

# Splints and immobilisation approaches used for second to fifth metacarpal fractures: a review

Supplementary table: Summary of findings

Authors	Study design, sampling strategy and type of metacarpal fracture	Splints/immobilisation device description and time frame of wear	Surgical or conservative intervention	Follow-up periods	Outcome measures used (for each outcome)	Results on outcomes first assessment (copy for each outcome)	Results on outcomes Second and more assessments (copy for each outcome)	Grade
Al-Qattan <sup>14</sup> (no control group)	Prospective study, n = 42, purposive sampling All patients with spiral/long oblique metacarpal shaft fractures treated conservatively with a palmar wrist splint between 2003 and 2006	Palmar wrist splint (POP immobilisation) 20–30° wrist extension and fingers free for 2 weeks  No formal PT  Active and passive exercises of all finger joints  Splint removed at 2 weeks with more exercises	Conservative management	2 weeks, (patients included with a minimum of 6 weeks follow-up)	TAM Grip strength	n = 54 <b>2 weeks</b> TAM = lag of 26° (mean range 234°) Grip strength = difficult to assess		Low
				6 weeks			<b>6 weeks</b> TAM = mean lag of 19° (mean range 241°) Grip strength = 60%	
				3 months			n = 36 <b>3 months</b> TAM = mean lag of 15° (mean range 253°) Grip strength = 74%	
				6 months			n = 25 <b