distribution	Distribution parameters
Cost of initial fracture clinic attendance	£128	Gamma	α=18.1, β=7.0
Cost of follow-up fracture clinic attendance	£102	Gamma	α=9.5, β=10.7
Cost of ED attendance	£120	Gamma	α=3.1, β=38.7
Quality of life			
EQ-5D index at 1-year post scaphoid fracture	0.819	Beta	α=290, β=64
General population EQ5D	0.930	Beta	α=700, β=53

(a) Parameters for this input were based on the same sample size as the study used for the prevalence of scaphoid fracture as only the point estimate was provided in the study.

M.2.3.3 Prevalence of scaphoid fracture and displacement of fracture

One study, Duckworth et al. 2011[159], on the assessment of suspected scaphoid fractures, reported that previous studies found the prevalence of scaphoid fractures among those who attend ED with a suspected fracture to be between 5% and 20%. Another study, Geijer et al. 2013[194], reported an average of 16% from a meta-analysis, and a range from 5% to 19%. The GDG agreed to use the value of 16% in the base case and a range of 5% to 20% in the sensitivity analysis.

The prevalence of displacement, as reported by Dias et al. 2011[147], is 20% in mid waist scaphoid fractures. This was assumed to be the prevalence among all scaphoid fractures.

M.2.3.4 Diagnostic accuracy

The clinical review assessed diagnostic studies that used MRI as the reference standard. The GDG considered this to be the most reliable reference standard due to its high sensitivity for diagnosing scaphoid fractures in comparison to X-ray and CT. They acknowledged that the specificity of MRI may be imperfect as it is likely to identify other injuries that are indistinguishable from fractures, which would cause the sensitivity of the index tests to be underestimated and the specificity overestimated. As MRI was chosen as the reference standard, the estimates of sensitivity and specificity for the other modalities are relative to this modality. Therefore, the model used values of 100% for both sensitivity and specificity of MRI, but these values along with the sensitivity and specificity for the other imaging modalities were varied in sensitivity analyses to assess the potential impact of the uncertainty.

This data was found from the clinical review but it was assumed that all displaced fractures would be identified on any imaging modality. The diagnostic accuracy data was therefore assumed to apply to those with non-displaced fractures. These values were tested in sensitivity analyses.

The diagnostic accuracy of follow-up X-rays was not found in the clinical review and so the GDG assumed that it was the same as for the initial X-ray. A sensitivity analysis was performed to account for a potential improvement in diagnostic accuracy.

M.2.3.5 Age and life expectancy

The mean age of the population of people with scaphoid fractures was assumed by the GDG to be 30 years. This was based on the mean ages given by the included clinical studies, which ranged from 22 to 39 years.

Life expectancy was estimated from the Office for National Statistics Life Tables[399], and was estimated for a 30 year old as 49.87 remaining years. This gives an average age at death of 80 years.

M.2.3.6 Costs and resource use

The cost of cast immobilisation was taken from the expert opinion of the GDG. All other costs are from NHS reference costs 2012-2013. The number of fracture clinic visits was assumed based on the expert opinion of the GDG.

The cost of a first ED visit is not included in any strategy as this is assumed to apply to all patients.

Those who have surgical fixation performed have the cost of a CT scan applied, as this is required for surgery planning. This is not applied where a CT scan was already used as part of the diagnostic strategy. The cost of immobilisation is also applied as the patient is sent home for a later planned surgery attendance.

A patient who returns to hospital following a false negative diagnosis on CT is given an MRI to assess the injury before surgery is planned. Those who return after a false negative diagnosis from MRI will have a CT scan to assess the injury before surgery is planned.

People whose fracture is identified on first imaging and immobilised in plaster have the cost of a follow-up fracture clinic attendance applied, which is required to have the cast removed.

Those who are discharged following a false negative diagnosis from CT or MRI have the cost of an ED visit, additional immobilisation as well as the cost of the salvage procedure, which is planned on a later surgery list.

M.2.3.7 Quality of life

A systematic search, incorporated as part of the literature economic search in the guideline, was undertaken to identify relevant quality of life estimates. One relevant study was found, MacDermid et al. 1998[329], which was a validation study of the Patient Rated Wrist Evaluation (PRWE) from Canada. The PRWE is a questionnaire made up of two components: a pain component and a function component. Each component consists of questions about the person's pain and functional ability in different situations and asks them to rate each question on a scale from 0 to 10, where 0 means no problems or pain and 10 means unable to function or worst pain. In this study, 35 people with a scaphoid fracture provided a score at 1-year post scaphoid fracture. These people also had a distal radial fracture but the GDG thought that the mean score of 22 was a good enough estimate. This quality of life score was translated into a utility value as described in M.2.4.1.

M.2.4 Computations

M.2.4.1 Mapping

To derive a utility from the PRWE score, we predicted the EQ-5D index for the PRWE score using a mapping function. There were no published mapping studies for these two outcome measures so we developed our own mapping function using data from a population with distal radial fractures.[126] These patients were asked to complete both the PRWE and EQ-5D questionnaires at 3 months, 6 months and 12 months post injury; as well as a retrospective one to assess the patient's quality of life pre-injury.

The mapping function was derived using linear regression performed with SPSS version 22. The dependent variables used to predict the EQ5D score were: the pre-injury EQ5D score, the pain component of the PRWE, the function component of the EQ5D and the product of the components. The mapping function was validated using the 6 month dataset as a validation set to test for stability in the performance of the mapping function.

The mapping function developed is given by:

$$EQ5D_S = 0.344 \times EQ5D_B - 0.0059 \times PRWE_P - 0.0062 \times PRWE_F + 0.00013 \times PRWE_{P \times F} + 0.623$$

Where:

$EQ5D_S$ is the EQ5D estimate for a person with a scaphoid fracture.

$EQ5D_B$ is the baseline EQ5D of the person before they had a fracture.

$PRWE_P$ is the PRWE pain component score out of 50.

$PRWE_F$ is the PRWE function component score out of 100

$PRWE_{P \times F}$ is the product of $PRWE_F$ and $PRWE_P$.

M.2.4.2 QALYs

The model applies the utility score calculated from the mapping, as described in section M.2.4.1 above, to each person with a scaphoid fracture. Those without a fracture are given a utility for the general population.[274] If the fracture is identified on initial imaging (or by the first follow-up image in the follow-up strategies) then the patient will return to the general population utility for each of the remaining life years. If they are not identified, they will remain in the initial reduced health state for the remaining years of life. The utilities are summed across the lifetime for all patients along each diagnostic pathway to calculate the total QALYs accrued for a particular diagnostic strategy. This will be done for each strategy in order to calculate the net monetary benefit as described in section M.2.7 below.

M.2.4.3 Discounting

Costs were not discounted as they were all incurred in the first year. QALYs were discounted to reflect time preference (discount rate 3.5%) using the following formula:

Discount formula:

$$\text{Discounted total} = \frac{\text{Total}}{(1+r)^n}$$	Where: *r*=discount rate per annum *n*=time (years)

In the analysis, the total number of QALYs and resource costs accrued by each branch of the tree was recorded. These subtotals were summed across all branches to ascertain the total number of patients in the population and the total QALYs and resource costs accrued for the population. The total cost and QALYs accrued by the cohort was divided by the number of patients in the population to calculate the mean cost per patient and mean QALYs per patient. The net benefit of each strategy was calculated in order to find the optimal strategy. This is explained in section M.2.7 below.

M.2.5 Sensitivity analyses

One-way sensitivity analyses were performed on the parameters shown in Table 30 below. The upper and lower values are given as well as any additional values. All values were provided by the GDG.

Table 30: Parameter values used in sensitivity analyses

Input	Lower	Upper	Additional analyses.
Baseline risk			
Prevalence of scaphoid fracture among those where a fracture is suspected.	5%	20%	
Probability that the fracture is displaced.	10%	30%	

Input		Lower	Upper	Additional analyses.
Probability that surgery is performed on a non-displaced fracture.		1%	10%	50%
Test accuracy				
Sensitivity of initial X-ray		65%	75%	
Sensitivity of follow-up X-ray		65%	75%	5% higher than initial
Sensitivity of CT	Immediate	90%	100%	
	After indeterminate X-ray	80%	100%	
Sensitivity of MRI		98%	N/A	
Specificity of initial X-ray		95%	100%	
Specificity of follow-up X-ray		95%	100%	
Specificity of CT		95%	N/A	
Specificity of MRI		95%	N/A	
Costs				
Cost of X-ray		£0		
Cost of CT		£70	£100	
Cost of MRI		£100	£200	
Cost of immobilisation		£5	£15	
Cost of surgical fixation		£1000	£2000	
Cost of salvage surgery		N/A	£5000	
Cost of initial fracture clinic attendance		£100	£150	
Cost of follow-up fracture clinic attendance		£75	£125	
Mean number of follow-up visits		1	5	
Quality of life				
PRWE 1-year post scaphoid		10	30	
EQ-5D mapped from PRWE scores above		0.89	0.78	

M.2.6 Model validation

The model was developed in consultation with the GDG; model structure, inputs and results were presented to and discussed with the GDG for clinical validation and interpretation.

The model was systematically checked by the health economist undertaking the analysis; this included inputting null and extreme values and checking that results were plausible given inputs. The model was peer reviewed by a second experienced health economist from the NCGC; this included systematic checking of many of the model calculations.

M.2.7 Estimation of cost effectiveness

The widely used cost-effectiveness metric is the incremental cost-effectiveness ratio (ICER). This is calculated by dividing the difference in costs associated with 2 alternatives by the difference in QALYs. The decision rule then applied is that if the ICER falls below a given cost per QALY threshold the result is considered to be cost effective. If both costs are lower and QALYs are higher the option is said to dominate and an ICER is not calculated.

$$ICER = \frac{Costs(B) - Costs(A)}{QALYs(B) - QALYs(A)}$$	Cost-effective if: • ICER < Threshold

Where: Costs(A) = total costs for option A; QALYs(A) = total QALYs for option A

When there are more than 2 comparators, as in this analysis, options must be ranked in order of increasing cost then options ruled out by dominance or extended dominance before calculating ICERs excluding these options. An option is said to be dominated, and ruled out, if another intervention is less costly and more effective. An option is said to be extendedly dominated if a combination of 2 other options would prove to be less costly and more effective.

It is also possible, for a particular cost-effectiveness threshold, to re-express cost-effectiveness results in terms of net monetary benefit (NMB). This is calculated by multiplying the total QALYs for a comparator by the threshold cost per QALY value (for example, £20,000) and then subtracting the total costs (formula below). The decision rule then applied is that the comparator with the highest NMB is the most cost-effective option at the specified threshold. That is the option that provides the highest number of QALYs at an acceptable cost. For clarity in presenting the results, the incremental NMB was calculated in reference to a single strategy to easily identify the differences in NMB.

$\textit{Net Monetary Benefit}\,(X) = \left(QALYs(X) \times \lambda\right) - Costs(X)$ *Where: λ = threshold (£20,000 per QALY gained)*	Cost-effective if: • Highest net benefit

Both methods of determining cost effectiveness will identify exactly the same optimal strategy. For ease of computation NMB is used in this analysis to identify the optimal strategy.

Results are also presented graphically where total costs and total QALYs for each diagnostic strategy are shown. Comparisons not ruled out by dominance or extended dominance are joined by a line on the graph where the slope represents the incremental cost-effectiveness ratio.

M.2.8 Interpreting Results

NICE's report, 'Social value judgements: principles for the development of NICE guidance'[381], sets out the principles that GDGs should consider when judging whether an intervention offers good value for money. In general, an intervention was considered to be cost effective if either of the following criteria applied (given that the estimate was considered plausible):

- The intervention dominated other relevant strategies (that is, it was both less costly in terms of resource use and more clinically effective compared with all the other relevant alternative strategies), or
- The intervention costs less than £20,000 per quality-adjusted life-year (QALY) gained compared with the next best strategy.

As we have several interventions, we use the NMB to rank the strategies on the basis of their relative cost-effectiveness. The highest NMB identifies the optimal strategy at a willingness to pay of £20,000 per QALY gained.

M.3 Results

Table 31 below shows the results of the probabilistic analysis. This consists of the mean costs and QALYs per patient from which the NMB was calculated. Below this shows the difference in NMB in reference to the follow-up X-ray strategy. The final row shows the ranking of the strategies in terms of cost effectiveness i.e. the immediate MRI strategy is cost effective in comparison to all other strategies. Table 32 shows the number of people with a true positive diagnosis (TP), a true negative diagnosis (TN), a false positive diagnosis (FP) and a false negative diagnosis (FN) in each imaging strategy.

Table 31: Probabilistic analysis

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Mean cost per patient	£416	£292	£343	£151	£214
Mean QALYs per patient	22.560	22.549	22.561	22.545	22.561
Net monetary benefit at £20,000 per QALY threshold	£450,780	£450,685	£450,884	£450,751	£451,013
Incremental net monetary benefit	Reference	-£95	£104	-£29	£234
Ranking	3rd	5th	2nd	4th	1st

Table 32: Event rates per 1000 individuals with suspected scaphoid fracture

	TP	TN	FP	FN
Follow up X-rays	148	811	29	12
X-ray then CT	155	826	14	5
X-ray then MRI	160	826	14	0
Immediate CT	154	840	0	6
Immediate MRI	160	840	0	0

Table 33 below shows the non-dominated strategies ranked from lowest cost to highest. The ICERs reported are compared to the strategy in the previous row.

Table 33: ICERs of non-dominated strategies

Strategy (a)	Cost per patient	QALY per patient	ICER
Immediate CT	£151	22.545	
Immediate MRI	£214	22.561	£3,854

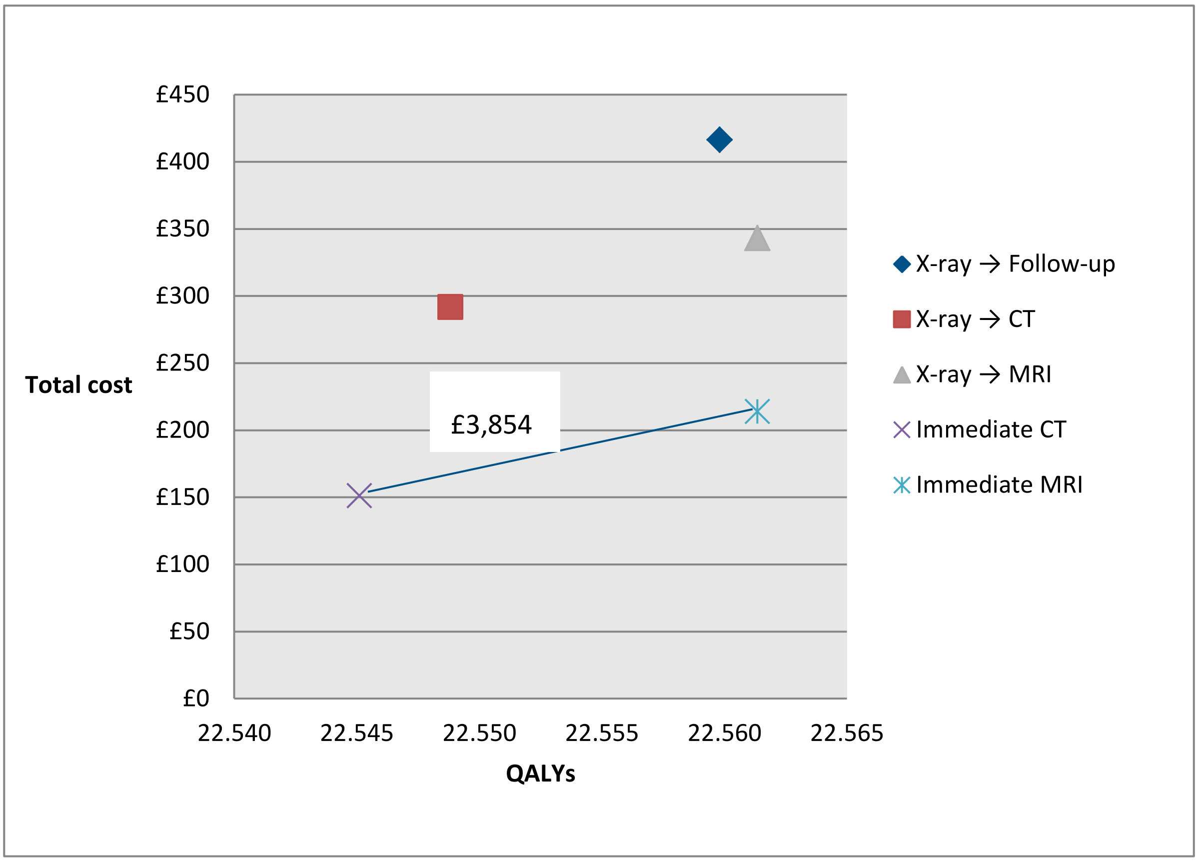
(a) Follow up x-rays and X-ray followed by CT were dominated by immediate MRI which is less costly and more effective. X-ray followed by MRI is also dominated as immediate MRI produces the same number of QALYs at a lower cost.

Using the ICER decision rule, we can see that the most cost effective option is Immediate MRI, as immediate MRI compared to immediate CT has an ICER below the NICE threshold of £20,000 and all other options are dominated. Immediate MRI is confirmed as being the most cost effective strategy using the net benefit decision rule as shown in Table 31.

The cost effectiveness plane in Figure 220 below is a graphical representation of the costs and utilities per patient from each strategy.

The slope of the line between two strategies represents the ICER, this can be seen for immediate MRI compared to immediate CT.

Figure 220: Cost effectiveness plane



A key driver in the overall cost is the number of extra visits required for those who have an initial X-ray, especially those who go on to have follow-up X-rays after this. This makes the immediate strategies the cheapest and then the key driver separating CT and MRI is health related quality of life detriment from the missed fractures on CT. This makes the additional cost for the MRI strategy cost effective.

M.4 Sensitivity Analysis Results

The tables below show the results of the sensitivity analyses for which the overall conclusion of the model changed, i.e. immediate MRI was no longer the optimal strategy. Table 37 is included to show the point at which the analysis in Table 36 changes back to the same conclusion as the base case analysis. The complete set of results from all sensitivity analyses can be seen in section M.6.

Table 34: Sensitivity of CT = 100%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.558	22.539	22.560	22.527	22.560
Net monetary benefit	£450,743	£450,498	£450,847	£450,381	£450,977
Incremental net monetary benefit	Reference	-£245	£104	-£363	£234

Table 35: PRWE at 1 year post fracture = 0

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total QALYs per patient	22.577	22.577	22.577	22.577	22.577
Net monetary benefit	£451,127	£451,252	£451,201	£451,393	£451,331
Incremental net monetary benefit	Reference	£125	£74	£265	£203

Table 36: Reduced HRQoL following missed fracture sustained for only four additional years

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.559	22.558	22.560	22.557	22.560
Net monetary benefit	£450,769	£450,859	£450,847	£450,988	£450,977
Incremental net monetary benefit	Reference	£90	£79	£219	£208

Table 37: Reduced HRQoL following missed fracture sustained for five additional years

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.559	22.557	22.560	22.556	22.560
Net monetary benefit	£450,768	£450,850	£450,847	£450,976	£450,977
Incremental net monetary benefit	Reference	£82	£80	£208	£209

M.5 Discussion

M.5.1 Summary of results

In the probabilistic analysis, the most expensive strategy was the follow-up X-rays. The two immediate strategies were the cheapest even though they used more expensive imaging modalities. This was due to a reduction in number of return visits to the fracture clinic by discharging patients at the initial imaging stage. The cheapest strategy of the two immediate strategies was CT due to cheaper imaging costs than MRI. When considering the health effects alongside costs, however, the net benefit was in favour of the immediate MRI strategy due to the higher sensitivity and therefore reduction in the number of missed fractures. This was based on extrapolated health effects of missed fractures over a lifetime and for all patients with missed fractures.

The sensitivity analysis where the extrapolation is only extended to four additional years, the optimal strategy changes to immediate CT, as the difference in QALYs becomes much smaller and the cost effectiveness tends towards the cheaper strategy. When this value is five additional years, immediate MRI is the optimal strategy.

Reducing the PRWE score to 0 means there is no difference in quality of life between the strategies and so it is purely driven by costs. The optimal strategy in this analysis is therefore immediate CT.

Due to a suspected lower specificity of the reference standard, MRI, it was thought that the sensitivity of CT could be underestimated in the studies included and it could in fact be as sensitive as MRI. For this reason, a sensitivity analysis was performed with a sensitivity of 100% for CT. This makes immediate CT the optimal strategy as it becomes as effective as MRI but with a lower cost.

M.5.2 Limitations and interpretation

A key limitation of this analysis is that HRQoL data was only available from a short term study[329] over a 12 month period. This meant that an assumption was made that the long term quality of life for patients with missed fractures was sustained for a lifetime due to patients developing arthritis after delayed treatment. This limitation was explored through a sensitivity analysis.

For missed fractures, when reduced HRQoL is sustained for only four additional years then the optimal strategy changes from immediate MRI to immediate CT. Since the model assumes, in this sensitivity analysis, that the whole group of missed fractures sustains the reduced health for the four additional years out of remaining 49 (the lifetime), it can also be interpreted, when not considering discounting, as 8% (4/49) of the group sustaining this health effect for the lifetime. The optimal strategy changes between four and five additional years. We can therefore say that the change would occur when the proportion of people with missed fractures who are affected by a lifelong health detriment is at some point between 8% and 10%. Taking into account discounting, this proportion rises to between 16% and 19%.

Radiation risk has not been included in the analysis due to a lack of data. However, the GDG considered the risk of cancer from radiation to the wrist and although they acknowledged that children are more susceptible to radiation, they believed it to be too small a risk to have an effect on the results of this analysis. The model within the Spinal Injuries guideline considered radiation in a sensitivity analysis and found this did not change the conclusions.

The lack of data showing the accuracy of follow-up X-rays is also a limitation. There are two factors that may affect the accuracy of follow-up X-rays: firstly that the likelihood of the follow-up X-ray result is in some way conditional on the initial results; secondly the reduction in swelling at the follow-up stage allowing a fracture to be more visible on the image. The GDG thought that the follow-up X-ray is likely to have equal sensitivity and specificity to the initial X-ray and maybe even slightly higher sensitivity. This was taken into account in a sensitivity analysis but showed no effect on the overall conclusions.

MRI was chosen as the reference standard in the diagnostic accuracy review as it was thought to be the most sensitive. However, it may not be 100% specific and could therefore over diagnose injuries. This means that the sensitivity of the index tests would be underestimated when compared to MRI as a reference standard so the sensitivity of CT could be closer to MRI. This could mean that CT is cost effective.

There is a large service delivery change in providing immediate MRI to people with suspected scaphoid fractures, which has a large cost. However, there are newly developed extremity scanners that have lower operating costs according to the GDG and they believed that these could provide benefit to other populations, for example, people with suspected ligamentous injuries.

M.5.3 Generalisability to other populations or settings

The analysis considered both adults and children and these were considered to be similar in terms of prevalence of the injury.

It is uncertain whether the model will be applicable to other types of fracture. It is not normally the case that MRI is seen as the gold standard for bony injuries. The GDG considered the results were robust for adults and children with a suspected scaphoid fracture.

M.5.4 Comparisons with published studies

Patel et al. 2013[409] conducted an economic analysis within an RCT, which showed that using MRI after an indeterminate X-ray was cost saving when compared to follow-up X-rays. This study did not compare CT after an indeterminate X-ray nor did it compare immediate imaging strategies. Health related quality of life was also not included in this study. The results showed that MRI was cost saving in comparison to follow-up X-rays.

M.5.5 Conclusions

Immediate MRI is likely to be the most cost effective imaging strategy for patients with a suspected scaphoid fracture.

An initial X-ray may be cost effective if there are likely to be fractures that are missed on MRI but captured on X-ray. If this is the case, a screening X-ray followed by MRI in the same attendance may be cost effective as the additional cost of an attendance would not be required.

Immediate CT may be cost effective if the effects of missing a scaphoid fracture either last no longer than four years or only occur in a small proportion of patients with missed fractures. This may also be optimal if the sensitivity of CT is greater than the evidence suggests.

This analysis is assessed as directly applicable with potentially serious limitations.

M.5.6 Implications for future research

Future research would be useful to assess the quality of life of patients with scaphoid fractures in the long term, following a particular imaging strategy. A way in which this could be done is with a test and treat randomised controlled trial, comparing the strategies outlined in this report and subsequent treatment. With an accompanying economic evaluation, this would allow the assessment of cost effectiveness without the need for diagnostic accuracy data and hence remove the limitation of having MRI as a reference standard, which may underestimate the sensitivity of comparator modalities due to having a suspected specificity of less than 100%.

M.6 Results of Sensitivity Analyses

Table 38: Prevalence of scaphoid fracture = 5%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£404	£263	£318	£106	£165
Total QALYs per patient	22.571	22.568	22.572	22.567	22.572
Net monetary benefit	£451,020	£451,093	£451,116	£451,226	£451,268
Incremental net monetary benefit	Reference	£73	£96	£206	£248

Table 39: Prevalence of scaphoid fracture = 20%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£421	£303	£352	£168	£231
Total QALYs per patient	22.553	22.539	22.555	22.535	22.555
Net monetary benefit	£450,642	£450,486	£450,750	£450,529	£450,871
Incremental net monetary benefit	Reference	-£156	£108	-£114	£229

Table 40: Prevalence of displacement = 10%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£397	£272	£324	£132	£193
Total QALYs per patient	22.558	22.545	22.560	22.541	22.560
Net monetary benefit	£450,759	£450,636	£450,867	£450,694	£450,998
Incremental net monetary benefit	Reference	-£123	£108	-£65	£239

Table 41: Prevalence of displacement = 30%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£436	£312	£362	£171	£234
Total QALYs per patient	22.558	22.549	22.560	22.545	22.560
Net monetary benefit	£450,727	£450,660	£450,828	£450,736	£450,956
Incremental net monetary benefit	Reference	-£68	£101	£9	£229

Table 42: Probability of surgery = 1%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£410	£285	£336	£145	£206
Total QALYs per patient	22.559	22.547	22.560	22.543	22.560
Net monetary benefit	£450,775	£450,655	£450,854	£450,721	£450,984
Incremental net monetary benefit	Reference	-£120	£80	-£53	£209

Table 43: Probability of surgery = 10%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£426	£301	£351	£160	£222

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total QALYs per patient	22.556	22.547	22.560	22.543	22.560
Net monetary benefit	£450,704	£450,639	£450,839	£450,706	£450,968
Incremental net monetary benefit	Reference	-£65	£135	£3	£265

Table 44: Probability of surgery = 50%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£496	£370	£421	£226	£291
Total QALYs per patient	22.544	22.547	22.560	22.543	22.560
Net monetary benefit	£450,390	£450,570	£450,769	£450,640	£450,899
Incremental net monetary benefit	Reference	£181	£380	£251	£509

Table 45: Probability of surgery following false positive diagnosis = 0.1%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,743	£450,648	£450,847	£450,715	£450,977
Incremental net monetary benefit	Reference	-£95	£104	-£28	£234

Table 46: Sensitivity of X-ray = 65%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£418	£293	£344	£151	£213
Total QALYs per patient	22.557	22.545	22.560	22.543	22.560
Net monetary benefit	£450,732	£450,609	£450,846	£450,715	£450,977
Incremental net monetary benefit	Reference	-£123	£114	-£17	£245

Table 47: Sensitivity of X-ray = 75%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£415	£291	£341	£151	£213
Total QALYs per patient	22.558	22.549	22.560	22.543	22.560
Net monetary benefit	£450,755	£450,694	£450,849	£450,715	£450,977
Incremental net monetary benefit	Reference	-£61	£95	-£40	£222

Table 48: Sensitivity of delayed X-ray + 5%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,748	£450,648	£450,847	£450,715	£450,977
Incremental net monetary benefit	Reference	-£100	£99	-£34	£229

Table 49: Specificity of X-ray = 95%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£407	£289	£338	£151	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,753	£450,651	£450,852	£450,715	£450,977
Incremental net monetary benefit	Reference	-£102	£99	-£38	£224

Table 50: Specificity of X-ray = 100%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£422	£294	£345	£151	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,738	£450,646	£450,845	£450,715	£450,977
Incremental net monetary benefit	Reference	-£92	£107	-£23	£239

Table 51: Sensitivity of CT = 80% (after indeterminate X-ray), 90% (immediate CT)

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.558	22.539	22.560	22.527	22.560
Net monetary benefit	£450,743	£450,498	£450,847	£450,381	£450,977
Incremental net monetary benefit	Reference	-£245	£104	-£363	£234

Table 52: Sensitivity of CT = 100%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£152	£213
Total QALYs per patient	22.558	22.560	22.560	22.560	22.560
Net monetary benefit	£450,743	£450,898	£450,847	£451,038	£450,977
Incremental net monetary benefit	Reference	£155	£104	£295	£234

Table 53: Specificity of CT = 95%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£297	£343	£156	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,743	£450,643	£450,847	£450,710	£450,977
Incremental net monetary benefit	Reference	-£100	£104	-£33	£234

Table 54: Sensitivity of MRI = 98%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.558	22.547	22.558	22.543	22.553
Net monetary benefit	£450,743	£450,648	£450,807	£450,715	£450,845
Incremental net monetary benefit	Reference	-£95	£64	-£28	£102

Table 55: Specificity of MRI = 95%

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£347	£151	£218
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,743	£450,648	£450,843	£450,715	£450,972
Incremental net monetary benefit	Reference	-£95	£100	-£28	£229

Table 56: PRWE at 1 year post fracture = 10

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.571	22.568	22.572	22.566	22.572
Net monetary benefit	£451,004	£451,058	£451,088	£451,175	£451,217
Incremental net monetary benefit	Reference	£54	£84	£171	£213

Table 57: PRWE at 1 year post fracture = 30

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.551	22.535	22.553	22.530	22.553
Net monetary benefit	£450,597	£450,417	£450,713	£450,456	£450,842
Incremental net monetary benefit	Reference	-£179	£116	-£140	£246

Table 58: PRWE at 1 year post fracture = 0

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.577	22.577	22.577	22.577	22.577
Net monetary benefit	£451,127	£451,252	£451,201	£451,393	£451,331
Incremental net monetary benefit	Reference	£125	£74	£265	£203

Table 59: X-ray cost =£0

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£329	£264	£315	£151	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,831	£450,676	£450,876	£450,715	£450,977
Incremental net monetary benefit	Reference	-£155	£45	-£116	£146

Table 60: MRI cost =£100

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£305	£151	£170
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,743	£450,648	£450,885	£450,715	£451,020
Incremental net monetary benefit	Reference	-£95	£142	-£28	£277

Table 61: MRI cost =£200

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£392	£151	£270
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,743	£450,648	£450,798	£450,715	£450,920
Incremental net monetary benefit	Reference	-£95	£55	-£28	£177

Table 62: CT cost = £70

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£416	£278	£342	£136	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,744	£450,662	£450,848	£450,730	£450,978
Incremental net monetary benefit	Reference	-£82	£104	-£14	£234

Table 63: CT cost = £100

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£305	£343	£166	£214
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,743	£450,635	£450,847	£450,700	£450,976
Incremental net monetary benefit	Reference	-£108	£104	-£42	£234

Table 64: Cast cost = £5

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£405	£287	£338	£151	£212
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,754	£450,653	£450,853	£450,716	£450,978
Incremental net monetary benefit	Reference	-£101	£98	-£39	£223

Table 65: Cast cost = £15

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£428	£297	£348	£152	£214
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,732	£450,643	£450,842	£450,714	£450,976
Incremental net monetary benefit	Reference	-£89	£111	-£18	£244

Table 66: Initial fracture clinic cost = £100

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£393	£268	£319	£151	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,767	£450,672	£450,871	£450,715	£450,977
Incremental net monetary benefit	Reference	-£95	£104	-£52	£210

Table 67: Initial fracture clinic cost = £150

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£436	£311	£362	£151	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,724	£450,629	£450,828	£450,715	£450,977
Incremental net monetary benefit	Reference	-£95	£104	-£9	£253

Table 68: Follow-up fracture clinic cost = £75

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£380	£289	£339	£148	£210
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,780	£450,651	£450,851	£450,718	£450,980
Incremental net monetary benefit	Reference	-£128	£71	-£62	£200

Table 69: Follow-up fracture clinic cost = £125

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£449	£295	£346	£154	£216
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,711	£450,645	£450,844	£450,712	£450,974
Incremental net monetary benefit	Reference	-£66	£133	£1	£263

Table 70: Fixation cost = £1000

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£403	£278	£328	£137	£199
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,757	£450,662	£450,862	£450,729	£450,991
Incremental net monetary benefit	Reference	-£95	£105	-£28	£234

Table 71: Fixation cost = £2000

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£440	£316	£367	£175	£237
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,719	£450,624	£450,823	£450,691	£450,953
Incremental net monetary benefit	Reference	-£95	£104	-£28	£234

Table 72: Salvage surgery = £5000

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£419	£293	£343	£153	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,741	£450,647	£450,847	£450,714	£450,977
Incremental net monetary benefit	Reference	-£94	£106	-£27	£236

Table 73: Reduced HRQoL following missed fracture sustained for only four additional years

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.559	22.558	22.560	22.557	22.560
Net monetary benefit	£450,769	£450,859	£450,847	£450,988	£450,977
Incremental net monetary benefit	Reference	£90	£79	£219	£208

Table 74: Reduced HRQoL following missed fracture sustained for five additional years

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£417	£292	£343	£151	£213
Total QALYs per patient	22.559	22.557	22.560	22.556	22.560
Net monetary benefit	£450,768	£450,850	£450,847	£450,976	£450,977
Incremental net monetary benefit	Reference	£82	£80	£208	£209

Table 75: Only one additional fracture clinic visit

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£359	£292	£343	£151	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,801	£450,648	£450,847	£450,715	£450,977
Incremental net monetary benefit	Reference	-£153	£47	-£86	£176

Table 76: Five additional fracture clinic visits

Strategy	X-ray → X-ray	X-ray → CT	X-ray → MRI	CT	MRI
Total cost per patient	£820	£292	£343	£151	£213
Total QALYs per patient	22.558	22.547	22.560	22.543	22.560
Net monetary benefit	£450,339	£450,648	£450,847	£450,715	£450,977
Incremental net monetary benefit	Reference	£308	£508	£375	£638

Appendix N: Mapping of DRAFFT trial data to predict an EQ5D index score from a PRWE score

N.1 Objective

To estimate the EQ5D index score from a Patient Reported Wrist Evaluation (PRWE) score in patients with a scaphoid fracture. This estimate would be used for all patients with a fracture in the non-complex fractures imaging of scaphoid economic model, with assumptions applied as to the duration of disutility following timely or delayed treatment.

N.2 Method

To derive a mapping function using data from a surgical intervention trial (DRAFFT) with a population of patients who had a distal radial fracture and reported outcomes from both the PRWE and the EQ5D.

The PRWE is a patient reported outcome measure that can be used for a variety of injuries that involve the wrist. It has two components: a pain component and a functional component. Each component consists of a number of questions that are answered using a scale from 0 to 10 to assess the patient's level of ability or pain in different situations. A high score represents a higher level of pain and a lower level of function. The pain component has five of these questions to give an overall component score out of 50. The functional component has two sub sections, each of five questions, to give an overall component score of 100. The overall PRWE score is given as the pain score plus half of the functional score to give an overall score out of 100.

To derive the mapping function, ordinary least squares regression was performed using SPSS version 22. The dependent variable used in the regression was EQ5D at 12 months. This was used because the published PRWE score for scaphoid fractures was obtained at 12 months. The independent variables used were:

- baseline EQ5D score
- age
- the pain component score
- the functional component score
- the product of the PRWE pain and function component scores
- square terms

All SPSS input methods for entering variables into the model were used to find the most appropriate mapping function. Each function was assessed by comparing the R-squared as well as statistical significance of the coefficient for each of the included variables.

The regression model was validated by assessing the performance across intervals of EQ5D and of PRWE scores. For EQ5D, the model was assessed in increments of 0.25 up to 0.5 and then increments of 0.1 beyond that. For PRWE, the model was assessed in increments of 25. The mean error, mean absolute error, and mean squared error were compared within each range as well as the mean EQ5D and mean predicted EQ5D. The model coefficients were also applied to the 6 month PRWE data to calculate predictions and the same methods were used to assess performance on this external data set.

N.3 Results

The best fitting model included baseline EQ5D score, the two PRWE component scores as well as the product of these. Other variables were excluded as they did not have a statistically significant coefficient when included. The best fitting model showed a goodness of fit R-squared value of 0.453.

The mean predicted EQ5D was fairly similar to the actual mean at 0.8497 and 0.8412 respectively. The mean error was 0.0000, the mean absolute error was 0.0944 and the mean squared error was 0.0167. When the coefficients were applied to the 6 month data, the mean predicted EQ5D and mean actual EQ5D were 0.8090 and 0.7907. The mean error was 0.0135, the mean absolute error was 0.1033 and the mean squared error was 0.0230.

When the model dataset was assessed on intervals of the actual EQ5D at 12 months, the performance of the model was shown to be much better for higher EQ5D values than for lower values. However, this is not surprising given the low numbers of people with a low EQ5D score. A more useful assessment is to show how well the model predicts over intervals of PRWE score, given that this is the known value to be mapped from. The mean predicted EQ5D and actual EQ5D were very similar for the ranges 0-25 and 25-50. For the range 0-25, the predicted and actual EQ5D scores were 0.8951 and 0.8967 respectively, and for the PRWE range 25-50, the predicted and actual EQ5D scores were 0.7015 and 0.6973 respectively.

Applying the same splits to the 6 month data showed a similar trend with better predictions among those with a higher EQ5D, but again this is to be expected with reduced numbers of people. When split by PRWE score the results were similar to the 12 month data. For the PRWE range 0-25 the mean predicted EQ5D and mean actual EQ5D were 0.8774 and 0.8629 respectively.

For a full SPSS output, see section **Error! Reference source not found.** below.

N.4 Conclusion

Given that the R-squared is relatively low, this means that only about half of the variability in the data can be explained by the predicted regression. This means there would be a lot of uncertainty if used on patient level data. However, for predicting a mean EQ5D from a PRWE score in the range 0-25, it appears to produce an accurate prediction. Therefore, for the purposes of the imaging of scaphoid economic model, it is expected to provide a reasonable estimate of EQ5D for patients who have a scaphoid fracture with a PRWE score of 22.

N.5 Full SPSS output

The goodness of fit results of the DRAFFT utility mapping analysis are summarised in Table 77 below. This table shows the R, R-squared and adjusted R-squared statistics as well as the standard error.

Table 77: Model Summary[(b)]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.673[a]	.453	.447	.13017

(a) Predictors: (Constant), PRWE_12_PxF, EQ5D_0, PRWE_12_P, PRWE_12_F
(b) Dependent Variable: EQ5D_12

Table 78 below shows the ANOVA results, in which the F-statistic is used to test the hypothesis that all the coefficients are equal to zero.

Table 78: ANOVA[(a)]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.877	4	1.219	71.949	.000[(b)]
	Residual	5.880	347	.017		
	Total	10.756	351			

(a) Dependent Variable: EQ5D_12
(b) Predictors: (Constant), EQ5D_0, PRWE_12_P, PRWE_12_F, PRWE_12_PxF

Table 79 below shows the coefficients computed from the analysis. The baseline EQ5D score is denoted EQ5D_0, the pain component of the PRWE score at 12 months is denoted PRWE_12_P, the function component of the PRWE score at 12 months is denoted PRWE_12_F and the product of the two is denoted PRWE_12_PxF.

Table 79: Coefficients[(a)]

	Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
Model	B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound
1 (Constant)	.623	.044		14.206	.000	.537	.710
EQ5D_0	.344	.045	.319	7.619	.000	.255	.433
PRWE_12_P	-.006	.002	-.286	-3.817	.000	-.009	-.003
PRWE_12_F	-.006	.001	-.568	-5.748	.000	-.008	-.004
PRWE_12_PxF	.000	.000	.332	3.209	.001	.000	.000

(a) Dependent Variable: EQ5D_12

The descriptive statistics in Table 80 below show the range, mean, standard deviation and variance of the actual EQ5D score, the predicted EQ5D score, the error in the prediction, the squared error and the absolute error, for the development dataset collected at 12 months.

Table 80: Descriptive Statistics – 12 months

	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
EQ5D_12	398	-.09	1.00	.8412	.00968	.19304	.037
EQ5D_12_PRED	409	.33	.97	.8497	.00600	.12133	.015
EQ5D_12_RES	352	-.75	.36	.0000	.00690	.12943	.017

EQ5D_12_RES_SQ	352	.00	.56	.0167	.00244	.04572	.002
EQ5D_12_RES_ABS	352	.00	.75	.0944	.00471	.08840	.008
Valid N (listwise)	352						

The descriptive statistics in Table 81 below show the same as Table 80 above but for the validation dataset collected at 6 months.

Table 81: Descriptive Statistics – 6 months

	N	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
EQ5D_6	394	-.18	1.00	.7907	.01009	.20020	.040
EQ5D_6_PRED	406	.31	.97	.8090	.00628	.12651	.016
EQ5D_6_RES	348	-.32	.86	.0135	.00810	.15116	.023
EQ5D_6_RES_SQ	348	.00	.74	.0230	.00370	.06911	.005
EQ5D_6_RES_ABS	348	.00	.86	.1033	.00595	.11105	.012
Valid N (listwise)	348						

Table 82 to Table 85 below show the same descriptive statistics as tables Table 80 and Table 81 above across difference intervals of EQ5D score and PRWE score. These are denoted with the suffix ‘level’ and the value given in the first column is the upper limit of the interval.

Table 82: Descriptive Statistics

		N	Minimum	Maximum	Mean		Std. Deviation	Variance
EQ5D_12_level		Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
.	EQ5D_12	0						
	EQ5D_12_PRED	57	.36	.97	.8227	.01841	.13896	.019
	EQ5D_12_RES	0						
	EQ5D_12_RES_SQ	0						
	EQ5D_12_RES_ABS	0						
	Valid N (listwise)	0						
.25	EQ5D_12	10	-.09	.19	.1020	.02577	.08149	.007
	EQ5D_12_PRED	6	.35	.84	.5664	.08235	.20172	.041
	EQ5D_12_RES	6	-.75	-.17	-.4530	.08687	.21280	.045
	EQ5D_12_RES_SQ	6	.03	.56	.2430	.07997	.19589	.038

	EQ5D_12_RES_ABS	6	.17	.75	.4530	.08687	.21280	.045
	Valid N (listwise)	6						
.50	EQ5D_12	7	.26	.49	.3557	.03184	.08423	.007
	EQ5D_12_PRED	4	.61	.97	.7428	.07807	.15615	.024
	EQ5D_12_RES	4	-.56	-.12	-.3753	.09251	.18503	.034
	EQ5D_12_RES_SQ	4	.01	.31	.1665	.06078	.12156	.015
	EQ5D_12_RES_ABS	4	.12	.56	.3753	.09251	.18503	.034
	Valid N (listwise)	4						
.60	EQ5D_12	13	.52	.59	.5523	.01007	.03632	.001
	EQ5D_12_PRED	10	.33	.81	.6415	.04345	.13739	.019
	EQ5D_12_RES	10	-.22	.19	-.0935	.03876	.12257	.015
	EQ5D_12_RES_SQ	10	.00	.05	.0223	.00528	.01669	.000
	EQ5D_12_RES_ABS	10	.01	.22	.1311	.02373	.07504	.006
	Valid N (listwise)	10						
.70	EQ5D_12	47	.62	.69	.6713	.00370	.02533	.001
	EQ5D_12_PRED	40	.47	.97	.7452	.01796	.11361	.013
	EQ5D_12_RES	40	-.28	.15	-.0739	.01748	.11058	.012
	EQ5D_12_RES_SQ	40	.00	.08	.0174	.00338	.02136	.000
	EQ5D_12_RES_ABS	40	.00	.28	.1012	.01354	.08566	.007
	Valid N (listwise)	40						
.80	EQ5D_12	108	.71	.80	.7782	.00259	.02692	.001
	EQ5D_12_PRED	98	.59	.97	.8289	.00942	.09325	.009
	EQ5D_12_RES	98	-.24	.18	-.0511	.00897	.08882	.008
	EQ5D_12_RES_SQ	98	.00	.06	.0104	.00108	.01072	.000
	EQ5D_12_RES_ABS	98	.00	.24	.0877	.00529	.05241	.003
	Valid N (listwise)	98						
.90	EQ5D_12	32	.81	.88	.8591	.00328	.01855	.000

	EQ5D_12_PRED	29	.55	.97	.8483	.01804	.09717	.009
	EQ5D_12_RES	29	-.13	.33	.0106	.01938	.10434	.011
	EQ5D_12_RES_SQ	29	.00	.11	.0106	.00386	.02079	.000
	EQ5D_12_RES_ABS	29	.00	.33	.0774	.01286	.06927	.005
	Valid N (listwise)	29						
1.00	EQ5D_12	181	1.00	1.00	1.0000	.00000	.00000	.000
	EQ5D_12_PRED	165	.64	.97	.9224	.00436	.05600	.003
	EQ5D_12_RES	165	.03	.36	.0776	.00436	.05600	.003
	EQ5D_12_RES_SQ	165	.00	.13	.0091	.00125	.01609	.000
	EQ5D_12_RES_ABS	165	.03	.36	.0776	.00436	.05600	.003
	Valid N (listwise)	165						

Table 83: Descriptive Statistics

PRWE_12_level		N	Minimum	Maximum	Mean		Std. Deviation	Variance
		Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
.	EQ5D_12	44	-.09	1.00	.7364	.04279	.28386	.081
	EQ5D_12_PRED	0						
	EQ5D_12_RES	0						
	EQ5D_12_RES_SQ	0						
	EQ5D_12_RES_ABS	0						
	Valid N (listwise)	0						
25.00	EQ5D_12	287	.09	1.00	.8967	.00823	.13939	.019
	EQ5D_12_PRED	325	.47	.97	.8951	.00427	.07696	.006
	EQ5D_12_RES	285	-.75	.33	.0018	.00727	.12268	.015
	EQ5D_12_RES_SQ	285	.00	.56	.0150	.00264	.04463	.002
	EQ5D_12_RES_ABS	285	.00	.75	.0924	.00477	.08055	.006

	Valid N (listwise)	285						
50.00	EQ5D_12	49	.08	1.00	.6973	.02757	.19297	.037
	EQ5D_12_PRED	60	.36	.81	.7015	.01050	.08133	.007
	EQ5D_12_RES	49	-.51	.36	-.0167	.02426	.16980	.029
	EQ5D_12_RES_SQ	49	.00	.26	.0285	.00808	.05657	.003
	EQ5D_12_RES_ABS	49	.00	.51	.1144	.01794	.12556	.016
	Valid N (listwise)	49						
75.00	EQ5D_12	15	.52	.80	.6713	.01756	.06802	.005
	EQ5D_12_PRED	20	.53	.70	.6407	.01030	.04606	.002
	EQ5D_12_RES	15	-.02	.16	.0376	.01535	.05945	.004
	EQ5D_12_RES_SQ	15	.00	.03	.0047	.00221	.00857	.000
	EQ5D_12_RES_ABS	15	.00	.16	.0448	.01391	.05387	.003
	Valid N (listwise)	15						
100.00	EQ5D_12	3	.08	.52	.2633	.13220	.22898	.052
	EQ5D_12_PRED	4	.33	.66	.4255	.07924	.15847	.025
	EQ5D_12_RES	3	-.27	.19	-.0831	.13896	.24068	.058
	EQ5D_12_RES_SQ	3	.03	.07	.0455	.01419	.02458	.001
	EQ5D_12_RES_ABS	3	.17	.27	.2085	.03198	.05538	.003
	Valid N (listwise)	3						

Table 84: Descriptive Statistics

EQ5D_6_level		N	Minimum	Maximum	Mean		Std. Deviation	Variance
		Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
.	EQ5D_6	0						
	EQ5D_6_PRED	58	.31	.97	.8077	.01838	.13998	.020
	EQ5D_6_RES	0						

	EQ5D_6_RES_SQ	0						
	EQ5D_6_RES_ABS	0						
	Valid N (listwise)	0						
.25	EQ5D_6	15	-.18	.23	.0733	.03580	.13865	.019
	EQ5D_6_PRED	14	.34	.75	.6157	.03716	.13906	.019
	EQ5D_6_RES	14	.26	.86	.5249	.04508	.16868	.028
	EQ5D_6_RES_SQ	14	.07	.74	.3020	.04826	.18058	.033
	EQ5D_6_RES_ABS	14	.26	.86	.5249	.04508	.16868	.028
	Valid N (listwise)	14						
.50	EQ5D_6	2	.26	.33	.2950	.03500	.04950	.002
	EQ5D_6_PRED	1	.66	.66	.6592	.	.	.
	EQ5D_6_RES	1	.33	.33	.3292	.	.	.
	EQ5D_6_RES_SQ	1	.11	.11	.1084	.	.	.
	EQ5D_6_RES_ABS	1	.33	.33	.3292	.	.	.
	Valid N (listwise)	1						
.60	EQ5D_6	17	.52	.59	.5612	.00861	.03551	.001
	EQ5D_6_PRED	15	.48	.97	.6875	.03588	.13898	.019
	EQ5D_6_RES	15	-.11	.38	.1209	.03420	.13245	.018
	EQ5D_6_RES_SQ	15	.00	.14	.0310	.00999	.03869	.001
	EQ5D_6_RES_ABS	15	.02	.38	.1454	.02649	.10260	.011
	Valid N (listwise)	15						
.70	EQ5D_6	69	.62	.69	.6675	.00284	.02360	.001
	EQ5D_6_PRED	56	.33	.93	.7122	.01562	.11687	.014
	EQ5D_6_RES	56	-.29	.24	.0454	.01481	.11086	.012
	EQ5D_6_RES_SQ	56	.00	.08	.0141	.00229	.01714	.000
	EQ5D_6_RES_ABS	56	.00	.29	.0969	.00929	.06950	.005
	Valid N (listwise)	56						

.80	EQ5D_6	143	.73	.80	.7773	.00208	.02484	.001
	EQ5D_6_PRED	125	.54	.97	.7973	.00841	.09400	.009
	EQ5D_6_RES	125	-.22	.18	.0192	.00794	.08879	.008
	EQ5D_6_RES_SQ	125	.00	.05	.0082	.00078	.00872	.000
	EQ5D_6_RES_ABS	125	.00	.22	.0761	.00440	.04918	.002
	Valid N (listwise)	125						
.90	EQ5D_6	34	.81	.88	.8559	.00399	.02324	.001
	EQ5D_6_PRED	33	.62	.96	.8394	.01385	.07958	.006
	EQ5D_6_RES	33	-.22	.11	-.0158	.01334	.07663	.006
	EQ5D_6_RES_SQ	33	.00	.05	.0059	.00186	.01070	.000
	EQ5D_6_RES_ABS	33	.00	.22	.0585	.00888	.05101	.003
	Valid N (listwise)	33						
1.00	EQ5D_6	114	1.00	1.00	1.0000	.00000	.00000	.000
	EQ5D_6_PRED	104	.68	.97	.9114	.00582	.05939	.004
	EQ5D_6_RES	104	-.32	-.03	-.0886	.00582	.05939	.004
	EQ5D_6_RES_SQ	104	.00	.10	.0113	.00167	.01701	.000
	EQ5D_6_RES_ABS	104	.03	.32	.0886	.00582	.05939	.004
	Valid N (listwise)	104						

Table 85: Descriptive Statistics

		N	Minimum	Maximum	Mean		Std. Deviation	Variance
PRWE_6_level		Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
.	EQ5D_6	44	-.17	1.00	.7459	.03149	.20891	.044
	EQ5D_6_PRED	0						
	EQ5D_6_RES	0						
	EQ5D_6_RES_SQ	0						

	EQ5D_6_RES_ABS	0						
	Valid N (listwise)	0						
25.00	EQ5D_6	235	.08	1.00	.8629	.00970	.14872	.022
	EQ5D_6_PRED	272	.53	.97	.8774	.00432	.07124	.005
	EQ5D_6_RES	233	-.26	.65	.0142	.00788	.12031	.014
	EQ5D_6_RES_SQ	233	.00	.42	.0146	.00255	.03894	.002
	EQ5D_6_RES_ABS	233	.00	.65	.0917	.00517	.07889	.006
	Valid N (listwise)	233						
50.00	EQ5D_6	87	-.17	1.00	.7010	.01942	.18111	.033
	EQ5D_6_PRED	101	.46	.79	.7011	.00674	.06776	.005
	EQ5D_6_RES	87	-.32	.86	.0024	.01991	.18575	.035
	EQ5D_6_RES_SQ	87	.00	.74	.0341	.01123	.10475	.011
	EQ5D_6_RES_ABS	87	.00	.86	.1117	.01586	.14794	.022
	Valid N (listwise)	87						
75.00	EQ5D_6	26	-.18	.80	.5685	.04916	.25067	.063
	EQ5D_6_PRED	31	.31	.69	.5903	.01826	.10167	.010
	EQ5D_6_RES	26	-.29	.67	.0242	.04722	.24075	.058
	EQ5D_6_RES_SQ	26	.00	.44	.0563	.02148	.10951	.012
	EQ5D_6_RES_ABS	26	.00	.67	.1651	.03409	.17384	.030
	Valid N (listwise)	26						
100.00	EQ5D_6	2	.08	.08	.0800	.00000	.00000	.000
	EQ5D_6_PRED	2	.34	.37	.3581	.01378	.01949	.000
	EQ5D_6_RES	2	.26	.29	.2781	.01378	.01949	.000
	EQ5D_6_RES_SQ	2	.07	.09	.0776	.00767	.01084	.000
	EQ5D_6_RES_ABS	2	.26	.29	.2781	.01378	.01949	.000
	Valid N (listwise)	2						

Appendix O: Qualitative study checklist

O.1 Information and support

Table 86: Qualitative study checklist: Information and support

Link to GRADE criteria	Question	Forsberg 2014[182]	Sleney 2014[467]	Okonta 2011[400]	O'Brien 2010[396]
Limitations of evidence	Is a qualitative study/survey an appropriate approach?	✓	✓	✓	✓
Limitations of evidence	Is the study clear in what it seeks to do?	✓	✓	✓	✓
Limitations of evidence	How defensible/rigorous is the research design/methodology?	?	✓	✓	✓
Limitations of evidence	How well was the data collection carried out?	✓	✓	✓	✓
Limitations of evidence	Is the role of the researcher clearly described?	×	✓	×	✓
Limitations of evidence	Is the context clearly described?	✓	✓	×	✓
Limitations of evidence	Were the methods reliable?	✓	✓	✓	✓
Limitations of evidence	Is the data analysis sufficiently rigorous?	?	✓	?	✓
Limitations of evidence	Are the data rich (for qualitative study and open ended survey questions)?	✓	✓	✓	✓
Limitations of evidence	Is the analysis reliable?	?	✓	?	✓
Limitations of evidence/ Applicability of evidence/ Sufficiency of evidence	Are the findings convincing?	✓	✓	✓	✓
Applicability of evidence	Are the findings relevant to the aims of the study?	✓	✓	✓	✓
Limitations of evidence/ Applicability of evidence/	Are the conclusions adequate?	✓	✓	✓	✓

Link to GRADE criteria	Question	Forsberg 2014[182]	Sleney 2014[467]	Okonta 2011[400]	O'Brien 2010[396]
Sufficiency of evidence					

Appendix P: Research recommendations

P.1 Ankle imaging

Research question: Is CT scanning in addition to initial plain film X-ray clinically effective and cost effective for planning surgical treatment of unstable/displaced ankle fractures compared with plain film X ray alone?

Why this is important: Ankle fractures are common and affect a significant number of people every year. Outcomes following surgery are important for patients' long-term function and quality of life, and may also be associated with additional cost if another operation is needed. It is important to know whether adding CT scanning to plain film X-ray improves outcomes following surgery and is cost effective.

Criteria for selecting high priority research recommendations:

PICO question	Is the use of CT scanning in addition to initial plain film X-ray clinically and cost effective for planning surgical treatment of unstable/displaced ankle fractures compared to plain film X ray alone? Population - Adults and children with a suspected unstable/displaced ankle fracture I – CT scan plus X-ray C – X-ray alone O –Health-related quality of life, pain/discomfort, return to normal activities, psychological wellbeing, adverse effects (unnecessary imaging, need for revision surgery, functional outcomes), Radiological outcomes – satisfactory fracture reduction.
Importance to patients or the population	Ankle fracture affects 122 per 100,000 people per year. There is on-going debate as to the relative risks versus benefits of surgery for the treatment of displaced ankle fractures.[155] The decision to operate or not, and the type of surgery planned, is usually based upon the interpretation of plain radiographs (X-rays). However, it is not always easy to interpret these X-rays; with particular regard to the reduction of the syndesmosis (the joint between the two bones of the lower leg).[330] Pre-operative CT scanning may allow the surgeon to more accurately determine which patients would benefit and from what surgery. However, pre-operative CT scanning requires additional time and resources.
Relevance to NICE guidance	The production of high quality research in this area could inform clinical practice for patients and surgeons. It would identify the most effective imaging technique to use with this population.
Relevance to the NHS	The identification of the most clinical and cost-effective way to plan surgical treatment of unstable/displaced ankle fractures would prevent unnecessary operations and improve outcome for patients with this common injury.
National priorities	Ankle fractures affect all types of patients, from top athletes with high-energy injuries to elderly patients whose fracture is related to osteoporosis. Patients have both short and long-term restrictions in mobility which affect health-related quality of life.[320] Improving the diagnosis and treatment of patients with

	this injury is a research priority for the National Institute for Health Research, Orthopaedic Trauma Society and Arthritis Research UK.
Current evidence base	There is increasing recognition that it is difficult to assess fractures involving syndesmosis of the ankle joint using X-rays alone.[330] However, it is not known if pre-operative CT scanning will improve the ability of surgeons to plan surgery and therefore improve outcomes for patients. There have been no trials at all in this area.
Equality	
Study design	Primary research using a randomised controlled design would be appropriate to investigate this question. This would ideally use the most reliable and valid patients-reported outcomes for ankle fracture and health-related quality of life..
Feasibility	The large numbers of people affected by this condition, and the increasing availability of CT scanning in Emergency Departments, means that such a trial is feasible
Other comments	There is no current research in this area
Importance	High priority: Ankle fractures affect a large proportion of the population, leading to significant short and long-term disability. The current evidence base does not allow NICE to make a clear recommendation regarding the most clinically effective and cost effective imaging technique for patients with ankle fracture. Specifically, is the use of CT scanning in addition to initial plain film X-ray clinically and cost effective for planning surgical treatment of unstable/displaced ankle fractures?

P.2 Clinics

Research question: What is the clinical and cost effectiveness of virtual new patient fracture systems versus next day consultant-led face-to-face new patient fracture clinics in people presenting with non complex fractures in the emergency department and thought to need an orthopaedic opinion?

Why this is important: Currently many people with fractures are asked to attend a next-day clinic led by a consultant, although it is believed that a virtual clinic may be at least as effective. If this is the case, face-to-face clinics may be an unnecessary use of time and resources for both patients and the NHS. Firm evidence of clinical and cost effectiveness is needed before virtual clinics can be introduced as part of a change in service structure.

Criteria for selecting high priority research recommendations:

PICO question	**Population:** patients with non-complex fractures seen in ED not for admission, thought to require an orthopaedic opinion **Intervention:** Virtual (remotely managed) new patient fracture systems (with discharge direct from ED protocols, orthopaedic consultant virtual review, telephone follow up, and triage to specialist clinics). This will include consideration of MDT issues. **Comparator:** Next day consultant-led face to face new patient fracture clinics **Outcomes:** • Patient satisfaction

	• Quality of life • Serious adverse incidents • Cost • Resource use • Time off work • Return to normal activities
Importance to patients or the population	Currently most patients with fractures are required to attend for face to face clinics, although there is a belief that the virtual clinic system may be at least as effective. If so, having to travel to attend face to face clinics may be a drain on patients' time and resources, and any research indicating that such patients have equivalent or better outcomes if given a virtual clinic appointment will reduce the burden on patients.
Relevance to NICE guidance	This research question will allow NICE to provide more definitive guidance on referral for people with fractures.
Relevance to the NHS	Currently most patients with fractures are required to attend for face to face clinics, although there is a belief that the virtual clinic system may be at least as effective. If so, unnecessary face to face clinics may be a drain on NHS resources, and any research indicating that such patients have equivalent or better outcomes if given a virtual clinic appointment will reduce the burden on the NHS.
National priorities	None
Current evidence base	No good quality evidence in this area currently exists.
Equality	All groups may benefit
Study design	Randomised controlled trial? Cluster randomised controlled trial?
Feasibility	This should be highly feasible, with no technical or ethical issues.
Other comments	There is no current research in this area
Importance	**High**

P.3 Distal radius fracture manipulation with image intensifier

Research question: For patients with displaced fractures of the distal radius, is manipulation with real time image guidance more clinically and cost effective than manipulation without real time image guidance?

Why this is important: In a large minority of patients with a distal radius fracture the bone fragments are displaced and need manipulation and reduction into an anatomical position. Currently in the NHS, most manipulations for distal radius fractures are performed in the emergency department without real time image guidance. It is believed that image guidance may be important, but despite hundreds of patients having manipulation of their displaced distal radius fracture in the ED each day, no high-quality research exists in this area.

Criteria for selecting high priority research recommendations:

PICO question	**Population:** Adults with closed, displaced distal radius fractures who are being considered for

	manipulation in the ED Sub-grouping criteria: • 16-50 and over 50 as surrogate for bone density • intra-articular/extra articular fracture of the radial carpal joint **Intervention:** • Manipulation with image intensifier at first presentation **Comparator:** • Manipulation without image intensifier at first presentation **Outcomes:** • Wrist function • Health related quality of life • Radiographic outcome • Resource use • Adverse events (Including second procedures)
Importance to patients or the population	Most distal radius fractures are 'undisplaced' i.e. the bones remain aligned in a normal anatomical position. However, in a large minority of patients the bone fragments are displaced and require manipulation and reduction into an anatomical position. Currently in the NHS, most manipulations for distal radius fractures are performed in the emergency department without real time image guidance. The GDG considered that manipulation without the use of real time image guidance could potentially lead to more inadequate reductions, more re-manipulations, and hence more interventions for the patient and potentially more damage to the soft-tissues around the wrist. 'Failed' reductions may also lead to more secondary surgical procedures for patients and greater cost for the NHS. Manipulations can be painful procedures and reducing this burden on patients is a high priority for this research.
Relevance to NICE guidance	This would answer the question of whether distal radius fractures should be reduced with the aid of real time image guidance or not. This would form an integral part of future NICE non-complex fracture guidelines.
Relevance to the NHS	The majority of people with displaced distal radius fractures will first present in the emergency department (ED) and, if required, that is where they will have their fracture manipulated. Currently, manipulations in the ED are carried out without the aid of real-time image guidance. Real-time image guidance may provide better outcomes for the patients. However, there would be a cost associated with installing the imaging equipment in the ED. If real time image guidance is clinically and cost effective for patients with a dorsally displaced distal radius fracture this would lead to a large change in ED services across the NHS.
National priorities	This question has been identified as a research priority by the Orthopaedic Trauma Society. Reducing demand for resource and costs in over-stretched Emergency Departments is a priority for the NHS.
Current evidence base	There are currently no published trials comparing closed manipulations of distal

	radius fractures with and without real time image guidance.
Equality	This research recommendation would potentially benefit all adults, but particularly older people who frequently have manipulations in the ED for fragility fractures of the distal radius.
Study design	The GDG felt that a randomised study comparing manipulation with real time image guidance versus manipulation without real time image guidance would be the most rigorous approach. The study with subgroup by age (16-50 and over 50, as a surrogate for bone density) and intra-articular/extra articular fractures to provide information on the groups who may benefit more from one approach or the other.
Feasibility	This is a common injury and a common procedure in ED. There is likely to be equipoise among clinicians. There will be (NHS excess treatment) costs associated with providing real time image guidance in ED but these may be offset against potential cost savings in terms of reduced need for further interventions and reduced adverse events.
Other comments	Reducing the need for further interventions will improve flow of patients through ED, reducing waiting times for patients and potentially reducing costs.
Importance	**Hundreds of patients have manipulation of their displaced distal radius fracture in the ED each day, but there is no high-quality research in this area.**

P.4 Post-operative ankle weight bearing strategy

Research question: What is the most clinically and cost effective strategy for weight in people who have had surgery for internal fixation of an ankle fracture?

Why this is important: In the NHS, open reduction and internal fixation of the ankle is often performed. Currently there is variation in the advice about mobilisation and weight-bearing given to people who have had this done. There is uncertainty as to whether people should be advised to immediately start unrestricted weight-bearing as tolerated or to wait a number of weeks.

Criteria for selecting high priority research recommendations:

PICO question	Population • Skeletally mature people who have had internal fixation for an ankle fracture. All patterns of injury (including contralateral) and fixation will be included. Subgroup by cast type; i.e.: ○ non-removable cast ○ removable cast or splint ○ no immobilisation device Intervention • Advise unrestricted weight bearing immediately post-op (weight bearing as tolerated). Written and verbal advice. Comparison • Advise restricted weight bearing for 6 weeks post-op (partial and non-weight bearing) with unrestricted weight-bearing thereafter. Written

	and verbal advice. Outcomes • Ankle function (8 weeks, 3 months, 6 months) • Health related quality of life (8 weeks, 3 months, 6 months) • Return to normal activities • Resource use • Adverse events (incl. secondary interventions) Exclusions • People with neuropathy
Importance to patients or the population	The GDG considered the possible advantages of immediate unrestricted weight bearing to be facilitation of faster rehabilitation for people who have open reduction and internal fixation (ORIF) of the ankle. It could minimise inactivity osteopenia, reduce muscle atrophy, and result in fewer post-surgical pulmonary embolisms and deep vein thrombosis. This in turn should allow for a faster return to normal activities. Hence research definitively demonstrating this would improve the quality of life for patients.
Relevance to NICE guidance	It would answer the clinical question around weight bearing strategy in post-operative patients following open reduction and internal fixation of ankle fractures and be the basis for a clinical recommendation in the non-complex fractures guideline.
Relevance to the NHS	The population of people in the UK receiving ORIF for ankle fractures is large; there were 1000 procedures carried out by the NHS in 2014. At the moment health professionals are uncertain what weight bearing advice to give to people with concerns that early unrestricted weight bearing will lead to additional re-displacements while delaying weight bearing leads to slower recovery and other adverse events, for example post-surgical pulmonary embolisms. There would be significant cost and resource use gains for the NHS if this question were answered. These would be manifested through fewer secondary interventions and reduced length of stay for patients.
National priorities	
Current evidence base	All eight studies included in the clinical review were small, with fewer than 100 participants in each and an overall average of 59. All evidence identified in the systematic review was graded as very low quality due to risk of bias and imprecision. This led to inconclusive results for the critical outcomes of interest.
Equality	This research recommendation would potentially benefit all groups, particularly older people, who may be particularly affected by immobility.
Study design	A randomised controlled trial would be the most appropriate form of research methodology for this question.
Feasibility	The research would be very feasible, with low cost and no serious technical issues. One potential ethical issue may be randomising people to the immediate weight bearing group, where the possibility of re-displacement may exist. However this is offset by the likelihood that most patients would benefit from

	such an intervention, based on the clinical experience of the GDG.
Other comments	Potential funders of this study may be include Orthopaedic Research UK or the Chartered Society of Physiotherapy. The study should measure compliance with the advice given, to assess fidelity of the intervention; for example, by using pressure measurements.
Importance	This research recommendation is of high importance: the research is essential to inform future updates of key recommendations in the guideline

P.5 Torus fractures treatment

Research question: What is the clinical effectiveness and cost effectiveness of no treatment for torus fractures of the distal radius in children compared with soft splints, removable splints or bandages?

Why this is important: Torus fractures of the distal radius are among the most common fractures in children but management varies widely between immediate discharge from the emergency department to repeated outpatient reviews with casting and imaging. These fractures result from trauma to growing bones and account for an estimated 500,000 emergency department attendances a year in the UK. Current treatment often involves application of a bandage, or a removable cast or a soft cast, with review in outpatient clinics and repeated X-ray imaging. This is despite anecdotal evidence that treatment with simple analgesia and immediate discharge from the emergency department is safe and effective. There have been no studies comparing current treatments with no intervention in children with torus fractures. A randomised controlled trial is needed to evaluate the clinical and cost effectiveness of no treatment compared with soft splints, removable splints or bandages.

Criteria for selecting high priority research recommendations:

PICO question	Is no treatment more clinically and cost effective for treating buckle fractures of the distal radius in children than soft splints, removable splints or bandages? P: Children aged 1-9 years with an isolated buckle fracture of the distal radius I: No treatment C: soft splints, removable splints or bandages. Note that these will <u>not</u> be compared to each other. O: patient reported pain/discomfort, parent or carer satisfaction with treatment, return to normal activities, skin problems and re-fracture
Importance to patients or the population	If no treatment with immediate discharge is found to be as effective as active treatments this will reduce the need for the child to wear, and the parents or carers to look after, what may be an inconvenient or uncomfortable cast. It will also reduce the need for patients to unnecessarily attending clinics.
Relevance to NICE guidance	In the current guidelines we have advised against rigid casts but have been unable to recommend that no treatment is given because of the lack of evidence, despite the feeling in the GDG that there would be no disadvantages to no treatment
Relevance to the NHS	If no treatment with immediate discharge is found to be as effective as active treatments this will reduce costs in terms of splint materials or bandages, as well as reducing time costs involved in instructing children and parents/carers in the use and care of the materials. It will also reduce the costs of the number of attendances to hospital.

National priorities	This study does not relate to any National priorities
Current evidence base	The current evidence shows that soft casts, bandages or removable casts may be more effective than rigid casts. No evidence exists regarding the relative effectiveness of no treatment.
Equality	This study will specifically relate to children.
Study design	A stratified randomization design is important to ensure that each of the three strata (soft cast v no treatment; removable cast v no treatment; bandage v no treatment) are free from selection bias. The entire sample should first be randomized to the three strata and then allocation to the intervention and comparator should occur via independent randomization. The three strata may also be collapsed into one to give an overall result for no treatment versus active treatment. This should be a non-inferiority trial rather than one required to show greater efficacy, as if no treatment is equal to the other treatments it can be inferred it is more desirable because of inevitable reductions in costs. Thus it should be powered and analysed accordingly.
Feasibility	With the large number of torus fracture cases per year there should be little problem recruiting enough patients for a valid trial. There are no ethical issues. Overall this should be a feasible project.
Other comments	None
Importance	The results of this study could significantly reduce costs in the NHS, given the common prevalence of this injury.

Appendix Q: NICE technical team

Name	Role
Sharon Summers-Ma	Guideline Lead
Phil Alderson	Clinical Advisor
Steven Barnes	Clinical Lead
Ross Maconachie	Health Economist
Ben Doak	Guideline Commissioning Manager
Thomas Feist	Guideline Coordinator
Anne-Louise Clayton	Editor

References

1 Abbott MD, Loder RT, Anglen JO. Comparison of submuscular and open plating of pediatric femur fractures: A retrospective review. Journal of Pediatric Orthopaedics. 2013; 33(5):519-523

2 Abraham A, Handoll H.H.G., Khan T. Interventions for treating wrist fractures in children. Cochrane Database of Systematic Reviews. 2008; Issue 2:CD004576. DOI:10.1002/14651858.CD004576.pub2

3 Achten J. A randomised controlled trial of percutaneous fixation with Kirschner wires versus volar locking-plate fixation in the treatment of adult patients with a displaced fracture of the distal radius [due for publication 2015]. 2015. Available from: http://www.controlled-trials.com/ISRCTN31379280 [Last accessed: 27 November 2014]

4 Adolphson P, Abbaszadegan H, Jonsson U, Dalen N, Sjoberg HE, Kalen S. No effects of piroxicam on osteopenia and recovery after Colles' fracture. A randomized, double-blind, placebo-controlled, prospective trial. Archives of Orthopaedic and Trauma Surgery. 1993; 112(3):127-130

5 af Ekenstam F, Jakobsson OP, Wadin K. Repair of the triangular ligament in Colles' fracture. No effect in a prospective randomized study. Acta Orthopaedica Scandinavica. 1989; 60(4):393-396

6 Afridi HD, Ansar ?, Aftab H. Prospective randomised study of the management of supracondylar (humerus) fractures in children. Med Channelâ . 2002; 8(1)

7 Agarwal A, Hammer AJ, Deep D, Morar. Is elastic intramedullary naling technique better in children? A prospective randomized trial. European Journal of Trauma. 2004; 30(3):214

8 Ahl T, Dalen N, Holmberg S, Selvik G. Early weight bearing of malleolar fractures. Acta Orthopaedica Scandinavica. 1986; 57(6):526-529

9 Ahl T, Dalen N, Holmberg S, Selvik G. Early weight bearing of displaced ankle fractures. Acta Orthopaedica Scandinavica. 1987; 58(5):535-538

10 Ahl T, Dalen N, Lundberg A, Bylund C. Early mobilization of operated on ankle fractures. Prospective, controlled study of 40 bimalleolar cases. Acta Orthopaedica Scandinavica. 1993; 64(1):95-99

11 Ahl T, Dalen N, Selvik G. Mobilization after operation of ankle fractures. Good results of early motion and weight bearing. Acta Orthopaedica Scandinavica. 1988; 59(3):302-306

12 Ahl T, Dalen N, Selvik G. Ankle fractures. A clinical and roentgenographic stereophotogrammetric study. Clinical Orthopaedics and Related Research. 1989;(245):246-255

13 Akinyoola AL, Orekha O, Taiwo F, Odunsi A. Outcome of non-operative management of femoral shaft fractures in children. African Journal of Paediatric Surgery. 2011; 8(1):34-39

14 Ali M, Raza A. Union and complications after thomas splint and early hip spica for femoral shaft fractures in children. Journal of College of Physicians and Surgeons Pakistan. 2005; 15(12):799-801

15 Allerston J, Justham D. Nurse practitioners and the Ottawa Ankle Rules: comparisons with medical staff in requesting X-rays for ankle injured patients. Accident and Emergency Nursing. 2000; 8(2):110-115

16 Allison P, Dahan-Oliel N, Jando VT, Yang SS, Hamdy RC. Open fractures of the femur in children: analysis of various treatment methods. Journal of Children's Orthopaedics. 2011; 5(2):101-108

17 Altay MA, Erturk C, Altay M, Belhan O, Isikan UE. Ultrasonographic examination of the radial and ulnar nerves after percutaneous cross-wiring of supracondylar humerus fractures in children: a prospective, randomized controlled study. Journal of Pediatric Orthopaedics B. 2011; 20(5):334-340

18 Altay MA, Erturk C, Cece H, Isikan UE. Mini-open versus closed reduction in titanium elastic nailing of paediatric femoral shaft fractures : A comparative study. Acta Orthopaedica Belgica. 2011; 77(2):211-217

19 Amiri HR, Safari S, Makarem J, Rahimi M, Jahanshahi B. Comparison of combined femoral nerve block and spinal anesthesia with lumbar plexus block for postoperative analgesia in intertrochanteric fracture surgery. Anesthesiology and Pain Medicine. 2012; 2(1):32-35

20 Amrami KK. Radiology corner: Diagnosing radiographically occult scaphoid fractures - What's the best second test? Journal of the American Society for Surgery of the Hand. 2005; 5(3):134-138

21 Anakwenze OA, Zoller S, Ahmad CS, Levine WN. Reverse shoulder arthroplasty for acute proximal humerus fractures: a systematic review. Journal of Shoulder and Elbow Surgery. 2014; 23(4):e73-e80

22 Ang SH, Lee SW, Lam KY. Ultrasound-guided reduction of distal radius fractures. American Journal of Emergency Medicine. 2010; 28(9):1002-1008

23 Anis AH, Stiell IG, Stewart DG, Laupacis A. Cost-effectiveness analysis of the Ottawa Ankle Rules. Annals of Emergency Medicine. 1995; 26(4):422-428

24 Arora R, Lutz M, Deml C, Krappinger D, Haug L, Gabl M. A prospective randomized trial comparing nonoperative treatment with volar locking plate fixation for displaced and unstable distal radial fractures in patients sixty-five years of age and older. Orthopedics. 2012; 35(1):50-51

25 Atroshi I, Brogren E, Larsson GU, Kloow J, Hofer M, Berggren AM. Wrist-bridging versus non-bridging external fixation for displaced distal radius fractures: a randomized assessor-blind clinical trial of 38 patients followed for 1 year. Acta Orthopaedica. 2006; 77(3):445-453

26 Auge WK, Velazquez PA. The application of indirect reduction techniques in the distal radius: The role of adjuvant arthroscopy. Arthroscopy. 2000; 16(8):830-835

27 Auleley GR, Kerboull L, Durieux P, Cosquer M, Courpied JP, Ravaud P. Validation of the Ottawa ankle rules in France: a study in the surgical emergency department of a teaching hospital. Annals of Emergency Medicine. 1998; 32(1):14-18

28 Auleley GR, Ravaud P, Giraudeau B, Kerboull L, Nizard R, Massin P et al. Implementation of the Ottawa ankle rules in France. A multicenter randomized controlled trial. JAMA. 1997; 277(24):1935-1939

29 Axelrod TS. A prospective randomized trial of external fixation and plaster cast immobilization in the treatment of distal radius fractures. Journal of Orthopaedic Trauma. 1991; 5(1):114-115

30 Bachmann LM, Haberzeth S, Steurer J, Ter Riet G. The accuracy of the Ottawa knee rule to rule out knee fractures: a systematic review. Annals of Internal Medicine. 2004; 140(2):121-124

31 Bachmann LM, Kolb E, Koller MT, Fletcher RH. The Ottawa ankle rules have a high sensitivity for excluding fractures of the ankle and midfoot in acute ankle sprain. Evidence-Based Medicine. 2003; 8(6):185

32 Bachmann LM, Kolb E, Koller MT, Steurer J, Ter Riet G. Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: systematic review. BMJ. 2003; 326(7386):417-419

33 Bae DS, Howard AW. Distal radius fractures: what is the evidence? Journal of Pediatric Orthopaedics. 2012; 32(Suppl.2):S128-S130

34 Baharuddin KA, Rahman NHNA, Wahab SFA, Halim NA, Ahmad R. Intravenous parecoxib sodium as an analgesic alternative to morphine in acute trauma pain in the emergency department. International Journal of Emergency Medicine. 2014; 7(1)

35 Bain GI, Hunt J, Mehta JA. Operative fluoroscopy in hand and upper limb surgery. One hundred cases. Journal of Hand Surgery - British Volume. 1997; 22(5):656-658

36 Baldwin K, Hsu JE, Wenger DR, Hosalkar HS. Treatment of femur fractures in school-aged children using elastic stable intramedullary nailing: a systematic review. Journal of Pediatric Orthopaedics B. 2011; 20(5):303-308

37 Bali K, Sudesh P, Patel S, Kumar V, Saini U, Dhillon MS. Pediatric femoral neck fractures: Our 10 years of experience. Clinics in Orthopedic Surgery. 2011; 3(4):302-308

38 Bancroft LW, Berquist TH, Morin RL, Pietan JH, Knudsen JM, Williams HJJ. Fracture interpretation using electronic presentation: a comparison. Journal of Digital Imaging. 2000; 13(1):13-18

39 Barker R, Schiferer A, Gore C, Gorove L, Lang T, Steinlechner B et al. Femoral nerve blockade administered preclinically for pain relief in severe knee trauma is more feasible and effective than intravenous metamizole: a randomized controlled trial. Journal of Trauma. 2008; 64(6):1535-1538

40 Barrington R. Single-blind study of diflunisal versus mefenamic acid in the treatment of pain after Colles' fracture. Current Medical Research and Opinion. 1980; 6(9):630-633

41 Bartl C, Stengel D, Bruckner T, Rossion I, Luntz S, Seiler C et al. Open reduction and internal fixation versus casting for highly comminuted and intra-articular fractures of the distal radius (ORCHID): protocol for a randomized clinical multi-center trial. Trials. 2011; 12:84

42 Bastian JD, Hertel R. Osteosynthesis and hemiarthroplasty of fractures of the proximal humerus: outcomes in a consecutive case series. Journal of Shoulder and Elbow Surgery. 2009; 18(2):216-219

43 Basumallick MN, Bandopadhyay A. Effect of dynamization in open interlocking nailing of femoral fractures. A prospective randomized comparative study of 50 cases with a 2-year follow-up. Acta Orthopaedica Belgica. 2002; 68(1):42-48

44 Bauer G, Hoellen I, Hohlbein O. Primary prosthetic humerus head replacement in dislocated multple fragment fracture of the humerus head in over 60-year-olds. Hefte Zur Der Unfallchirurg. 1999; 272:169-170

45 Bauer SJ, Hollander JE, Fuchs SH, Thode HCJ. A clinical decision rule in the evaluation of acute knee injuries. Journal of Emergency Medicine. 1995; 13(5):611-615

46 Bayreuther J, Macgregor A, Sajjanhar T. Management of limb fractures in children under 1 year of age in a dedicated paediatric emergency department. Emergency Medicine Journal. 2009; 26(3):173-176

47 Beaudoin FL, Haran JP, Liebmann O. A comparison of ultrasound-guided three-in-one femoral nerve block versus parenteral opioids alone for analgesia in emergency department patients with hip fractures: A randomized controlled trial. Academic Emergency Medicine. 2013; 20(6):584-591

48 Bech R, Lauritsen J, Ovesen OO, Emmeluth C, Lindholm P, Overgaard S. Promising effect of intraarticular ropivacaine in femoral neck fractures treated with internal fixation. Acta Anaesthesiologica Scandinavica, Supplement. 2009; 53(119):60

49 Bech RD, Lauritsen J, Ovesen O, Emmeluth C, Lindholm P, Overgaard S. Local anaesthetic wound infiltration after internal fixation of femoral neck fractures: A randomized, double-blind clinical trial in 33 patients. HIP International. 2011; 21(2):251-259

50 Beerekamp MS, Ubbink DT, Maas M, Luitse JS, Kloen P, Blokhuis TJ et al. Fracture surgery of the extremities with the intra-operative use of 3D-RX: a randomized multicenter trial (EF3X-trial). BMC Musculoskeletal Disorders. 2011; 12:151

51 Beeres FJP, Rhemrev SJ, den Hollander P, Kingma LM, Meylaerts SAG, Le Cessie S et al. Early magnetic resonance imaging compared with bone scintigraphy in suspected scaphoid fractures. Journal of Bone and Joint Surgery - British Volume. 2008; 90(9):1205-1209

52 Beiri A, Alani A, Ibrahim T, Taylor GJS. Trauma rapid review process: efficient out-patient fracture management. Annals of the Royal College of Surgeons of England. 2006; 88(4):408-411

53 Benegas E, Ferreira Neto AA, Gracitelli MEC, Malavolta EA, Assuncao JH, Prada FDS et al. Shoulder function after surgical treatment of displaced fractures of the humeral shaft: a randomized trial comparing antegrade intramedullary nailing with minimally invasive plate osteosynthesis. Journal of Shoulder and Elbow Surgery. 2014; 23(6):767-774

54 Benger JR, Lyburn ID. What is the effect of reporting all emergency department radiographs? Emergency Medicine Journal. 2003; 20(1):40-43

55 Bessen T, Clark R, Shakib S, Hughes G. A multifaceted strategy for implementation of the Ottawa ankle rules in two emergency departments. BMJ. 2009; 339(7717):396-399

56 Bevan P, Makin C, Benninger B. Ultrasound management and anatomy of distal radius fractures. Clinical Anatomy. 2013; 26(8):1038

57 Bhandari M, Adili A, Leone J, Lachowski RJ, Kwok DC. Early versus delayed operative management of closed tibial fractures. Clinical Orthopaedics and Related Research. 1999; 368(1):230-239

58 Bhat M, McCarthy M, Davis TRC, Oni JA, Dawson S. MRI and plain radiography in the assessment of displaced fractures of the waist of the carpal scaphoid. Journal of Bone and Joint Surgery - British Volume. 2004; 86(5):705-713

59 Biberthaler P, Braunstein V, Kirchhoff C, Kroetz M, Kettler M, Mutschler W. Surgical therapy of humeral head fractures with a locking plate: analysis of 176 cases. Journal of Bone and Joint Surgery - British Volume. 2009; 91-B(suppl.I):40-4b

60 Bigorre N, Talha A, Cronier P, Hubert L, Toulemonde JL, Massin P. A prospective study of a new locking plate for proximal humeral fracture. Injury. 2009; 40(2):192-196

61 Bing AJF, Eastwood G, Sharma R, Cross R, Taylor GJS, Harper WM. A randomised prospective trial comparing Polarus nail and Rush pins for fixation of proximal humeral fractures - Poster A5. British Orthopaedic Association Annual Congress. 2002 Sept 18-20:Cardiff 2002;2

62 Black JDJ, Bhavikatti M, Al-Hadithy N, Hakmi A, Kitson J. Early weight-bearing in operatively fixed ankle fractures: a systematic review. Foot. 2013; 23(2-3):78-85

63 Blakeney W, Webber L. Emergency Department management of Colles-type fractures: a prospective cohort study. Emergency Medicine Australasia. 2009; 21(4):298-303

64 Blank E, Lappan C, Belmont PJJ, Machen MS, Ficke J, Pope R et al. Early analysis of the United States Army's telemedicine orthopaedic consultation program. Journal of Surgical Orthopaedic Advances. 2011; 20(1):50-55

65 Blonna D, Barbasetti N, Banche G, Cuffini AM, Bellato E, Masse A et al. Incidence and risk factors for acute infection after proximal humeral fractures: a multicenter study. Journal of Shoulder and Elbow Surgery. 2014; 23(4):528-535

66 Blyth MJ, Kinninmonth AW, Asante DK. Bier's block: a change of injection site. Journal of Trauma. 1995; 39(4):726-728

67 Boons HW, Goosen JH, Van GS, Van Susante JL, Van Loon CJ. Hemiarthroplasty did not confer any benefit in older patients with four-part humeral fractures. Journal of Bone and Joint Surgery - American Volume. 2013; 95(10):941

68 Borgen D, Sprague BL. Treatment of distal femoral fractures with early weight-bearing. A preliminary report. Clinical Orthopaedics and Related Research. 1975;(111):156-162

69 Borland M, Milsom S, Esson A. Equivalency of two concentrations of fentanyl administered by the intranasal route for acute analgesia in children in a paediatric emergency department: a randomized controlled trial. Emergency Medicine Australasia. 2011; 23(2):202-208

70 Boudard G, Pomares G, Milin L, Lemonnier I, Coudane H, Mainard D et al. Locking plate fixation versus antegrade nailing of 3- and 4-part proximal humerus fractures in patients without osteoporosis. Comparative retrospective study of 63 cases. Orthopaedics and Traumatology, Surgery and Research. 2014; 100(8):917-924

71 Bounes V, Barthelemy R, Diez O, Charpentier S, Montastruc JL, Ducasse JL. Sufentanil is not superior to morphine for the treatment of acute traumatic pain in an emergency setting: a randomized, double-blind, out-of-hospital trial. Annals of Emergency Medicine. 2010; 56(5):509-516

72 Boutis K, Grootendorst P, Willan A, Plint AC, Babyn P, Brison RJ et al. Effect of the Low Risk Ankle Rule on the frequency of radiography in children with ankle injuries. CMAJ. 2013; 185(15):E731-E738

73 Boutis K, Komar L, Jaramillo D, Babyn P, Alman B, Snyder B et al. Sensitivity of a clinical examination to predict need for radiography in children with ankle injuries: a prospective study. Lancet. 2001; 358(9299):2118-2121

74 Boyle MJ, Youn SM, Frampton CMA, Ball CM. Functional outcomes of reverse shoulder arthroplasty compared with hemiarthroplasty for acute proximal humeral fractures. Journal of Shoulder and Elbow Surgery. 2013; 22(1):32-37

75 Brady OH, Mullan GB, Cashman WFC, Curtin JC, McGuiness A, Barry K. Manipulation of wrist fractures under haematoma block M.U.L.A. v.M.U.G.A. Journal of Bone and Joint Surgery - British Volume. 1998; 80(Suppl.1):63

76 Brahm J, Turner J. A randomized controlled trial of emergency department ultrasound-guided reduction of distal radius fractures. Annals of Emergency Medicine. 2011; 58(4 suppl.1):S230-S231

77 Brandis S, Murtagh S, Solia R. The Allied Health BONE (Best Orthopaedic New Enterprise) team: an interdisciplinary approach to orthopaedic early discharge and admission prevention. Australian Health Review. 1998; 21(3):211-222

78 Brealey S, King DG, Hahn S, Godfrey C, Crowe MTI, Bloor K et al. The costs and effects of introducing selectively trained radiographers to an A&E reporting service: a retrospective controlled before and after study. British Journal of Radiology. 2005; 78(930):499-505

79 Breederveld RS, Tuinebreijer WE. Investigation of computed tomographic scan concurrent criterion validity in doubtful scaphoid fracture of the wrist. Journal of Trauma. 2004; 57(4):851-854

80 Breitenseher MJ, Metz VM, Gilula LA, Gaebler C, Kukla C, Fleischmann D et al. Radiographically occult scaphoid fractures: value of MR imaging in detection. Radiology. 1997; 203(1):245-250

81 Bretlau T, Christensen OM, Edstrom P, Thomsen HS, Lausten GS. Diagnosis of scaphoid fracture and dedicated extremity MRI. Acta Orthopaedica Scandinavica. 1999; 70(5):504-508

82 Brooke KJ, Faux SG, Wilson SF, Liauw W, Bowman M, Klein L. Outcomes of motor vehicle crashes with fracture: a pilot study of early rehabilitation interventions. Journal of Rehabilitation Medicine. 2014; 46(4):335-340

83 Brooks S, Cicuttini FM, Lim S, Taylor D, Stuckey SL, Wluka AE. Cost effectiveness of adding magnetic resonance imaging to the usual management of suspected scaphoid fractures. British Journal of Sports Medicine. 2005; 39(2):75-79

84 Broomhead A, Stuart P. Validation of the Ottawa Ankle Rules in Australia. Emergency Medicine. 2003; 15(2):126-132

85 Brorson S. Management of proximal humeral fractures in the nineteenth century: An historical review of preradiographic sources. Clinical Orthopaedics and Related Research. 2011; 469(4):1197-1206

86 Brorson S, Bagger J, Sylvest A, Hrobjartsson A. Diagnosing displaced four-part fractures of the proximal humerus: a review of observer studies. International Orthopaedics. 2009; 33(2):323-327

87 Brorson S, Frich LH, Winther A, Hrobjartsson A. Locking plate osteosynthesis in displaced 4-part fractures of the proximal humerus. Acta Orthopaedica. 2011; 82(4):475-481

88 Brorson S, Olsen BS, Frich LH, Jensen SL, Johannsen HV, Sorensen AK et al. Effect of osteosynthesis, primary hemiarthroplasty, and non-surgical management for displaced four-part

fractures of the proximal humerus in elderly: a multi-centre, randomised clinical trial. Trials. 2009; 10:51

89 Brorson S, Rasmussen JV, Olsen BS, Frich LH, Jensen SL, Hrobjartsson A. Reverse shoulder arthroplasty in acute fractures of the proximal humerus: A systematic review. International Journal of Shoulder Surgery. 2013; 7(2):70-78

90 Bruijn HP. Functional treatment of Colles fracture. Acta Orthopaedica Scandinavica - Supplementum. 1987; 223:1-95

91 Buechsenschuetz KE, Mehlman CT, Shaw KJ, Crawford AH, Immerman EB. Femoral shaft fractures in children: traction and casting versus elastic stable intramedullary nailing. Journal of Trauma. 2002; 53(5):914-921

92 Buecking B, Mohr J, Bockmann B, Zettl R, Ruchholtz S. Deltoid-split or deltopectoral approaches for the treatment of displaced proximal humeral fractures? Clinical Orthopaedics and Related Research. 2014; 472(5):1576-1585

93 Buijze GA, Jorgsholm P, Thomsen NOB, Bjorkman A, Besjakov J, Ring D. Diagnostic performance of radiographs and computed tomography for displacement and instability of acute scaphoid waist fractures. Journal of Bone and Joint Surgery - American Volume. 2012; 94(21):1967-1974

94 Buijze GA, Mallee WH, Beeres FJP, Hanson TE, Johnson WO, Ring D. Diagnostic performance tests for suspected scaphoid fractures differ with conventional and latent class analysis. Clinical Orthopaedics and Related Research. 2011; 469(12):3400-3407

95 Bultitude MI, Wellwood JM, Hollingsworth RP. Intravenous diazepam: its use in the reduction of fractures of the lower end of the radius. Injury. 1972; 3(4):249-253

96 Burkhart KJ, Dietz SO, Bastian L, Thelen U, Hoffmann R, Muller LP. The treatment of proximal humeral fracture in adults. Deutsches Arzteblatt International. 2013; 110(35-36):591-597

97 Burton JH, Auble TE, Fuchs SM. Effectiveness of 50% nitrous oxide/50% oxygen during laceration repair in children. Academic Emergency Medicine. 1998; 5(2):112-117

98 Calderon S-L, Ring D. The diagnostic performance characteristics of imaging techniques used in the management of scaphoid fractures. Current Opinion in Orthopaedics. 2007; 18(4):309-314

99 Cameron CD, Meek RN, Blachut PA, O'Brien PJ, Pate GC. Intramedullary nailing of the femoral shaft: a prospective, randomized study. Journal of Orthopaedic Trauma. 1992; 6(4):448-451

100 Can U, Ruckert R, Held U, Buchmann P, Platz A, Bachmann LM. Safety and efficiency of the Ottawa Ankle Rule in a Swiss population with ankle sprains. Swiss Medical Weekly. 2008; 138(19-20):292-296

101 Canagasabey MD, Callaghan MJ, Carley S. The sonographic Ottawa Foot and Ankle Rules study (the SOFAR study). Emergency Medicine Journal. 2011; 28(10):838-840

102 Cao QQ, Xu XZ, Lu YY, Chen LM, Guo XY. [Comparison of lumbar plexus block and epidural block for elderly patients undergoing intertrochanteric femoral fracture surgery]. Zhonghua Yi Xue Za Zhi. 2008; 88(37):2614-2617

103 Carragee EJ, Csongradi JJ. Increased rates of complications in patients with severe ankle fractures following interinstitutional transfers. Journal of Trauma. 1993; 35(5):767-771

104 Carragee EJ, Csongradi JJ, Bleck EE. Early complications in the operative treatment of ankle fractures. Influence of delay before operation. Journal of Bone and Joint Surgery - British Volume. 1991; 73(1):79-82

105 Case RD. Haematoma block--a safe method of reducing Colles' fractures. Injury. 1985; 16(7):469-470

106 Cerezal L, Abascal F, Canga A, Garcia-Valtuille R, Bustamante M, Del PF. Usefulness of gadolinium-enhanced MR imaging in the evaluation of the vascularity of scaphoid nonunions. American Journal of Roentgenology. 2000; 174(1):141-149

107 Chalmers PN, Slikker W, Mall NA, Gupta AK, Rahman Z, Enriquez D et al. Reverse total shoulder arthroplasty for acute proximal humeral fracture: comparison to open reduction-internal fixation and hemiarthroplasty. Journal of Shoulder and Elbow Surgery. 2014; 23(2):197-204

108 Chan LM. Comparison of the accuracy of bernese ankle rules and ottawa ankle rules in ruling out ankle and mid-foot fractures. Hong Kong Journal of Emergency Medicine. 2010; 17(4):422

109 Chappuis J, Boute P, Putz P. Dorsally displaced extra-articular distal radius fractures fixation: Dorsal IM nailing versus volar plating. A randomized controlled trial. Orthopaedics and Traumatology, Surgery and Research. 2011; 97(5):471-478

110 Chartier LB, Chenkin J, Woolfrey KGH. Use of bedside ultrasound in distal radius fractures: A review of the literature. Canadian Journal of Emergency Medicine. 2012; 14:S22

111 Chen M, Zhao JM, Li B, Peng XZ, Ding XF, Su W et al. Effectiveness and safety of external fixation versus open reduction and internal fixation for the adults' unstable distal radius fractures: a systematic review. Chinese Journal of Evidence-Based Medicine. 2010; 10(11):1269-1275

112 Chinnock B, Khaletskiy A, Kuo K, Hendey GW. Ultrasound-guided reduction of distal radius fractures. Journal of Emergency Medicine. 2011; 40(3):308-312

113 Chirpaz-Cerbat JM, Ruatti S, Houillon C, Ionescu S. Dorsally displaced distal radius fractures treated by fixed-angle volar plating: Grip and pronosupination strength recovery. A prospective study. Orthopaedics and Traumatology, Surgery and Research. 2011; 97(5):465-470

114 Chong AKS, Tan DMK, Ooi BS, Mahadevan M, Lim AYT, Lim BH. Comparison of forearm and conventional Bier's blocks for manipulation and reduction of distal radius fractures. Journal of Hand Surgery - European Volume. 2007; 32(1):57-59

115 Chung KC, Kim HM, Haase SC, Lawton J, Ozer K, Waljee JF et al. Reflections 1 year into the 21-center national institutes of health-funded wrist study: A primer on conducting a multicenter clinical trial. Journal of Hand Surgery - American Volume. 2013; 38(6):1194-1201

116 Chung KC, Shauver MJ, Malay S. A first-year update and reflection of the 21 center nih-funded wrist and radius injury surgical trial (WRIST). Journal of Hand Surgery - American Volume. 2013; 38(10 Suppl.1):e36

117 Chung KC, Kotsis SV, Kim HM. Predictors of functional outcomes after surgical treatment of distal radius fractures. Journal of Hand Surgery - American Volume. 2007; 32(1):76-83

118 Cimino W, Ichtertz D, Slabaugh P. Early mobilization of ankle fractures after open reduction and internal fixation. Clinical Orthopaedics and Related Research. 1991; 267:152-156

119 Clark KD, Tanner S. Evaluation of the Ottawa ankle rules in children. Pediatric Emergency Care. 2003; 19(2):73-78

120 Clinkscales CM, Peterson HA. Isolated closed diaphyseal fractures of the femur in children: comparison of effectiveness and cost of several treatment methods. Orthopedics. 1997; 20(12):1131-1136

121 Coad NR. Post-operative analgesia following femoral-neck surgery--a comparison between 3 in 1 femoral nerve block and lateral cutaneous nerve block. European Journal of Anaesthesiology. 1991; 8(4):287-290

122 Cobb AG, Houghton GR. Local anaesthetic infiltration versus Bier's block for Colles' fractures. BMJ. 1985; 291(6510):1683-1684

123 Cohen DM, Jasser JW, Kean JR, Smith GA. Clinical criteria for using radiography for children with acute knee injuries. Pediatric Emergency Care. 1998; 14(3):185-187

124 Cook PA, Yu JS, Wiand W, Cook AJ, Coleman CR, Cook AJ. Suspected scaphoid fractures in skeletally immature patients: application of MRI. Journal of Computer Assisted Tomography. 1997; 21(4):511-515

125 Cooper L, Mauffrey C, Hull P, Brewster M, Lewis C, Makrides P. A short term functional outcome study comparing closed reduction percutaneous wire fixation with open reduction internal fixation for fractures of the distal radius: A pilot study. European Journal of Orthopaedic Surgery and Traumatology. 2008; 18(8):551-554

126 Costa ML, Achten J, Parsons NR, Rangan A, Edlin RP, Brown J et al. UK DRAFFT - a randomised controlled trial of percutaneous fixation with kirschner wires versus volar locking-plate fixation in the treatment of adult patients with a dorsally displaced fracture of the distal radius. BMC Musculoskeletal Disorders. 2011; 12:201

127 Coyte PC, Bronskill SE, Hirji ZZ, Daigle-Takacs G, Trerise BS, Wright JG. Economic evaluation of 2 treatments for pediatric femoral shaft fractures. Clinical Orthopaedics and Related Research. 1997; 336(1):205-215

128 Craig NJA, Maffulli N. Subtrochanteric fractures: current management options. Disability and Rehabilitation. 2005; 27(18-19):1181-1190

129 Crossley K. A negative result on the Ottawa knee rules excludes fracture in patients with acute knee injury. Australian Journal of Physiotherapy. 2004; 50(2):116

130 Cruickshank J, Meakin A, Breadmore R, Mitchell D, Pincus S, Hughes T et al. Early computerized tomography accurately determines the presence or absence of scaphoid and other fractures. Emergency Medicine Australasia. 2007; 19(3):223-228

131 Cuff DJ, Pupello DR. Comparison of hemiarthroplasty and reverse shoulder arthroplasty for the treatment of proximal humeral fractures in elderly patients. Journal of Bone and Joint Surgery - American Volume. 2013; 95(22):2050-2055

132 Cui Z, Yu B, Hu Y, Lin Q, Wang B. Dynamic versus static external fixation for unstable distal radius fractures: an up-to-date meta-analysis. Injury. 2012; 43(7):1006-1013

133 Curtis JF, Killian JT, Alonso JE. Improved treatment of femoral shaft fractures in children utilizing the pontoon spica cast: a long-term follow-up. Journal of Pediatric Orthopaedics. 1995; 15(1):36-40

134 Dabbo S, Varner C, Bleakney R, Ovens H. Clinical impact of extending after-hours radiology coverage for emergency department computed tomography imaging. Open Access Emergency Medicine. 2013; 6:33-35

135 Daglar B, Gungor E, Delialioglu OM, Karakus D, Ersoz M, Tasbas BA et al. Comparison of knee function after antegrade and retrograde intramedullary nailing for diaphyseal femoral fractures: results of isokinetic evaluation. Journal of Orthopaedic Trauma. 2009; 23(9):640-644

136 Dai J, Chai Y, Wang C, Wen G. Meta-analysis comparing locking plate fixation with hemiarthroplasty for complex proximal humeral fractures. European Journal of Orthopaedic Surgery and Traumatology. 2014; 24(3):305-313

137 Davidson JS, Brown DJ, Barnes SN, Bruce CE. Simple treatment for torus fractures of the distal radius. Journal of Bone and Joint Surgery - British Volume. 2001; 83(8):1173-1175

138 Davis TR, Ackroyd CE. Non-steroidal anti-inflammatory agents in the management of Colles' fractures. British Journal of Clinical Practice. 1988; 42(5):184-189

139 Dayan PS, Vitale M, Langsam DJ, Ruzal-Shapiro C, Novick MK, Kuppermann N et al. Derivation of clinical prediction rules to identify children with fractures after twisting injuries of the ankle. Academic Emergency Medicine. 2004; 11(7):736-743

140 Den Hartog D, De Haan J, Schep NW, Tuinebreijer WE. Primary shoulder arthroplasty versus conservative treatment for comminuted proximal humeral fractures: a systematic literature review. Open Orthopaedics Journal. 2010; 4:87-92

141 Den Hartog D, Van Lieshout EMM, Tuinebreijer WE, Polinder S, Van Beeck EF, Breederveld RS et al. Primary hemiarthroplasty versus conservative treatment for comminuted fractures of the proximal humerus in the elderly (ProCon): a multicenter randomized controlled trial. BMC Musculoskeletal Disorders. 2010; 11:97

142 Department of Health. NHS reference costs 2012-13. 2013. Available from: https://www.gov.uk/government/publications/nhs-reference-costs-2012-to-2013 [Last accessed: 12 March 2015]

143 Derakhshanfar H. Nitrous oxide/oxygen compared with fentanyl in reducing pain among adults with isolated extremity trauma: A randomized trial. Journal of Pain. 2014; 15(4 Suppl.1):S93

144 Derakhshanfar H, Noori S. Nitrous oxide/oxygen compared with fentanyl in reducing pain among adults with isolated extremity trauma: A randomized trial. Pain Practice. 2014; 14:50

145 Derksen RJ, Commandeur JP, Deij R, Breederveld RS. Swim cast versus traditional cast in pediatric distal radius fractures: a prospective randomized controlled trial. Journal of Children's Orthopaedics. 2013; 7(2):117-121

146 DeVellis P, Thomas SH, Wedel SK, Stein JP, Vinci RJ. Prehospital fentanyl analgesia in air-transported pediatric trauma patients. Pediatric Emergency Care. 1998; 14(5):321-323

147 Dias JJ, Singh HP. Displaced fracture of the waist of the scaphoid. Journal of Bone and Joint Surgery - British Volume. 2011; 93(11):1433-1439

148 Dias JJ, Thompson J, Barton NJ, Gregg PJ. Suspected scaphoid fractures. The value of radiographs. Journal of Bone and Joint Surgery - British Volume. 1990; 72(1):98-101

149 Diaz-Garcia RJ, Oda T, Shauver MJ, Chung KC. A systematic review of outcomes and complications of treating unstable distal radius fractures in the elderly. Journal of Hand Surgery - American Volume. 2011; 36(5):824-835

150 Diehr P, Highley R, Dehkordi F, Wood R, Krueger L, Teitz C et al. Prediction of fracture in patients with acute musculoskeletal ankle trauma. Medical Decision Making. 1988; 8(1):40-47

151 Dissmann PD, Han KH. The tuning fork test--a useful tool for improving specificity in "Ottawa positive" patients after ankle inversion injury. Emergency Medicine Journal. 2006; 23(10):788-790

152 DiStasio AJ, Jaggears FR, DePasquale LV, Frassica FJ, Turen CH. Protected early motion versus cast immobilization in postoperative management of ankle fractures. Contemporary Orthopaedics. 1994; 29(4):273-277

153 Dogra AS, Rangan A. Early mobilisation versus immobilisation of surgically treated ankle fractures. Prospective randomised control trial. Injury. 1999; 30(6):417-419

154 Domb BG, Sponseller PD, Ain M, Miller NH. Comparison of dynamic versus static external fixation for pediatric femur fractures. Journal of Pediatric Orthopaedics. 2002; 22(4):428-430

155 Donken Christian CMA, Al-Khateeb H, Verhofstad Michael HJ, van Laarhoven Cornelis JHM. Surgical versus conservative interventions for treating ankle fractures in adults. Cochrane Database of Systematic Reviews. 2012; Issue 8:CD008470. DOI:10.1002/14651858.CD008470.pub2

156 Dorsay TA, Major NM, Helms CA. Cost-effectiveness of immediate MR imaging versus traditional follow-up for revealing radiographically occult scaphoid fractures. American Journal of Roentgenology. 2001; 177(6):1257-1263

157 Dowling S, Spooner CH, Liang Y, Dryden DM, Friesen C, Klassen TP et al. Accuracy of Ottawa Ankle Rules to exclude fractures of the ankle and midfoot in children: a meta-analysis. Academic Emergency Medicine. 2009; 16(4):277-287

158 Drendel AL, Gorelick MH, Weisman SJ, Lyon R, Brousseau DC, Kim MK. A randomized clinical trial of ibuprofen versus acetaminophen with codeine for acute pediatric arm fracture pain. Annals of Emergency Medicine. 2009; 54(4):553-560

159 Duckworth AD, Ring D, McQueen MM. Assessment of the suspected fracture of the scaphoid. Journal of Bone and Joint Surgery - British Volume. 2011; 93(6):713-719

160 Duda D, Müller H, Brandt L. [Comparative clinical study of nalbuphine and fentanyl. Effects and side effects with special reference to the induction phase]. Der Anaesthesist. 1987; 36(8):407-411

161 Durrani HD, Butt KJ, Khosa AH, Umer A, Pervaiz M. Pain relief during positioning for spinal anesthesia in patients with femoral fracture: A comparison between femoral nerve block and intravenous nalbuphine. Pakistan Journal of Medical and Health Sciences. 2013; 7(4):928-932

162 Edelmann K, Obruba P, Kopp L, Cihlar J, Celko AM. Comparison of functional outcomes in angle-stable osteosynthesis of comminuted fractures of the proximal humerus with those in

percutaneous kirschner-wire fixation. a prospective study of mid-term results. Acta Chirurgiae Orthopaedicae Et Traumatologiae Cechoslovaca. 2011; 78(4):314-320

163 Ellwein A, Lill H, Voigt C, Wirtz P, Jensen G, Katthagen JC. Arthroplasty compared to internal fixation by locking plate osteosynthesis in comminuted fractures of the distal humerus. International Orthopaedics. 2015; 39(4):747-754

164 Esposito J, Schemitsch EH, Saccone M, Sternheim A, Kuzyk PRT. External fixation versus open reduction with plate fixation for distal radius fractures: a meta-analysis of randomised controlled trials. Injury. 2013; 44(4):409-416

165 Evans E, Turley N, Robinson N, Clancy M. Randomised controlled trial of patient controlled analgesia compared with nurse delivered analgesia in an emergency department. Emergency Medicine Journal. 2005; 22(1):25-29

166 Even JL, Richards JE, Crosby CG, Kregor PJ, Mitchell EJ, Jahangir AA et al. Preoperative skeletal versus cutaneous traction for femoral shaft fractures treated within 24 hours. Journal of Orthopaedic Trauma. 2012; 26(10):e177-e182

167 Eventov I, Salama R, Goodwin DR, Weissman SL. An evaluation of surgical and conservative treatment of fractures of the ankle in 200 patients. Journal of Trauma. 1978; 18(4):271-274

168 Faierman E, Jupiter JB. The management of acute fractures involving the distal radio-ulnar joint and distal ulna. Hand Clinics. 1998; 14(2):213-229

169 Falk SSI, Mielsch N, Wendt M, Mittlmeier T, Gierer P, Gradl G. Intramedullary fixation of intra-articular distal radius fractures - First results for the Targon DR. Injury. 2012; 43:S24

170 Farahmand S, Shiralizadeh S, Talebian MT, Bagheri-Hariri S, Arbab M, Basirghafouri H et al. Nebulized fentanyl vs intravenous morphine for ED patients with acute limb pain: a randomized clinical trial. American Journal of Emergency Medicine. 2014; 32(9):1011-1015

171 Farsi D, Movahedi M, Hafezimoghadam P, Abbasi S, Shahlaee A, Rahimi-Movaghar V. Acute pain management with intravenous 0.10 mg/kg vs. 0.15 mg/kg morphine sulfate in limb traumatized patients: a randomized double-blinded placebo-controlled trial. Ulusal Travma Ve Acil Cerrahi Dergisi. 2013; 19(5):398-404

172 Ferris BD, Thomas NP, Dewar ME, Simpson DA. Brace treatment of Colles' fracture. Acta Orthopaedica Scandinavica. 1989; 60(1):63-65

173 Fialka C, Stampfl P, Arbes S, Reuter P, Oberleitner G, Vecsei V. Primary hemiarthroplasty in four-part fractures of the proximal humerus: randomized trial of two different implant systems. Journal of Shoulder and Elbow Surgery. 2008; 17(2):210-215

174 Fiesseler F, Szucs P, Kec R, Richman PB. Can nurses appropriately interpret the Ottawa Ankle Rule? American Journal of Emergency Medicine. 2004; 22(3):145-148

175 Finsen V, Benum P. Osteopenia after ankle fractures. The influence of early weight bearing and muscle activity. Clinical Orthopaedics and Related Research. 1989; 245:261-268

176 Finsen V, Saetermo R, Kibsgaard L, Farran K, Engebretsen L, Bolz KD et al. Early postoperative weight-bearing and muscle activity in patients who have a fracture of the ankle. Journal of Bone and Joint Surgery - American Volume. 1989; 71(1):23-27

177 Firmin F, Crouch R. Splinting versus casting of "torus" fractures to the distal radius in the paediatric patient presenting at the emergency department (ED): a literature review. International Emergency Nursing. 2009; 17(3):173-178

178 Fjalestad T, Hole MO, Jorgensen JJ, Stromsoe K, Kristiansen IS. Health and cost consequences of surgical versus conservative treatment for a comminuted proximal humeral fracture in elderly patients. Injury. 2010; 41(6):599-605

179 Fjalestad T, Iversen P, Hole MO, Smedsrud M, Madsen JE. Clinical investigation for displaced proximal humeral fractures in the elderly: a randomized study of two surgical treatments: reverse total prosthetic replacement versus angular stable plate Philos (The DELPHI-trial). BMC Musculoskeletal Disorders. 2014; 15:323

180 Fletcher AK, Rigby AS, Heyes FLP. Three-in-one femoral nerve block as analgesia for fractured neck of femur in the emergency department: a randomized, controlled trial. Annals of Emergency Medicine. 2003; 41(2):227-233

181 Fogel GR, Morrey BF. Delayed open reduction and fixation of ankle fractures. Clinical Orthopaedics and Related Research. 1987;(215):187-195

182 Forsberg A, Soderberg S, Engstrom A. People's experiences of suffering a lower limb fracture and undergoing surgery. Journal of Clinical Nursing. 2014; 23(1-2):191-200

183 Fowler C, Sullivan B, Williams LA, McCarthy G, Savage R, Palmer A. A comparison of bone scintigraphy and MRI in the early diagnosis of the occult scaphoid waist fracture. Skeletal Radiology. 1998; 27(12):683-687

184 Fox A, Wykes P, Eccles K, Barrie J. Five years of ankle fractures grouped by stability. Injury. 2005; 36(7):836-841

185 Franck WM, Dahlen C, Amlang M, Friese F, Zwipp H. [Distal radius fracture--is non-bridging articular external fixator a therapeutic alternative? A prospective randomized study]. Der Unfallchirurg. 2000; 103(10):826-833

186 Freeman BJC, Atherton WG, Howard PW, Burke FD. External fixation or manipulation and plaster for severely displaced comminuted Colles' fractures? Journal of Bone and Joint Surgery - British Volume. 2000; 82(Suppl.2):171

187 Fritz T, Wersching D, Klavora R, Krieglstein C, Friedl W. Combined Kirschner wire fixation in the treatment of Colles fracture. A prospective, controlled trial. Archives of Orthopaedic and Trauma Surgery. 1999; 119(3-4):171-178

188 Fuchtmeier B, May R, Hente R, Maghsudi M, Volk M, Hammer J et al. Proximal humerus fractures: a comparative biomechanical analysis of intra and extramedullary implants. Archives of Orthopaedic and Trauma Surgery. 2007; 127(6):441-447

189 Funk L. A prospective trial to compare three anaesthetic techniques used for the reduction of fractures of the distal radius. Injury. 1997; 28(3):209-212

190 Furia JP, Alioto RJ, Marquardt JD. The efficacy and safety of the hematoma block for fracture reduction in closed, isolated fractures. Orthopedics. 1997; 20(5):423-426

191 Gabler C, Kukla C, Breitenseher MJ, Trattnig S, Vecsei V. Diagnosis of occult scaphoid fractures and other wrist injuries. Are repeated clinical examinations and plain radiographs still state of the art? Langenbeck's Archives of Surgery. 2001; 386(2):150-154

192 Gaebler C, Kukla C, Breitenseher M, Trattnig S, Mittlboeck M, Vecsei V. Magnetic resonance imaging of occult scaphoid fractures. Journal of Trauma. 1996; 41(1):73-76

193 Gaid M, Jeer P. Cost analysis of managing paediatric femoral shaft fractures: Flexible intramedullary nailing versus non-operative management. Acta Orthopaedica Belgica. 2006; 72(2):170-175

194 Geijer M. Diagnosis of scaphoid fracture: Optimal imaging techniques. Reports in Medical Imaging. 2013; 6(1):57-69

195 Ghimire A, Bhattarai B, Koirala S. Analgesia before performing subarachnoid block in the sitting position in patients with proximal femoral fracture: A comparison between fascia iliaca block and femoral nerve block. Anaesthesia and Intensive Care. 2012; 40(3):538

196 Gibbons CL, Woods DA, Pailthorpe C, Carr AJ, Worlock P. The management of isolated distal radius fractures in children. Journal of Pediatric Orthopaedics. 1994; 14(2):207-210

197 Goksel KA, GunaydIn R, Kaya T, KarlIbas U, Ozbek G. Validation of the Turkish version of the foot and ankle outcome score. Rheumatology International. 2009; 30(2):169-173

198 Gomberawalla MM, Miller BS, Coale RM, Bedi A, Gagnier JJ. Meta-analysis of joint preservation versus arthroplasty for the treatment of displaced 3- and 4-part fractures of the proximal humerus. Injury. 2013; 44(11):1532-1539

199 Gomez-Rice A, Villarrubia E, Bau A. Methodological issues of: should unstable extra-articular distal radial fractures be treated with fixed-angle volar-locked plates or percutaneous Kirschner wires? A prospective randomised controlled trial. Injury. 2012; 43(7):1219-1222

200 Good DW, Lui DF, Leonard M, Morris S, McElwain JP. Skype: a tool for functional assessment in orthopaedic research. Journal of Telemedicine and Telecare. 2012; 18(2):94-98

201 Gooding A, Coates M, Rothwell A. Cost analysis of traditional follow-up protocol versus MRI for radiographically occult scaphoid fractures: a pilot study for the Accident Compensation Corporation. New Zealand Medical Journal. 2004; 117(1201):1049

202 Gradl G, Wendt M, Mielsch N, Stedtfeld HW, Mittlmeier T. Intramedullary locked nailing for extraarticular fracturues of the distal radius. 2 years results of a aprospective randomized trial in comparison to palmar locked plating. Injury. 2011; 42:S4

203 Gradl G, Mielsch N, Wendt M, Falk S, Mittlmeier T, Gierer P et al. Intramedullary nail versus volar plate fixation of extra-articular distal radius fractures. Two year results of a prospective randomized trial. Injury. 2014; 45(Suppl.1):S3-S8

204 Graudins A, Meek R, Egerton-Warburton D, Seith R, Furness T, Chapman R. The PICHFORK (Pain InCHildren Fentanyl OR Ketamine) trial comparing the efficacy of intranasal ketamine and fentanyl in the relief of moderate to severe pain in children with limb injuries: study protocol for a randomized controlled trial. Trials. 2013; 14(1):208

205 Graudins A, Meek R, Egerton-Warburton D, Oakley E, Seith R. The PICHFORK (Pain in Children Fentanyl or Ketamine) Trial: A Randomized Controlled Trial Comparing Intranasal Ketamine and

Fentanyl for the Relief of Moderate to Severe Pain in Children With Limb Injuries. Annals of Emergency Medicine. 2015; 65(3):248-254

206 Gravier R, Flecher X, Parratte S, Rapaie P, Argenson JN. Trans-styloid and intrafocal pinning of pouteau-colles fractures: Advantage in terms of postoperative stability compared with simple intrafocal pinning. Journal of Bone and Joint Surgery - British Volume. 2005; 87-B(Suppl.II):130-13a

207 Gregory P, Sullivan JA, Herndon WA. Adolescent femoral shaft fractures: rigid versus flexible nails. Orthopedics. 1995; 18(7):645-649

208 Grewal R, MacDermid JC. The risk of adverse outcomes in extra-articular distal radius fractures is increased with malalignment in patients of all ages but mitigated in older patients. Journal of Hand Surgery - American Volume. 2007; 32(7):962-970

209 Groves AM, Cheow H, Balan K, Courtney H, Bearcroft P, Dixon A. 16-MDCT in the detection of occult wrist fractures: a comparison with skeletal scintigraphy. AJR American Journal of Roentgenology. 2005; 184(5):1470-1474

210 Gupta MN, Salaria AQ, Gupta R, Sharma S, Bala S, Basit MA. Treatment of fracture shaft of femur in children (a comparative study of operative versus conservative management). JK Practitioner. 2007; 14(1):28-30

211 Gwilym SE, Aslam N, Ribbans WJ, Holloway V. The impact of implementing the Ottawa ankle rules on ankle radiography requests in A&E. International Journal of Clinical Practice. 2003; 57(7):625-627

212 Haddad FS, Williams RL. Femoral nerve block in extracapsular femoral neck fractures. Journal of Bone and Joint Surgery British Volume. 1995; 77(6):922-923

213 Hahnloser D, Platz A, Amgwerd M, Trentz O. Internal fixation of distal radius fractures with dorsal dislocation: pi-plate or two 1/4 tube plates? A prospective randomized study. Journal of Trauma. 1999; 47(4):760-765

214 Hamdan A, Thompson M. Emergency analgesia administration in children: Retrospective analysis and recommendations. Archives of Disease in Childhood. 2012; 97:A458-A459

215 Hamilton TW, Hutchings L, Alsousou J, Tutton E, Hodson E, Smith CH et al. The treatment of stable paediatric forearm fractures using a cast that may be removed at home: Comparison with traditional management in a randomised controlled trial. Bone and Joint Journal. 2013; 95-B(12):1714-1720

216 Handoll Helen HG, Huntley JS, Madhok R. Different methods of external fixation for treating distal radial fractures in adults. Cochrane Database of Systematic Reviews. 2008; Issue 1:CD006522. DOI:10.1002/14651858.CD006522.pub2

217 Handoll Helen HG, Madhok R. Closed reduction methods for treating distal radial fractures in adults. Cochrane Database of Systematic Reviews. 2003; Issue 1:CD003763. DOI:10.1002/14651858.CD003763

218 Handoll Helen HG, Madhok R. Surgical interventions for treating distal radial fractures in adults. Cochrane Database of Systematic Reviews. 2009; Issue 3:CD003209. DOI:10.1002/14651858.CD003209.pub2

219 Handoll Helen HG, Madhok R, Dodds C. Anaesthesia for treating distal radial fracture in adults. Cochrane Database of Systematic Reviews. 2002; Issue 3:CD003320. DOI:10.1002/14651858.CD003320

220 Handoll Helen HG, Vaghela M, V, Madhok R. Percutaneous pinning for treating distal radial fractures in adults. Cochrane Database of Systematic Reviews. 2007; Issue 3:CD006080. DOI:10.1002/14651858.CD006080.pub2

221 Handoll Helen HG, Watts AC. Internal fixation and comparisons of different fixation methods for treating distal radial fractures in adults. Cochrane Database of Systematic Reviews. 2013; Issue 3:CD006951. DOI:10.1002/14651858.CD006951.pub2

222 Handoll H, Brealey S, Rangan A, Torgerson D, Dennis L, Armstrong A et al. Protocol for the ProFHER (PROximal Fracture of the Humerus: Evaluation by Randomisation) trial: a pragmatic multi-centre randomised controlled trial of surgical versus non-surgical treatment for proximal fracture of the humerus in adults. BMC Musculoskeletal Disorders. 2009; 10:140

223 Hansen MS, Mathiesen O, Trautner S, Dahl JB. Intranasal fentanyl in the treatment of acute pain--a systematic review. Acta Anaesthesiologica Scandinavica. 2012; 56(4):407-419

224 Hansen TB, Petersen RB, Barckman J, Uhre P, Larsen K. Cost-effectiveness of MRI in managing suspected scaphoid fractures. Journal of Hand Surgery - European Volume. 2009; 34(5):627-630

225 Heath FR, Blum F, Rockwell S. Physical examination as a screening test for pelvic fractures in blunt trauma patients. West Virginia Medical Journal. 1997; 93(5):267-269

226 Hedin H, Borgquist L, Larsson S. A cost analysis of three methods of treating femoral shaft fractures in children. A comparison of traction in hospital, traction in hospital/home and external fixation. Acta Orthopaedica Scandinavica. 2004; 75(3):241-248

227 Hedstrom M, Ahl T, Dalen N. Early postoperative ankle exercise. A study of postoperative lateral malleolar fractures. Clinical Orthopaedics and Related Research. 1994;(300):193-196

228 Heffernan MJ, Gordon JE, Sabatini CS, Keeler KA, Lehmann CL, O'Donnell JC et al. Treatment of femur fractures in young children: a multicenter comparison of flexible intramedullary nails to spica casting in young children aged 2 to 6 years. Journal of Pediatric Orthopedics. 2015; 35(2):126-129

229 Henderson D, Gray WK, Booth L. Assessment of a reporting radiographer-led discharge system for minor injuries: a prospective audit over 2 years. Emergency Medicine Journal. 2013; 30(4):298-302

230 Henry MH. Distal radius fractures: current concepts. Journal of Hand Surgery - American Volume. 2008; 33(7):1215-1227

231 Heyworth J. Ottawa ankle rules for the injured ankle. British Journal of Sports Medicine. 2003; 37(3):194

232 Hiscox C, Lamothe C, White N, Bromley M, Oddone Paolucci E, Hildebrand K. Diagnosis of occult scaphoid fractures: a randomized, controlled trial comparing bone scans to radiographs for diagnosis. Canadian Journal of Emergency Medical Care. 2013; 15(0):1-8

233 Hoellen IP, Bauer G, Holbein O. Primary endoprosthesis in comminuted fractures of the proximal - Humerus an alternative treatment for elderly patients?. <original> Der prothetische

humeruskopfersatz bei der dislozierten humerusmehrfragmentfraktur des alten menschen - eine alternative zur minimalosteosynthese? Zentralblatt Fur Chirurgie. 1997; 122(11):994-1001

234 Hoellen IP, Holbein O, Bauer G. Prothetic humerus head replacement in dislocated humerus head multiple fracture in older people: An alternative to minimla osteosynthesis? Hefte Zur Der Unfallchirurg. 1997; 268:49-51

235 Holbein O, Bauer G, Hoellen I, Keppler P, Hehl G, Kinzl L. Is primary endoprosthetic replacement of the humeral head an alternative treatment for comminuted fractures of the proximal humerus in elderly patients? Osteosynthese International. 1999; 7(Suppl.2)

236 Hollingworth A, Wallace WA, Dabir R, Ellis SJ, Smith AF. Comparison of bupivacaine and prilocaine used in Bier block--a double blind trial. Injury. 1982; 13(4):331-336

237 Honigmann P, Goldhahn S, Rosenkranz J, Audige L, Geissmann D, Babst R. Aftertreatment of malleolar fractures following ORIF -- functional compared to protected functional in a vacuum-stabilized orthesis: a randomized controlled trial. Archives of Orthopaedic and Trauma Surgery. 2007; 127(3):195-203

238 Hoogewijs J, Diltoer MW, Hubloue I, Spapen HD, Camu F, Corne L et al. A prospective, open, single blind, randomized study comparing four analgesics in the treatment of peripheral injury in the emergency department. European Journal of Emergency Medicine. 2000; 7(2):119-123

239 Hopkins M. A comparative analysis of ENP's and SHO's in the application of the Ottawa ankle rules. International Emergency Nursing. 2010; 18(4):188-195

240 Horne G. A prospective randomized trial of external fixation and plaster cast immobilization in the treatment of distal radius fractures. Journal of Orthopaedic Trauma. 1991; 5(2):246

241 Hossain M. Re: a randomised comparison of locking and non-locking palmar plating for unstable Colles' fractures in the elderly, Koshimune et al., Journal of Hand Surgery, 2005, 30B: 499-503. Journal of Hand Surgery - British Volume. 2006; 31(2):244

242 Hove LM, Krukhaug Y, Revheim K, Helland P, Finsen V. Dynamic compared with static external fixation of unstable fractures of the distal part of the radius: a prospective, randomized multicenter study. Journal of Bone and Joint Surgery - American Volume. 2010; 92(8):1687-1696

243 Howes MC, Cutting P, Thomas M. Splinting of buckle fractures of the distal radius in children. Emergency Medicine Journal. 2008; 25(4):222-223

244 Hull JB, Bell MJ. Modern trends for external fixation of fractures in children: a critical review. Journal of Pediatric Orthopaedics B. 1997; 6(2):103-109

245 Hulsker CC, Kleinveld S, Zonnenberg CB, Hogervorst M, Bekerom MP. Evidence-based treatment of open ankle fractures. Archives of Orthopaedic and Trauma Surgery. 2011;(3):1545-1553

246 Hutchinson DT, Bachus KN, Higgenbotham T. External fixation of the distal radius: to predrill or not to predrill. Journal of Hand Surgery - American Volume. 2000; 25(6):1064-1068

247 Iamaroon A, Raksakietisak M, Halilamien P, Hongsawad J, Boonsararuxsapong K. Femoral nerve block versus fentanyl: Analgesia for positioning patients with fractured femur. Local and Regional Anesthesia. 2010; 3:21-26

248 Ilchmann T, Ochsner PE, Wingstrand H, Jonsson K. Non-operative treatment versus tension-band osteosynthesis in three- and four-part proximal humeral fractures. A retrospective study of 34 fractures from two different trauma centers. International Orthopaedics. 1998; 22(5):316-320

249 Ilica AT, Ozyurek S, Kose O, Durusu M. Diagnostic accuracy of multidetector computed tomography for patients with suspected scaphoid fractures and negative radiographic examinations. Japanese Journal of Radiology. 2011; 29(2):98-103

250 Indelicato PA. Efficacy of diflunisal versus acetaminophen with codeine in controlling mild to moderate pain after arthroscopy. Clinical Therapeutics. 1986; 8(2):164-169

251 Jadon A, Kedia SK, Dixit S, Chakraborty S. Comparative evaluation of femoral nerve block and intravenous fentanyl for positioning during spinal anaesthesia in surgery of femur fracture. Indian Journal of Anaesthesia. 2014; 58(6):705-708

252 Jakubietz MG, Gruenert JG, Jakubietz RG. Palmar and dorsal fixed-angle plates in AO C-type fractures of the distal radius: is there an advantage of palmar plates in the long term? Journal of Orthopaedic Surgery and Research. 2012; 7(1):8

253 Jakubietz RG, Gruenert JG, Kloss DF, Schindele S, Jakubietz MG. A randomised clinical study comparing palmar and dorsal fixed-angle plates for the internal fixation of AO C-Type fractures of the distal radius in the elderly. Journal of Hand Surgery - European Volume. 2008; 33(5):600-604

254 Jarvis J, Davidson D, Letts M. Management of subtrochanteric fractures in skeletally immature adolescents. Journal of Trauma. 2006; 60(3):613-619

255 Jayaram PR, Bhattacharyya R, Jenkins PJ, Anthony I, Rymaszewski LA. A new "virtual" patient pathway for the management of radial head and neck fractures. Journal of Shoulder and Elbow Surgery. 2014; 23(3):297-301

256 Jencikova-Celerin L, Phillips JH, Werk LN, Wiltrout SA, Nathanson I. Flexible interlocked nailing of pediatric femoral fractures: Experience with a new flexible interlocking intramedullary nail compared with other fixation procedures. Journal of Pediatric Orthopaedics. 2008; 28(8):864-873

257 Jenkins NH, Jones DG, Mintowt-Czyz WJ. The role of external fixation in treating the Colles' fracture. Journal of Bone and Joint Surgery - British Volume. 1989; 71(2):340

258 Jenkins PJ, Slade K, Huntley JS, Robinson CM. A comparative analysis of the accuracy, diagnostic uncertainty and cost of imaging modalities in suspected scaphoid fractures. Injury. 2008; 39(7):768-774

259 Johnson PQ, Noffsinger MA. Hematoma block of distal forearm fractures. Is it safe? Orthopaedic Review. 1991; 20(11):977-979

260 Jones NC, Pugh SC. The addition of tenoxicam to prilocaine for intravenous regional anaesthesia. Anaesthesia. 1996; 51(5):446-448

261 Jorgsholm P, Thomsen NOB, Besjakov J, Abrahamsson SO, Bjorkman A. The benefit of magnetic resonance imaging for patients with posttraumatic radial wrist tenderness. Journal of Hand Surgery - American Volume. 2013; 38(1):29-33

262 Kaiser SP, Holland T, Baidoo PK, Coughlin RC, Konadu P, Awariyah D et al. An observational cohort study of the adoption of elastic stable intramedullary nailing for the treatment of pediatric femur fractures in Kumasi, Ghana. World Journal of Surgery. 2014; 38(11):2818-2824

263 Karpas A, Hennes H, Walsh-Kelly CM. Utilization of the Ottawa ankle rules by nurses in a pediatric emergency department. Academic Emergency Medicine. 2002; 9(2):130-133

264 Kasapinova K, Kamiloski V. Open reduction and internal fixation versus external fixation and/or Kirschner wires for distal radius fractures. A systematic review. Database of Abstracts of Reviews of Effects. 2014;(1):225-237

265 Kaufman AM, Pensy RA, O'Toole RV, Andrew EW. Safety of immediate open reduction and internal fixation of geriatric open fractures of the distal radius. Injury. 2014; 45(3):534-539

266 Kec RM, Richman PB, Szucs PA, Mandell M, Eskin B. Can emergency department triage nurses appropriately utilize the Ottawa Knee Rules to order radiographs? - An implementation trial. Academic Emergency Medicine. 2003; 10(2):146-150

267 Kendall JM, Reeves BC, Latter VS, Nasal Diamorphine Trial Group. Multicentre randomised controlled trial of nasal diamorphine for analgesia in children and teenagers with clinical fractures. BMJ. 2001; 322(7281):261-265

268 Kennedy SA, Slobogean GP, Mulpuri K. Does degree of immobilization influence refracture rate in the forearm buckle fracture? Journal of Pediatric Orthopaedics B. 2010; 19(1):77-81

269 Keogh SP, Shafi A, Wijetunge DB. Comparison of Ottawa ankle rules and current local guidelines for use of radiography in acute ankle injuries. Journal of the Royal College of Surgeons of Edinburgh. 1998; 43(5):341-343

270 Kerr LKAM, Richards D, Kerr L, Grant J, O'Donovan P, Basire K et al. Failed validation of a clinical decision rule for the use of radiography in acute ankle injury. New Zealand Medical Journal. 1994; 107(982):294-295

271 Kidd S, Brennan S, Stephen R, Minns R, Beattie T. Comparison of morphine concentration-time profiles following intravenous and intranasal diamorphine in children. Archives of Disease in Childhood. 2009; 94(12):974-978

272 Kim JW, Oh CW, Jung WJ, Kim JS. Minimally invasive plate osteosynthesis for open fractures of the proximal tibia. Clinics in Orthopedic Surgery. 2012; 4(4):313-320

273 Kimmel LA, Edwards ER, Liew SM, Oldmeadow LB, Webb MJ, Holland AE. Rest easy? Is bed rest really necessary after surgical repair of an ankle fracture? Injury. 2012; 43(6):766-771

274 Kind P, Hardman G, and Macran S. UK population norms for EQ-5D. York. Centre for Health Economics, 1999. Available from: http://www.york.ac.uk/che/pdf/DP172.pdf

275 Kitsis C, Taylor M, Chandey J, Smith R, Latham J, Turner S et al. Imaging the problem scaphoid. Injury. 1998; 29(7):515-520

276 Klassen TP, Ropp LJ, Sutcliffe T, Blouin R, Dulberg C, Raman S et al. A randomized, controlled trial of radiograph ordering for extremity trauma in a pediatric emergency department. Annals of Emergency Medicine. 1993; 22(10):1524-1529

277 Kodama N, Takemura Y, Ueba H, Imai S, Matsusue Y. Ultrasound-assisted closed reduction of distal radius fractures. Journal of Hand Surgery - American Volume. 2014; 39(7):1287-1294

278 Kongsholm J, Buring K, Lindh C, Duarte-Martins H. A prospective study on the treatment of Colles' fracture. Acta Orthopaedica Scandinavica. 1981; 52:693

279 Kontakis G, Koutras C, Tosounidis T, Giannoudis P. Early management of proximal humeral fractures with hemiarthroplasty: a systematic review. Journal of Bone and Joint Surgery - British Volume. 2008; 90-B(11):1407-1413

280 Kopylov P, Aspenberg P, Yuan X, Ryd L. Radiostereometric analysis of distal radial fracture displacement during treatment: a randomized study comparing Norian SRS and external fixation in 23 patients. Acta Orthopaedica Scandinavica. 2001; 72(1):57-61

281 Kopylov P, Runnqvist K, Jonsson K, Aspenberg P. Norian SRS versus external fixation in redisplaced distal radial fractures. A randomized study in 40 patients. Acta Orthopaedica Scandinavica. 1999; 70(1):1-5

282 Koshimune M, Kamano M, Takamatsu K, Ohashi H. A randomized comparison of locking and non-locking palmar plating for unstable Colles' fractures in the elderly. Journal of Hand Surgery - British Volume. 2005; 30(5):499-503

283 Krannitz KW, Fallat LM, Schwartz SM. Radiographic healing of conservative versus operative management of supination-external rotation II fractures in a smoking and premature weight-bearing population. Journal of Foot and Ankle Surgery. 2007; 46(4):218-222

284 Kreder HJ, Hanel DP, Agel J, McKee M, Schemitsch EH, Trumble TE et al. Indirect reduction and percutaneous fixation versus open reduction and internal fixation for displaced intra-articular fractures of the distal radius. Journal of Bone and Joint Surgery - British Volume. 2005; 87(6):829-836

285 Krishnan J, Wigg AER, Walker RW, Slavotinek J. Intra-articular fractures of the distal radius: A prospective randomised controlled trial comparing static bridging and dynamic non-bridging external fixation. Journal of Hand Surgery - British Volume. 2003; 28 B(5):417-421

286 Kristiansen B, Kofoed H. Transcutaneous reduction and external fixation of displaced fractures of the proximal humerus. A controlled clinical trial. Journal of Bone and Joint Surgery - British Volume. 1988; 70(5):821-824

287 Krukhaug Y, Ugland S, Lie SA, Hove LM. External fixation of fractures of the distal radius: a randomized comparison of the Hoffman compact II non-bridging fixator and the Dynawrist fixator in 75 patients followed for 1 year. Acta Orthopaedica. 2009; 80(1):104-108

288 Kubiak EN, Beebe MJ, North K, Hitchcock R, Potter MQ. Early weight bearing after lower extremity fractures in adults. Journal of the American Academy of Orthopaedic Surgeons. 2013; 21(12):727-738

289 Kulshrestha V, Roy T, Audige L. Dynamic vs static external fixation of distal radial fractures: A randomized study. Indian Journal of Orthopaedics. 2011; 45(6):527-534

290 Kumar S, Anand T, Singh S. Comparative Study Using Intramedullary K-wire Fixation Over Titanium Elastic Nail in Paediatric Shaft Femur Fractures. Journal of Clinical and Diagnostic Research. 2014; 8(11):LC08-LC10

291 Kumar S, O'Connor A, Despois M, Galloway H. Use of early magnetic resonance imaging in the diagnosis of occult scaphoid fractures: the CAST Study (Canberra Area Scaphoid Trial). New Zealand Medical Journal. 2005; 118(1209):U1296

292 Kumbaraci M, Kucuk L, Karapinar L, Kurt C, Coskunol E. Retrospective comparison of external fixation versus volar locking plate in the treatment of unstable intra-articular distal radius fractures. European Journal of Orthopaedic Surgery and Traumatology. 2014; 24(2):173-178

293 Kusunoki M. Treatment of scaphoid fractures with carpal instability. Osaka City Medical Journal. 1992; 38(2):89-109

294 Lacey PH, Dodd GD, Shannon DJ. A double blind, placebo controlled study of piroxicam in the management of acute musculoskeletal disorders. European Journal of Rheumatology and Inflammation. 1984; 7(3):95-104

295 Laflamme GY, Rouleau DM, Berry GK, Beaumont PH, Reindl R, Harvey EJ. Percutaneous humeral plating of fractures of the proximal humerus: results of a prospective multicenter clinical trial. Journal of Orthopaedic Trauma. 2008; 22(3):153-158

296 Laino DK, Tejwani N. Indications for operative fixation of distal radius fractures: a review of the evidence. Bulletin of the NYU Hospital for Joint Diseases. 2012; 70(1):35-40

297 Lamb L, Kashani P, Ryan J, Hebert G, Sheikh A, Thornhill R et al. Impact of an in-house emergency radiologist on report turnaround time. CJEM. 2014; 16(0):1-6

298 Lambrecht CJ, Canham WD, Gattey PH, McKenzie GM. Telemedicine and orthopaedic care. A review of 2 years of experience. Clinical Orthopaedics and Related Research. 1998;(348):228-232

299 Lau LH, Kerr D, Law I, Ritchie P. Nurse practitioners treating ankle and foot injuries using the Ottawa Ankle Rules: a comparative study in the emergency department. Australasian Emergency Nursing Journal. 2013; 16(3):110-115

300 Launonen AP, Lepola V, Flinkkila T, Strandberg N, Ojanpera J, Rissanen P et al. Conservative treatment, plate fixation, or prosthesis for proximal humeral fracture. A prospective randomized study. BMC Musculoskeletal Disorders. 2012; 13:167

301 Le May S, Gouin S, Fortin C, Messier A, Robert MA, Julien M. Efficacy of an ibuprofen/codeine combination for pain management in children presenting to the emergency department with a limb injury: a pilot study. Journal of Emergency Medicine. 2013; 44(2):536-542

302 Leddy JJ, Smolinski RJ, Lawrence J, Snyder JL, Priore RL. Prospective evaluation of the Ottawa Ankle Rules in a university sports medicine center. With a modification to increase specificity for identifying malleolar fractures. American Journal of Sports Medicine. 1998; 26(2):158-165

303 Leddy JJ, Kesari A, Smolinski RJ. Implementation of the Ottawa ankle rule in a university sports medicine center. Medicine and Science in Sports and Exercise. 2002; 34(1):57-62

304 Lee DH, Lee KB, Jung ST, Seon JK, Kim MS, Sung IH. Comparison of early versus delayed weightbearing outcomes after microfracture for small to midsized osteochondral lesions of the talus. American Journal of Sports Medicine. 2012; 40(9):2023-2028

305 Lee YH, Lim KB, Gao GX, Mahadev A, Lam KS, Tan SB et al. Traction and spica casting for closed femoral shaft fractures in children. Journal of Orthopaedic Surgery. 2007; 15(1):37-40

306 Lefevre Y, Laville JM, Boullet F, Salmeron F. Early correction of paediatric malunited distal metaphyseal radius fractures using percutaneous callus osteoclasis ("Calloclasis"). Orthopaedics and Traumatology, Surgery and Research. 2012; 98(4):450-454

307 Lefevre-Colau MM, Babinet A, Fayad F, Fermanian J, Anract P, Roren A et al. Immediate mobilization compared with conventional immobilization for the impacted nonoperatively treated proximal humeral fracture. A randomized controlled trial. Journal of Bone and Joint Surgery - American Volume. 2007; 89(12):2582-2590

308 Lehtonen H, Jarvinen TLN, Honkonen S, Nyman M, Vihtonen K, Jarvinen M. Use of a cast compared with a functional ankle brace after operative treatment of an ankle fracture. A prospective, randomized study. Journal of Bone and Joint Surgery - American Volume. 2003; 85-A(2):205-211

309 Leisey J. Prospective validation of the Ottawa Ankle Rules in a deployed military population. Military Medicine. 2004; 169(10):804-806

310 Leman P, Kapadia Y, Herington J. Randomised controlled trial of the onset of analgesic efficacy of dexketoprofen and diclofenac in lower limb injury. Emergency Medicine Journal. 2003; 20(6):511-513

311 LeMay S, Gouin S, Fortin C, Messier A, Robert M, Morin N. Combination of analgesics for pain management of children presenting to the ED with a limb trauma. Journal of Pain. 2010; 11(4 Suppl.1):S35

312 Li J, He C, Li D, Zheng W, Liu D, Xu W. Early failure of the durom prosthesis in metal-on-metal hip resurfacing in chinese patients. Journal of Arthroplasty. 2013; 28(10):1816-1821

313 Li Y-Z, Wu H, Min H, Cao H-P. Different plates for unstable fractures of distal radius. Journal of Clinical Rehabilitative Tissue Engineering Research. 2010; 14(43):8032-8035

314 Li Y, Wang C, Wang M, Huang L, Huang Q. Postoperative malrotation of humeral shaft fracture after plating compared with intramedullary nailing. Journal of Shoulder and Elbow Surgery. 2011; 20(6):947-954

315 Li Y, Ning G, Wu Q, Wu Q, Li Y, Feng S. Review of literature of radial nerve injuries associated with humeral fractures-an integrated management strategy. PloS One. 2013; 8(11):e78576

316 Li-hai Z, Ya-nan W, Zhi M, Li-cheng Z, Hong-da L, Huan Y et al. Volar locking plate versus external fixation for the treatment of unstable distal radial fractures: a meta-analysis of randomized controlled trials. Journal of Surgical Research. 2015; 193(1):324-333

317 Libetta C, Burke D, Brennan P, Yassa J. Validation of the Ottawa ankle rules in children. Journal of Accident and Emergency Medicine. 1999; 16(5):342-344

318 Liles R, Frierson JN, Wolf CL, Frnka T. Reduction of Colles' fracture by weight traction under local anesthesia. Southern Medical Journal. 1969; 62(1):45-48

319 Lill H, Katthagen C, Hertel A, Gille J, Voigt C. All-arthroscopic intramedullary nailing of 2- and 3-part proximal humeral fractures: A new arthroscopic technique and preliminary results. Archives of Orthopaedic and Trauma Surgery. 2012; 132(5):641-647

320 Lin CWC, Donkers NAJ, Refshauge KM, Beckenkamp PR, Khera K, Moseley AM. Rehabilitation for ankle fractures in adults. Cochrane Database of Systematic Reviews. 2012; Issue 11:CD005595

321 Liu Zz, Zhang Gm, Ge T. Use of a proximal humeral internal locking system enhanced by injectable graft for minimally invasive treatment of osteoporotic proximal humeral fractures in elderly patients. Orthopaedic Surgery. 2011; 3(4):253-258

322 London NJ, Osman FA, Ramagopal K, Journeaux SF. Hyaluronidase (Hyalase): a useful addition in haematoma block? Journal of Accident and Emergency Medicine. 1996; 13(5):337-338

323 Lopiz Y, Garcia-Coiradas J, Garcia-Fernandez C, Marco F. Proximal humerus nailing: a randomized clinical trial between curvilinear and straight nails. Journal of Shoulder and Elbow Surgery. 2014; 23(3):369-376

324 Low G, Raby N. Can follow-up radiography for acute scaphoid fracture still be considered a valid investigation? Clinical Radiology. 2005; 60(10):1106-1110

325 Lozano-Calderon S, Blazar P, Zurakowski D, Lee SG, Ring D. Diagnosis of scaphoid fracture displacement with radiography and computed tomography. Journal of Bone and Joint Surgery - American Volume. 2006; 88(12):2695-2703

326 Lozman J, Deno DC, Feustel PJ, Newell JC, Stratton HH, Sedransk N et al. Pulmonary and cardiovascular consequences of immediate fixation or conservative management of long-bone fractures. Archives of Surgery. 1986; 121(9):992-999

327 Lucchesi GM, Jackson RE, Peacock WF, Cerasani C, Swor RA. Sensitivity of the Ottawa rules. Annals of Emergency Medicine. 1995; 26(1):1-5

328 Ludvigsen TC, Johansen S, Svenningsen S. [Unstable fractures of the distal radius. External fixation or percutaneous pinning?]. Tidsskrift for Den Norske Lægeforening. 1996; 116(26):3093-3097

329 MacDermid JC, Turgeon T, Richards RS, Beadle M, Roth JH. Patient rating of wrist pain and disability: a reliable and valid measurement tool. Journal of Orthopaedic Trauma. 1998; 12(8):577-586

330 Magan A, Golano P, Maffulli N, Khanduja V. Evaluation and management of injuries of the tibiofibular syndesmosis. British Medical Bulletin. 2014; 111(1):101-115

331 Majeed MA, Yeo D. Fascia iliaca block, for fractured femur, in Emergency Departments. African Journal of Emergency Medicine. 2013; 3(4 SUPPL. 1):S12

332 Majidi A, Dinpanah H, Ashoori S, Motamed H, Tabatabaey A. Comparison of morphine-midazolam versus morphine injection for pain relief in patients with limb fractures - a clinical trial. Ulusal Travma Ve Acil Cerrahi Dergisi. 2015; 21(1):22-26

333 Malkin B. Auditing a nurse led fracture referral service. Emergency Nurse. 2003; 11(4):22-23

334 Mallee W, Doornberg JN, Ring D, van Dijk CN, Maas M, Goslings JC. Comparison of CT and MRI for diagnosis of suspected scaphoid fractures. Journal of Bone and Joint Surgery - American Volume. 2011; 93(1):20-28

335 Mallee WH, Doornberg JN, Poolman RW, Kloen P, Maas M, de Vet Henrica CW. Computed tomography versus magnetic resonance imaging versus bone scintigraphy for clinically suspected scaphoid fractures in patients with negative plain radiographs. Cochrane Database of Systematic Reviews. 2012; Issue 8:CD010023. DOI:10.1002/14651858.CD010023

336 Man SY, Woo WK, Lam PKW, Rainer TH. Feasibility study comparing oral paracetamol and oral non-steroidal anti-inflammatory drugs for treating pain after musculoskeletal injury: A randomized, double blind, controlled trial. Hong Kong Journal of Emergency Medicine. 2004; 11(2):78-84

337 Mann CJ, Grant I, Guly H, Hughes P. Use of the Ottawa ankle rules by nurse practitioners. Journal of Accident and Emergency Medicine. 1998; 15(5):315-316

338 Mao Z, Zhang L, Zhang L, Zeng X, Chen S, Liu D et al. Operative versus nonoperative treatment in complex proximal humeral fractures. Orthopedics. 2014; 37(5):e410-e419

339 Margaliot Z, Haase SC, Kotsis SV, Kim HM, Chung KC. A meta-analysis of outcomes of external fixation versus plate osteosynthesis for unstable distal radius fractures. Journal of Hand Surgery - American Volume. 2005; 30(6):1185-1199

340 Marinelli M, Cecconi S, Busilacchi A, De PL. Validation of the Ottawa ankle rules in a second level trauma center. Journal of Orthopaedics and Traumatology. 2011; 12:S36

341 Marinelli M, Di GA, Mancini M. Validation of the Ottawa ankle rules in a second-level trauma center in Italy. Journal of Orthopaedics and Traumatology. 2007; 8(1):16-20

342 Markert RJ, Walley ME, Guttman TG, Mehta R. A pooled analysis of the Ottawa ankle rules used on adults in the ED. American Journal of Emergency Medicine. 1998; 16(6):564-567

343 Martetschlager F, Siebenlist S, Weier M, Sandmann G, Ahrens P, Braun K et al. Plating of proximal humeral fractures. Orthopedics. 2012; 35(11):e1606-e1612

344 Mason LW, Dodds A. A prospective study comparing attempted weight bearing in fiberglass below-knee casts and prefabricated pneumatic braces. Foot and Ankle Specialist. 2010; 3(2):64-66

345 Matteucci MJ, Roos JA. Ottawa Knee Rule: a comparison of physician and triage-nurse utilization of a decision rule for knee injury radiography. Journal of Emergency Medicine. 2003; 24(2):147-150

346 McBride KL. Validation of the Ottawa ankle rules. Experience at a community hospital. Canadian Family Physician Medecin De Famille Canadien. 1997; 43:459-465

347 McCann PA. Should unstable extra-articular distal radial fractures be treated with fixed angle volar locked plates or percutaneous Kirschner wires? A prospective randomised controlled trial. Injury. 2012; 43(7):1222

348 McIlwain HH, Platt RD. Piroxicam versus naproxen in the treatment of acute musculoskeletal disorders in athletes. American Journal of Medicine. 1988; 84(5A):56-60

349 McLaren AC, Roth JH, Wright C. Intramedullary rod fixation of femoral shaft fractures: comparison of open and closed insertion techniques. Canadian Journal of Surgery. 1990; 33(4):286-290

350 McMillan J, James P, Kumar S, Kinninmonth AWG. Delayed primary manipulation of Colles' fractures - a prospective. Injury. 1996; 27(5):376

351 McQueen MM. Redisplaced unstable fractures of the distal radius. A randomised, prospective study of bridging versus non-bridging external fixation. Journal of Bone and Joint Surgery - British Volume. 1998; 80(4):665-669

352 Mehdinasab SA, Nejad SAM, Sarrafan N. Short term outcome of treatment of femoral shaft fractures in children by two methods: Traction plus casting, versus intramedullary pin fixation â?" a comparative study. Pakistan Journal of Medical Sciences. 2008; 24(1):147-151

353 Meier R, Krettek C, Probst C. Treatment of distal radius fractures. Percutaneous Kirschner-wires or palmar locking plates? Unfallchirurg. 2012;(4):598-605

354 Melnychuck D, MacDonald C, McLeod SL. Pain management of ankle fractures in the emergency department. Canadian Journal of Emergency Medicine. 2012; 14:S52

355 Memarsadeghi M, Breitenseher MJ, Schaefer-Prokop C, Weber M, Aldrian S, Gabler C et al. Occult scaphoid fractures: comparison of multidetector CT and MR imaging--initial experience. Radiology. 2006; 240(1):169-176

356 Migita RT, Klein EJ, Garrison MM. Sedation and analgesia for pediatric fracture reduction in the emergency department: a systematic review. Archives of Pediatrics and Adolescent Medicine. 2006; 160(1):46-51

357 Mikkelsen SS, Lindblad BE. The value of late remanipulation and nonrigid fixation of redislocated Colles' fracture: a retrospective study. Contemporary Orthopaedics. 1991; 23(6):588-593

358 Miller AG, Margules A, Raikin SM. Risk factors for wound complications after ankle fracture surgery. Journal of Bone and Joint Surgery - American Volume. 2012; 94(22):2047-2052

359 Milne L. Ottawa ankle decision rules. Western Journal of Medicine. 1996; 164(1):67

360 Milutinovic SM, Andjelkovic SZ, Palibrk TD, Zagorac SG, Bumbasirevic MZ. Distal radius fractures--systematic review. Acta Chirurgica Iugoslavica. 2013; 60(2):29-32

361 Mittal R, Vermani E. Femoral nerve blocks in fractures of femur: variation in the current UK practice and a review of the literature. Emergency Medicine Journal. 2014; 31(2):143-147

362 Modi CS, Ho K, Smith CD, Boer R, Turner SM. Dynamic and static external fixation for distal radius fractures--a systematic review. Injury. 2010; 41(10):1006-1011

363 Moller JM, Larsen L, Bovin J, Lausten GS, Hasselqvist M, Jensen CM et al. MRI diagnosis of fracture of the scaphoid bone: impact of a new practice where the images are read by radiographers. Academic Radiology. 2004; 11(7):724-728

364 Montazeri R, Atkinson PR, Fraser J, Benjamin S, Wagg J, Mayich J et al. Distal radial fractures: adequacy of reductions performed in the emergency department. Canadian Journal of Emergency Medicine. 2014; 16:S99

365 Moore BR, Hampers LC, Clark KD. Performance of a decision rule for radiographs of pediatric knee injuries. Journal of Emergency Medicine. 2005; 28(3):257-261

366 Morris N, Lovell ME. Demographics of 3929 ankle injuries, seasonal variation in diagnosis and more fractures are diagnosed in winter. Injury. 2013; 44(7):998-1001

367 Mosaffa F, Razavi S. A comparison between fascia iliaca block and IV fentanyl for analgesia before spinal block in the lateral decubitus position in femoral neck fractures. Pain Practice. 2009; 9:148

368 Moustafa F, Roux D, Macian N, Schmidt J, Dublanchet N, Dubray C et al. A new pharmaceutical form of paracetamol: Efficacy of transmucous buccal paracetamol in acute pain patients. Fundamental and Clinical Pharmacology. 2014; 28:57

369 Munk B, Frokjaer J, Larsen CF, Johannsen HG, Rasmussen LL, Edal A et al. Diagnosis of scaphoid fractures. A prospective multicenter study of 1,052 patients with 160 fractures. Acta Orthopaedica Scandinavica. 1995; 66(4):359-360

370 Murray J, Gross L. Treatment of distal radius fractures. Journal of the American Academy of Orthopaedic Surgeons. 2013; 21(8):502-505

371 Murray O, Christen K, Marsh A, Bayer J. Fracture clinic redesign: improving standards in patient care and interprofessional education. Swiss Medical Weekly. 2012; 142:w13630

372 Murthy NS. The role of magnetic resonance imaging in scaphoid fractures. Journal of Hand Surgery - American Volume. 2013; 38(10):2047-2054

373 Mutty CE, Jensen EJ, Manka MAJ, Anders MJ, Bone LB. Femoral nerve block for diaphyseal and distal femoral fractures in the emergency department. Journal of Bone and Joint Surgery American Volume. 2007; 89(12):2599-2603

374 Mutty CE, Jensen EJ, Manka MAJ, Anders MJ, Bone LB. Femoral nerve block for diaphyseal and distal femoral fractures in the emergency department. Surgical technique. Journal of Bone and Joint Surgery American Volume. 2008; 90 Suppl 2 Pt 2:218-226

375 Myderrizi N, Mema B. The hematoma block an effective alternative for fracture reduction in distal radius fractures. Medicinski Arhiv. 2011; 65(4):239-242

376 Myers A, Canty K, Nelson T. Are the Ottawa ankle rules helpful in ruling out the need for x ray examination in children? Archives of Disease in Childhood. 2005; 90(12):1309-1311

377 Nagpal K, Marathe M. Are Ottawa knee rules useful in actual trauma care? Central European Journal of Medicine. 2007; 2(2):216-221

378 Namdari S, Horneff JG, Baldwin K. Comparison of hemiarthroplasty and reverse arthroplasty for treatment of proximal humeral fractures: a systematic review. Journal of Bone and Joint Surgery - American Volume. 2013; 95(18):1701-1708

379 Nann AM, Pappasaras S, Rangan A, Checketts RG. Plaster cast vs the Pennig dynamic fixator for Colles' fracture - a prospective randomised trial. Journal of Bone and Joint Surgery - British Volume. 1994; 76(Suppl.2):149

380 Nascimento FP, Santili C, Akkari M, Waisberg G, Braga SR, Fucs PMMB. Flexible intramedullary nails with traction versus plaster cast for treating femoral shaft fractures in children: Comparative retrospective study. Sao Paulo Medical Journal. 2013; 131(1):5-12

381 National Institute for Health and Clinical Excellence. Social value judgements: principles for the development of NICE guidance. 2nd edition. London: National Institute for Health and Clinical Excellence; 2008. Available from: http://www.nice.org.uk/media/C18/30/SVJ2PUBLICATION2008.pdf

382 Nazar MA, Mansingh R, Bassi RS, Waseem M. Is there a Consensus in the Management of Distal Radial Fractures? Open Orthopaedics Journal. 2009; 3:96-99

383 Neal E. Comparison of splinting and casting in the management of torus fracture. Emergency Nurse. 2014; 21(9):22-26

384 Negahban H, Mazaheri M, Salavati M, Sohani SM, Askari M, Fanian H et al. Reliability and validity of the foot and ankle outcome score: a validation study from Iran. Clinical Rheumatology. 2010; 29(5):479-486

385 Neumann K, Clarius M, Gutsfeld P. [External fixator or bone pin osteosyntheses in unstable distal intra-articular radius fractures in elderly patients]. Langenbecks Archiv Für Chirurgie Supplement Kongressband Deutsche Gesellschaft Für Chirurgie Kongress. 1996; 113:912-913

386 Newman B, McCarthy L, Thomas PW, May P, Layzell M, Horn K. A comparison of pre-operative nerve stimulator-guided femoral nerve block and fascia iliaca compartment block in patients with a femoral neck fracture. Anaesthesia. 2013; 68(9):899-903

387 Nguyen Q, Chaudhry S, Sloan R, Bhoora I, Willard C. The clinical scaphoid fracture: early computed tomography as a practical approach. Annals of the Royal College of Surgeons of England. 2008; 90(6):488-491

388 Nichol G, Stiell IG, Wells GA, Juergensen LS, Laupacis A. An economic analysis of the Ottawa knee rule. Annals of Emergency Medicine. 1999; 34(4 Pt 1):438-447

389 Nork SE, Hoffinger SA. Skeletal traction versus external fixation for pediatric femoral shaft fractures: a comparison of hospital costs and charges. Journal of Orthopaedic Trauma. 1998; 12:563-568

390 Norris TR, Iannotti JP. Functional outcome after shoulder arthroplasty for primary osteoarthritis: a multicenter study. Journal of Shoulder and Elbow Surgery. 2002; 11(2):130-135

391 Northrup RL, Ragan BG, Bell GW. The Ottawa ankle rules and the "Buffalo" rule, part 1: Overview and background. Athletic Therapy Today. 2005; 10(1):56-59

392 Northrup RL, Ragan BG, Bell GW. The Ottawa ankle rules and the "buffalo" rule, part 2: A practical application. Athletic Therapy Today. 2005; 10(2):68-71

393 Nouraei MH, Majd DA, Zamani F. Comparing the treatment results of proximal humerus fracture based on surgical or nonsurgical methods. Advanced Biomedical Research. 2014; 3:253

394 Nugent PJ. Ottawa Ankle Rules accurately asses injuries and reduce reliance on radiographs. Journal of Family Practice. 2004; 53(10):785-788

395 Nugent PJ. The Ottawa knee rule: avoiding unnecessary radiographs in sports. Physician and Sportsmedicine. 2004; 32(5):26-32

396 O'Brien L, Presnell S. Patient experience of distraction splinting for complex finger fracture dislocations. Journal of Hand Therapy. 2010; 23(3):249-260

397 Ockert B, Braunstein V, Kirchhoff C, Korner M, Kirchhoff S, Kehr K et al. Monoaxial versus polyaxial screw insertion in angular stable plate fixation of proximal humeral fractures: radiographic analysis of a prospective randomized study. Journal of Trauma. 2010; 69(6):1545-1551

398 Ockert B, Pedersen V, Geyer L, Wirth S, Mutschler W, Grote S. Position of polyaxial versus monoaxial screws in locked plating for proximal humeral fractures: analysis of a prospective randomized study. European Journal of Orthopaedic Surgery and Traumatology. 2014; 24(5):747-752

399 Office for National Statistics. Interim life tables 2010-2012. 2013. Available from: http://www.ons.gov.uk/ons/rel/lifetables/interim-life-tables/2010-2012/index.html [Last accessed: 24 October 2013]

400 Okonta HI, Malemo KL, Ogunbanjo GA. The experience and psychosocial needs of patients with traumatic fractures treated for more than six months at doctors on call for service hospital, Goma, Democratic republic of Congo. South African Family Practice. 2011; 53(2):189-192

401 Ortiz MI, Monroy-Maya R, Soto-Rios M, Carrillo-Alarcon LC, Ponce-Monter HA, Rangel-Flores E et al. Effectiveness of diclofenac, ketorolac and etoricoxib in the treatment of acute pain from ankle fracture. Proceedings of the Western Pharmacology Society. 2010; 53:46-48

402 Osti M, Mittler C, Zinnecker R, Westreicher C, Allhoff C, Benedetto KP. Locking versus nonlocking palmar plate fixation of distal radius fractures. Orthopedics. 2012; 35(11):e1613-e1617

403 Paksima N, Panchal A, Posner MA, Green SM, Mehlman CT, Hiebert R. A meta-analysis of the literature on distal radius fractures: Review of 615 articles. Bulletin: Hospital for Joint Diseases. 2004; 62(1-2):40-46

404 Palombo A, Ferguson J, Rowlands A, Pedley D, Fraser S. An evaluation of a telemedicine fracture review clinic. Journal of Telemedicine and Telecare. 2003; 9 Suppl 1:S31-S33

405 Papacostas E, Malliaropoulos N, Papadopoulos A, Liouliakis C. Validation of Ottawa ankle rules protocol in Greek athletes: study in the emergency departments of a district general hospital and a sports injuries clinic. British Journal of Sports Medicine. 2001; 35(6):445-447

406 Parron CR, Tome BF, Barriga MA, Herrera Molpeceres JA, Poveda E, Pajares CS. Validity of the Ottawa rules for X-ray request in ankle and midfoot injuries in paediatric patients. European Journal of Orthopaedic Surgery and Traumatology. 2008; 18(5):361-364

407 Parsch CD. Modern trends in internal fixation of femoral shaft fractures in children: a critical review. Journal of Pediatric Orthopaedics. 1997; 6:117-125

408 Partio E, Böstman O, Hirvensalo E, Pätiälä H, Vainionpää S, Vihtonen K et al. Postoperative immobilization compared to early mobilization of the patients with ankle fracture treated by using absorbable screws. Suomen Ortopedia Ja Traumatologia. 1990; 13(3-4):387-389

409 Patel NK, Davies N, Mirza Z, Watson M. Cost and clinical effectiveness of MRI in occult scaphoid fractures: a randomised controlled trial. Emergency Medicine Journal. 2013; 30(3):202-207

410 Paul M, Jason CB. Paramedic performed Fascia Iliaca Compartment Nerve Block for Patients with Suspected Femoral Fractures: A paramedics personal perspective. Australasian Journal of Paramedicine. 2013; 10(2):3

411 Paul M, Jason CB, Veronica M, Paul MM. Paramedic performed fascia iliaca compartment block (FICB) for femoral fractures: a randomised controlled trial. Australasian Journal of Paramedicine. 2013; 10(3):14-15

412 Perry JJ, Stiell IG. Impact of clinical decision rules on clinical care of traumatic injuries to the foot and ankle, knee, cervical spine, and head. Injury. 2006; 37(12):1157-1165

413 Perry S, Raby N, Grant PT. Prospective survey to verify the Ottawa ankle rules. Journal of Accident and Emergency Medicine. 1999; 16(4):258-260

414 Pershad J, Williams S, Wan J, Sawyer JR. Pediatric distal radial fractures treated by emergency physicians. Journal of Emergency Medicine. 2009; 37(3):341-344

415 Petrack EM, Christopher NC, Kriwinsky J. Pain management in the emergency department: patterns of analgesic utilization. Pediatrics. 1997; 99(5):711-714

416 Pietzik P, Qureshi I, Langdon J, Molloy S, Solan M. Cost benefit with early operative fixation of unstable ankle fractures. Annals of the Royal College of Surgeons of England. 2006; 88(4):405-407

417 Pigman EC, Klug RK, Sanford S, Jolly BT. Evaluation of the Ottawa clinical decision rules for the use of radiography in acute ankle and midfoot injuries in the emergency department: an independent site assessment. Annals of Emergency Medicine. 1994; 24(1):41-45

418 Pijls BGCW, Werner PH, Eggen PJMG. Alternative humeral tubercle fixation in shoulder hemiarthroplasty for fractures of the proximal humerus. Journal of Shoulder and Elbow Surgery. 2010; 19(2):282-289

419 Pijnenburg ACM, Glas AS, De Roos MAJ, Bogaard K, Lijmer JG, Bossuyt PMM et al. Radiography in acute ankle injuries: the Ottawa Ankle Rules versus local diagnostic decision rules. Annals of Emergency Medicine. 2002; 39(6):599-604

420 Plint AC, Bulloch B, Osmond MH, Stiell I, Dunlap H, Reed M et al. Validation of the Ottawa Ankle Rules in children with ankle injuries. Academic Emergency Medicine. 1999; 6(10):1005-1009

421 Plint AC, Perry JJ, Tsang JLY. Pediatric wrist buckle fractures. Should we just splint and go? Canadian Journal of Emergency Medicine. 2004; 6(6):397-401

422 Podeszwa DA, Mooney III JF, Cramer KE, Mendelow MJ. Comparison of Pavlik harness application and immediate spica casting for femur fractures in infants. Journal of Pediatric Orthopaedics. 2004; 24(5):460-462

423 Ponce-Monter HA, Ortiz MI, Garza-Hernandez AF, Monroy-Maya R, Soto-Rios M, Carrillo-Alarcon L et al. Effect of diclofenac with B vitamins on the treatment of acute pain originated by lower-limb fracture and surgery. Pain Research and Treatment. 2012; 2012:104782

424 Poolman RW, Kocher MS, Bhandari M. Pediatric femoral fractures: a systematic review of 2422 cases. Journal of Orthopaedic Trauma. 2006; 20(9):648-654

425 Pope R. Ottawa Ankle Rules are more sensitive than Dutch in detecting significant ankle fracture. Australian Journal of Physiotherapy. 2002; 48(4):320

426 Port AM, McVie JL, Naylor G, Kreibich DN. Comparison of two conservative methods of treating an isolated fracture of the lateral malleolus. Journal of Bone and Joint Surgery - British Volume. 1996; 78(4):568-572

427 Pountos I, Clegg J, Siddiqui A. Diagnosis and treatment of greenstick and torus fractures of the distal radius in children: a prospective randomised single blind study. Journal of Children's Orthopaedics. 2010; 4(4):321-326

428 Pritchett JW. External fixation or closed medullary pinning for unstable Colles fractures? Journal of Bone and Joint Surgery - British Volume. 1995; 77(2):267-269

429 Quinton DN. Local anaesthetic toxicity of haematoma blocks in manipulation of Colles' fractures. Injury. 1988; 19:239-240

430 Raby N. Magnetic resonance imaging of suspected scaphoid fractures using a loe field dedicated extremity MR system. Clinical Radiology. 2001; 56(4):316-320

431 Rainer TH, Jacobs P, Ng YC, Cheung NK, Tam M, Lam PK et al. Cost effectiveness analysis of intravenous ketorolac and morphine for treating pain after limb injury: double blind randomised controlled trial. BMJ. 2000; 321(7271):1247-1251

432 Raja AS, Pines JM, Schuur JD, Muir M, Calfee RP, Carpenter CR. Evidence based diagnostics: Meta-analysis of the accuracy of physical exam and imaging for adult scaphoid fractures. Academic Emergency Medicine. 2013; 20(5 Suppl.1):S24-S25

433 Rajasekaran S, Naresh Babu J, Dheenadhayalan J, Shetty AP, Sundararajan SR, Kumar M et al. A score for predicting salvage and outcome in Gustilo type-IIIA and type-IIIB open tibial fractures. Journal of Bone and Joint Surgery - British Volume. 2006; 88(10):1351-1360

434 Rangan A. Pragmatic multi-centre randomised trial of surgical versus non-surgical treatment for proximal fracture of the humerus in adults [due for publication 2015]. 2015. Available from: http://www.nets.nihr.ac.uk/projects/hta/0640453 [Last accessed: 27 November 2014]

435 Reis ND, Aginsky J. A double compression medullary nail: preliminary report of an early clinical trial. Injury. 1980; 11(3):197-202

436 Rhemrev SJ, de Zwart AD, Kingma LM, Meylaerts SAG, Arndt JW, Schipper IB et al. Early computed tomography compared with bone scintigraphy in suspected scaphoid fractures. Clinical Nuclear Medicine. 2010; 35(12):931-934

437 Ricci WM, Borrelli J. Teleradiology in orthopaedic surgery: impact on clinical decision making for acute fracture management. Journal of Orthopaedic Trauma. 2002; 16(1):1-6

438 Ridderikhof ML, Lirk P, Schep NW, Hoeberichts A, Goddijn WT, Luitse JSK et al. The PanAM study: a multi-center, double-blinded, randomized, non-inferiority study of paracetamol versus non-steroidal anti-inflammatory drugs in treating acute musculoskeletal trauma. BMC Emergency Medicine. 2013; 13:19

439 Ring D, Jupiter JB, Brennwald J, Buchler U, Hastings H. Prospective multicenter trial of a plate for dorsal fixation of distal radius fractures. Journal of Hand Surgery - American Volume. 1997; 22(5):777-784

440 Roderer G, Erhardt J, Kuster M, Vegt P, Bahrs C, Kinzl L et al. Second generation locked plating of proximal humerus fractures - A prospective multicentre observational study. International Orthopaedics. 2011; 35(3):425-432

441 Rodrigues P, Rosa I, Campagnolo JL. Validation of the ottawa rules for the portuguese population a prospective study. Acta Medica Portuguesa. 2011; 24(5):713-718

442 Rosin A, Sinopoli M. Impact of the Ottawa Ankle Rules in a U.S. Army troop medical clinic in South Korea. Military Medicine. 1999; 164(11):793-794

443 Rouleau DM, Parent S, Feldman DE. Primary care management for isolated limb injury: referral to orthopedic surgery in a trauma center. Clinical and Investigative Medicine Medecine Clinique Et Experimentale. 2010; 33(2):E99

444 Ruch DS, Vallee J, Poehling GG, Smith BP, Kuzma GR. Arthroscopic reduction versus fluoroscopic reduction in the management of intra-articular distal radius fractures. Arthroscopy. 2004; 20(3):225-230

445 Sadeghifar AR, Heshmaty A, Saied AR, Ayatollahi MA, Pooladsanj AR, Arabnejhad F. The effect of prophylactic corticosteroid injection in decreasing the ulnar sided wrist pain in patients with acute distal radius fracture. Journal of Babol University of Medical Sciences. 2014; 16(7):7-13

446 Safi A, Hart R, Teknedzjan B, Kozak T. Treatment of extra-articular and simple articular distal radial fractures with intramedullary nail versus volar locking plate. Journal of Hand Surgery - European Volume. 2013; 38(7):774-779

447 Sahota O, Rowlands M, Bradley J, Van de Walt G, Bedforth N, Armstrong S et al. Femoral nerve block Intervention in Neck of Femur fracture (FINOF): study protocol for a randomized controlled trial. Trials. 2014; 15:189

448 Sahu RL, Gupta P. A comparative study of surgical management of subtrochanteric fractures in children. Bangladesh Journal of Medical Science. 2012; 11(2):91-97

449 Salt P, Clancy M. Implementation of the Ottawa Ankle Rules by nurses working in an accident and emergency department. Journal of Accident and Emergency Medicine. 1997; 14(6):363-365

450 Samuel P, Malcolm B. Prehospital femoral neck fracture management - A review of the literature. Australasian Journal of Paramedicine. 2013; 10(3):18

451 Sathiyakumar V, Apfeld JC, Obremskey WT, Thakore RV, Sethi MK. Prospective randomized controlled trial using telemedicine for follow-ups in an orthopedic trauma population: A pilot study. Journal of Orthopaedic Trauma. 2015; 29(3):e139-e145

452 Scheerder FJM, Schnater JM, Sleeboom C, Aronson DC. Bryant traction in paediatric femoral shaft fractures, home traction versus hospitalisation. Injury. 2008; 39(1):456-462

453 Schiferer A, Gore C, Gorove L, Lang T, Steinlechner B, Zimpfer M et al. A randomized controlled trial of femoral nerve blockade administered preclinically for pain relief in femoral trauma. Anesthesia and Analgesia. 2007; 105(6):1852-1854

454 Schonk JW. Comparative follow-up study of conservative and surgical treatment of femoral shaft fractures in children. Archivum Chirurgicum Neerlandicum. 1978; 30(4):231-238

455 Schonnemann JO, Hansen TB, Soballe K. Randomised study of non-bridging external fixation compared with intramedullary fixation of unstable distal radial fractures. Journal of Plastic Surgery and Hand Surgery. 2011; 45(4-5):232-237

456 Shaikh AH, Gulzar SA, Ahmed KZ, Bilal FS. A comparative study between early spica cast and skin traction followed by spica cast. Medical Channel. 2012; 19(2):88-92

457 Sharma H, Vashishtha P, Paode V, Sharma R, Kakar R. An audit on factors influencing infection in operated ankle fractures. European Journal of Orthopaedic Surgery and Traumatology. 2006; 16(4):336-339

458 Shauver MJ, Clapham PJ, Chung KC. An economic analysis of outcomes and complications of treating distal radius fractures in the elderly. Journal of Hand Surgery - American Volume. 2011; 36(12):1912-1913

459 Sherry E, Henderson A, Cotton J. comparison of midazolam and diazepam for the reduction of shoulder dislocations and Colles' fractures in skiers on an outpatient baisis. Australian Journal of Science and Medicine in Sport. 1989; 21(2):23-27

460 Shetty V, Wasnik S, Hegde C, Shetty V, Kasture S, Thakur H. The "Shetty test" in ankle injuries: validation of a novel test to rule out ankle fractures. European Journal of Orthopaedic Surgery and Traumatology. 2013; 23(7):831-833

461 Shyamalan G, Theokli C, Pearse Y, Tennent D. Volar locking plates versus Kirschner wires for distal radial fractures--a cost analysis study. Injury. 2009; 40(12):1279-1281

462 Siddique A, Prasad CVR, O'Connor D. Early active mobilization versus cast immobilization in operatively treated ankle fractures: A prospective analysis of early functional recovery. European Journal of Trauma. 2005; 31(4):398-400

463 Siddiqui MA, Pirwani MA, Naz N, Rehman AU, Soomro YH. Skin traction followed by spica cast versus early spica cast in femoral shaft fractures of children. Pakistan Journal of Surgery. 2008; 24(1):38-41

464 Singh GK, Manglik RK, Lakhtakia PK, Singh A. Analgesia for the reduction of Colles fracture. A comparison of hematoma block and intravenous sedation. Online Journal of Current Clinical Trials. 1992; Doc No 23

465 Singh-Ranger G, Marathias A. Comparison of current local practice and the Ottawa Ankle Rules to determine the need for radiography in acute ankle injury. Accident and Emergency Nursing. 1999; 7(4):201-206

466 Sleet RA, Khan MA. Comparative study of mefenamic acid and dextropropoxyphene plus paracetamol in an accident and emergency department. Current Medical Research and Opinion. 1980; 7(2):77-84

467 Sleney J, Christie N, Earthy S, Lyons RA, Kendrick D, Towner E. Improving recovery - Learning from patients' experiences after injury: A qualitative study. Injury. 2014; 45(1):312-319

468 Smejkal K, Didek T, Zvak I, Trlica J, Folvarsky J. Operation treatment of 2-3 fragments proximal humeral fractures using Zifko versus Philos. European Journal of Trauma and Emergency Surgery. 2008; 34(Suppl.1):44-45

469 Smejkal K, Lochman P, Dedek T, Trlica J, Koci J, Zvak I. Surgical treatment for proximal humerus fracture. Acta Chirurgiae Orthopaedicae Et Traumatologiae Cechoslovaca. 2011; 78(4):321-327

470 Smith KR, Brown CK, Brewer KL. Can clinical prediction rules used in acute pediatric ankle and midfoot injuries be applied to an adult population? American Journal of Emergency Medicine. 2011; 29(4):441-445

471 Snaith B, Hardy M. Emergency department image interpretation accuracy: The influence of immediate reporting by radiology. International Emergency Nursing. 2014; 22(2):63-68

472 Soleimanpour J, Ganjpour J, Rouhani S, Goldust M. Comparison of titanium elastic nails with traction and spica cast in treatment of children's femoral shaft fractures. Pakistan Journal of Biological Sciences. 2013; 16(8):391-395

473 Sommerkamp TG, Seeman M, Silliman J, Jones A, Patterson S, Walker J et al. Dynamic external fixation of unstable fractures of the distal part of the radius. A prospective, randomized

comparison with static external fixation. Journal of Bone and Joint Surgery - American Volume. 1994; 76(8):1149-1161

474 Sondenaa K, Hoigaard U, Smith D, Alho A. Immobilization of operated ankle fractures. Acta Orthopaedica Scandinavica. 1986; 57(1):59-61

475 Song H-R, Oh C-W, Shin H-D, Kim S-J, Kyung H-S, Baek S-H et al. Treatment of femoral shaft fractures in young children: Comparison between conservative treatment and retrograde flexible nailing. Journal of Pediatric Orthopaedics B. 2004; 13(4):275-280

476 Sorensen EL, Keeling A, Snyder A, Syverud S. Decreasing ED length of stay with use of the Ottawa Ankle Rules among nurses. Journal of Emergency Nursing. 2012; 38(4):350-352

477 Springer BA, Arciero RA, Tenuta JJ, Taylor DC. A prospective study of modified Ottawa ankle rules in a military population. Interobserver agreement between physical therapists and orthopaedic surgeons. American Journal of Sports Medicine. 2000; 28(6):864-868

478 Stableforth PG. Mefenamic acid and dextropropoxyphene with paracetamol as analgesics in the accident department. Current Medical Research and Opinion. 1977; 5(2):189-191

479 Stanhope B. Paracetamol/codeine probably had equivalent analgesia to ibuprofen in children with extremity injuries. Archives of Disease in Childhood Education and Practice Edition. 2010; 95(5):167

480 Staunstrup H, Ovesen J, Larsen UT, Elbaek K, Larsen U, Kroner K. Efficacy and tolerability of lornoxicam versus tramadol in postoperative pain. Journal of Clinical Pharmacology. 1999; 39(8):834-841

481 Stevermer JJ, Chambliss ML. Validation of decision rules for radiography in knee injuries. Journal of Family Practice. 1996; 42(6):564-565

482 Stewart B, Tudur Smith C, Teebay L, Cunliffe M, Low B. Emergency department use of a continuous femoral nerve block for pain relief for fractured femur in children. Emergency Medicine Journal. 2007; 24(2):113-114

483 Stiell I. Ottawa ankle rules. Canadian Family Physician Medecin De Famille Canadien. 1996; 42:478-480

484 Stiell I, Wells G, Laupacis A, Brison R, Verbeek R, Vandemheen K et al. Multicentre trial to introduce the Ottawa ankle rules for use of radiography in acute ankle injuries. Multicentre Ankle Rule Study Group. BMJ. 1995; 311(7005):594-597

485 Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, Reardon M et al. Decision rules for the use of radiography in acute ankle injuries. Refinement and prospective validation. JAMA. 1993; 269(9):1127-1132

486 Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, Worthington JR. A study to develop clinical decision rules for the use of radiography in acute ankle injuries. Annals of Emergency Medicine. 1992; 21(4):384-390

487 Stiell IG, McKnight RD, Greenberg GH, McDowell I, Nair RC, Wells GA et al. Implementation of the Ottawa ankle rules. JAMA. 1994; 271(11):827-832

488 Stiell IG, Wells GA, McDowell I, Greenberg GH, McKnight RD, Cwinn AA et al. Use of radiography in acute knee injuries: need for clinical decision rules. Academic Emergency Medicine. 1995; 2(11):966-973

489 Stiell IG, Bennett C. Implementation of clinical decision rules in the emergency department. Academic Emergency Medicine. 2007; 14(11):955-959

490 Strohm PC, Muller CA, Boll T, Pfister U. Two procedures for Kirschner wire osteosynthesis of distal radial fractures. A randomized trial. Journal of Bone and Joint Surgery - American Volume. 2004; 86-A(12):2621-2628

491 Suresh KN, Kiran N, Ravi M, Sebastian D, Punith Gowda RM. Dexamethasone as an additive to bupivacaine in fascia lliaca compartment block: A prospective, Randomized and double blind study. Journal of Clinical and Diagnostic Research. 2014; 8(8):GC05-GC08

492 Sutherland M. Casting vs. splinting for wrist fractures in children. American Family Physician. 2011; 83(9):1103-1104

493 Symons S, Rowsell M, Bhowal B, Dias JJ. Hospital versus home management of children with buckle fractures of the distal radius. Journal of Bone and Joint Surgery - Series B. 2001; 83(4):556-560

494 Szucs S, Morau D, Sultan SF, Iohom G, Shorten G. A comparison of three techniques (local anesthetic deposited circumferential to vs. above vs. below the nerve) for ultrasound guided femoral nerve block. BMC Anesthesiology. 2014; 14(1):6

495 Tai-Chang C, Ming J, Kuo-An L, Chyun-Yu Y. Sonography for monitoring closed reduction of displaced extra-articular distal radial fractures. Journal of Bone and Joint Surgery - American Volume. Boston: Journal of Bone and Joint Surgery, Inc. 2002; American volume(2):194-203

496 Tandeter HB, Shvartzman P, Stevens MA. Acute knee injuries: Use of decision rules for selective radiograph ordering. American Family Physician. 1999; 60(9):2599-2608

497 Taranu R, Webb J, Forth M, Brown G, Bowler C, Bayliss N. Using semi-rigid casts in the management of buckle fractures. Paediatric Nursing. 2011; 23(2):25-28

498 Tay SY, Thoo FL, Sitoh YY, Seow E, Wong HP. The Ottawa Ankle Rules in Asia: validating a clinical decision rule for requesting X-rays in twisting ankle and foot injuries. Journal of Emergency Medicine. 1999; 17(6):945-947

499 Temple CLF, Ross DC, Bennett JD, Garvin GJ, King GJW, Faber KJ. Comparison of sagittal computed tomography and plain film radiography in a scaphoid fracture model. Journal of Hand Surgery - American Volume. 2005; 30(3):534-542

500 Thomas TL, Meggitt BF. A comparative study of methods for treating fractures of the distal half of the femur. Journal of Bone and Joint Surgery - British Volume. 1981; 63-B(1):3-6

501 Thorpe AP, Murray AD, Smith FW, Ferguson J. Clinically suspected scaphoid fracture: a comparison of magnetic resonance imaging and bone scintigraphy. British Journal of Radiology. 1996; 69(818):109-113

502 Thorsness R, Iannuzzi J, Noyes K, Kates S, Voloshin I. Open reduction and internal fixation versus hemiarthroplasty in the management of proximal humerus fractures. Geriatric Orthopaedic Surgery and Rehabilitation. 2014; 5(2):56-62

503 Tiel-van Buul MM, Van Beek EJ, Borm JJ, Gubler FM, Broekhuizen AH, van Royen EA. The value of radiographs and bone scintigraphy in suspected scaphoid fracture. A statistical analysis. Journal of Hand Surgery - British Volume. 1993; 18(3):403-406

504 Tiel-Van Buul MMC, Roolker W, Verbeeten J, Broekhuizen AH. Magnetic resonance imaging versus bone scintigraphy in suspected scaphoid fracture. European Journal of Nuclear Medicine. 1996; 23(8):971-975

505 Tigges S, Pitts S, Baumgarten D, Ballard D. Use of the Ottawa knee rule: A cost minimization study. Emergency Radiology. 2001; 8(4):217-223

506 Tollefson B, Fromang G, Koury M, Nichols T. Validation of the sonographic ottawa foot and ankle rules study in a large urban trauma center. Annals of Emergency Medicine. 2012; 60(4 Suppl.1):S17

507 Trepat AD, Popescu D, Fernandez-Valencia JA, Cune J, Rios M, Prat S. Comparative study between locking plates versus proximal humeral nail for the treatment of 2-part proximal humeral fractures. European Journal of Orthopaedic Surgery and Traumatology. 2012; 22(5):373-379

508 Trevisan C, Klumpp R, Nava V, Riccardi D, Recalcati W. Surgical versus conservative treatment of distal radius fractures in elderly. Aging Clinical and Experimental Research. 2013; 25(Suppl.1):S83-S84

509 Trigg M, Reeves PJ. The efficacy of plain films vs MRI in the detection of scaphoid fractures. Radiography. 2007; 13(1):56-64

510 Tropp H, Norlin R. Ankle performance after ankle fracture: a randomized study of early mobilization. Foot and Ankle International. 1995; 16(2):79-83

511 Tsertsvadze A, Leas B, and Umscheid CA. Effects of non-steroidal anti-inflammatory drugs (NSAIDs) on bone fracture healing. Center for Evidence-based Practice (CEP), 2013

512 Tsui K-B, Kong LCW, Tsang LCY. Ottawa ankle rules for assessment of ankle injuries. Hong Kong Practitioner. 2011; 33(1):22-28

513 Ucar BY, Gem M, Bulut M, Azboy I, Demirtas A, Alemdar C. Titanium elastic intramedullary nailing: Closed or mini-open reduction ? Acta Orthopaedica Belgica. 2013; 79(4):406-410

514 van der Wees P, Hendriks E, van Beers H, van Rijn R, Dekker J, de Bie R. Validity and responsiveness of the ankle function score after acute ankle injury. Scandinavian Journal of Medicine and Science in Sports. 2012; 22(2):170-174

515 Van Der Wees PJ, Hendriks EJM, Bruls V, Dekker J, de Bie RA. Applicability of the Ottawa Ankle Rules in primary care: Results from a pilot study. Journal of Evaluation in Clinical Practice. 2011; 17(6):1246-1248

516 van Laarhoven CJ, Meeuwis JD, van dW. Postoperative treatment of internally fixed ankle fractures: a prospective randomised study. Journal of Bone and Joint Surgery - British Volume. 1996; 78(3):395-399

517 Van Leeuwen FL, Bronselaer K, Gilles M, Sabbe MB, Delooz HH. The 'three in one' block as locoregional analgesia in an emergency department. European Journal of Emergency Medicine. 2000; 7(1):35-38

518 van Niekerk JL, Schoots FJ. Femoral shaft fractures treated with plate fixation and interlocked nailing: a comparative retrospective study. Injury. 1992; 23(4):219-222

519 Vardy J, Jenkins PJ, Clark K, Chekroud M, Begbie K, Anthony I et al. Effect of a redesigned fracture management pathway and 'virtual' fracture clinic on ED performance. BMJ Open. 2014; 4(6)

520 Varitimidis SE, Basdekis GK, Dailiana ZH, Hantes ME, Bargiotas K, Malizos K. Treatment of intra-articular fractures of the distal radius: fluoroscopic or arthroscopic reduction? Journal of Bone and Joint Surgery - British Volume. 2008; 90(6):778-785

521 Verbeek PR, Stiell IG, Hebert G, Sellens C. Ankle radiograph utilization after learning a decision rule: a 12-month follow-up. Academic Emergency Medicine. 1997; 4(8):776-779

522 Vergnion M, Degesves S, Garcet L, Magotteaux V. Tramadol, an alternative to morphine for treating posttraumatic pain in the prehospital situation. Anesthesia and Analgesia. 2001; 92(6):1543-1546

523 Verma S, Hamilton K, Hawkins HH, Kothari R, Singal B, Buncher R et al. Clinical application of the Ottawa ankle rules for the use of radiography in acute ankle injuries: an independent site assessment. AJR American Journal of Roentgenology. 1997; 169(3):825-827

524 Vernooij CM, Vreeburg ME, Segers MJM, Hammacher ER. Treatment of torus fractures in the forearm in children using bandage therapy. Journal of Trauma and Acute Care Surgery. 2012; 72(4):1093-1097

525 Vijayasankar D, Boyle AA, Atkinson P. Can the Ottawa knee rule be applied to children? A systematic review and meta-analysis of observational studies. Emergency Medicine Journal. 2009; 26(4):250-253

526 Vioreanu M, Dudeney S, Hurson B, Kelly E, O'Rourke K, Quinlan W. Early mobilization in a removable cast compared with immobilization in a cast after operative treatment of ankle fractures: a prospective randomized study. Foot and Ankle International. 2007; 28(1):13-19

527 Walenkamp MMJ, Bentohami A, Beerekamp MS, Peters RW, van der Heiden R, Goslings JC et al. Functional outcome in patients with unstable distal radius fractures, volar locking plate versus external fixation: a meta-analysis. Strategies in Trauma and Limb Reconstruction. 2013; 8(2):67-75

528 Walenkamp MMJ, Goslings JC, Beumer A, Haverlag R, Leenhouts PA, Verleisdonk EJMM et al. Surgery versus conservative treatment in patients with type A distal radius fractures, a randomized controlled trial. BMC Musculoskeletal Disorders. 2014; 15:90

529 Wali MGR, Baba AN, Latoo IA, Bhat NA, Baba OK, Sharma S. Internal fixation of shaft humerus fractures by dynamic compression plate or interlocking intramedullary nail: a prospective, randomised study. Strategies in Trauma and Limb Reconstruction. 2014; 9(3):133-140

530 Wang J, Yang Y, Ma J, Xing D, Zhu S, Ma B et al. Open reduction and internal fixation versus external fixation for unstable distal radial fractures: a meta-analysis. Orthopaedics and Traumatology, Surgery and Research. 2013; 99(3):321-331

531 Wang X, Chang Sm, Yu GR, Rao Zt. Clinical value of the Ottawa ankle rules for diagnosis of fractures in acute ankle injuries. PloS One. 2013; 8(4):e63228

532 Ward CM, Kuhl TL, Adams BD. Early complications of volar plating of distal radius fractures and their relationship to surgeon experience. Hand. 2011; 6(2):185-189

533 Weaver CS, Terrell KM, Bassett R, Swiler W, Sandford B, Avery S et al. ED procedural sedation of elderly patients: is it safe? American Journal of Emergency Medicine. 2011; 29(5):541-544

534 Weber JE, Jackson RE, Peacock WF, Swor RA, Carley R, Larkin GL. Clinical decision rules discriminate between fractures and nonfractures in acute isolated knee trauma. Annals of Emergency Medicine. 1995; 26(4):429-433

535 Wei DH, Poolman RW, Bhandari M, Wolfe VM, Rosenwasser MP. External fixation versus internal fixation for unstable distal radius fractures: a systematic review and meta-analysis of comparative clinical trials. Journal of Orthopaedic Trauma. 2012; 26(7):386-394

536 Werber K-D, Raeder F, Brauer RB, Weiss S. External fixation of distal radial fractures: Four compared with five pins a randomized prospective study. Journal of Bone and Joint Surgery - American Volume. 2003; 85(4):660-666

537 West S, Andrews J, Bebbington A, Ennis O, Alderman P. The treatment of buckle fractures in a bandage: A prospective randomised trial. Journal of Bone and Joint Surgery - British Volume. 2004; 86-B(Suppl.III):286-28c

538 Wild JR, DeMers A, French R, Shipps MR, Bergin PF, Musapatika D et al. Functional outcomes for surgically treated 3- and 4-part proximal humerus fractures. Orthopedics. 2011; 34(10):e629-e633

539 Wilson JA, Kendall JM, Cornelius P. Intranasal diamorphine for paediatric analgesia: assessment of safety and efficacy. Journal of Accident and Emergency Medicine. 1997; 14(2):70-72

540 Witney-Lagen C, Smith C, Walsh G. Soft cast versus rigid cast for treatment of distal radius buckle fractures in children. Injury. 2013; 44(4):508-513

541 Woo WWK, Man SY, Lam PKW, Rainer TH. Randomized double-blind trial comparing oral paracetamol and oral nonsteroidal antiinflammatory drugs for treating pain after musculoskeletal injury. Annals of Emergency Medicine. 2005; 46(4):352-361

542 Wright E. Treating buckle fractures in children with removable splints. Nursing Children and Young People. 2011; 23(10):14-17

543 Wright JG. The treatment of femoral shaft fractures in children: a systematic overview and critical appraisal of the literature. Canadian Journal of Surgery. 2000; 43(3):180-189

544 Wynn-Thomas S, Love T, McLeod D, Vernall S, Kljakovic M, Dowell A et al. The Ottawa ankle rules for the use of diagnostic X-ray in after hours medical centres in New Zealand. New Zealand Medical Journal. 2002; 115(1162):U184

545 Xie X, Xie X, Qin H, Shen L, Zhang C. Comparison of internal and external fixation of distal radius fractures. Acta Orthopaedica. 2013; 84(3):286-291

546 Xun J-J, Feng J-G, Li Y-F. DVR system versus palm plate for internal fixation of C-type distal radius fractures. Journal of Clinical Rehabilitative Tissue Engineering Research. 2011; 15(26):4804-4808

547 Yao K, Haque T. The Ottawa knee rules - a useful clinical decision tool. Australian Family Physician. 2012; 41(4):223-224

548 Yazdani S, Jahandideh H, Ghofrani H. Validation of the Ottawa Ankle Rules in Iran: a prospective survey. BMC Emergency Medicine. 2006; 6:3

549 Yin ZG, Zhang JB, Kan SL, Wang XG. Diagnosing suspected scaphoid fractures: a systematic review and meta-analysis. Clinical Orthopaedics and Related Research. 2010; 468(3):723-734

550 Yin Z-G, Zhang J-B, Kan S-L, Wang X-G. Diagnostic accuracy of imaging modalities for suspected scaphoid fractures: Meta-analysis combined with latent class analysis. Journal of Bone and Joint Surgery - British Volume. 2012; 94 B(8):1077-1085

551 Yost J. Intranasal fentanyl and intravenous morphine did not differ for pain relief in children with closed long-bone fractures. Evidence-Based Nursing. 2008; 11(2):42

552 Younge PA, Kendall JM. Sedation for children requiring wound repair: a randomised controlled double blind comparison of oral midazolam and oral ketamine. Emergency Medicine Journal. 2001; 18(1):30-33

553 Younge PA, Nicol MF, Kendall JM, Harrington AP. A prospective randomised pilot comparison of intranasal fentanyl and intramuscular morphine for analgesia in children presenting to the emergency department with clinical fractures. Emergency Medicine. 1999; 11(2):90-94

554 Yuen MC, Saunders F. Towards evidence based emergency medicine: best BETs from the Manchester Royal Infirmary. The Ottawa ankle rules in children. Emergency Medicine Journal. 2001; 18(6):466-467

555 Yuen MC, Sim SW, Lam HS, Tung WK. Validation of the Ottawa ankle rules in a Hong Kong ED. American Journal of Emergency Medicine. 2001; 19(5):429-432

556 Yun MJ, Kim YH, Han MK, Kim JH, Hwang JW, Do SH. Analgesia before a spinal block for femoral neck fracture: fascia iliaca compartment block. Acta Anaesthesiologica Scandinavica. 2009; 53(10):1282-1287

557 Zennaro F, Grosso D, Fascetta R, Marini M, Odoni L, Di Carlo V et al. Teleradiology for remote consultation using iPad improves the use of health system human resources for paediatric fractures: prospective controlled study in a tertiary care hospital in Italy. BMC Health Services Research. 2014; 14:327

558 Zettl RP, Clauberg E, Nast-Kolb D, Ruchholtz S, KüHne CA. [Volar locking compression plating versus dorsal plating for fractures of the distal radius: a prospective, randomized study]. Der Unfallchirurg. 2009; 112(8):712-718

559 Zlowodzki M, Vogt D, Cole PA, Kregor PJ. Plating of femoral shaft fractures: Open reduction and internal fixation versus submuscular fixation. Journal of Trauma. 2007; 63(5):1061-1065

560 Zuckerman JD. Hemiarthroplasty improved health-related quality of life more than nonoperative treatment in older patients with four-part proximal humeral fractures: Commentary. Journal of Bone and Joint Surgery - American Volume. 2012; 94(10):942

561 Zyluk A, Janowski P. [A comparison of the results of the conservative vs operative by percutaneous Kirschner-wiring treatment of fractures of the distal radius] [Polish]. Chirurgia Narzadów Ruchu i Ortopedia Polska. 2007; 72(5):327-334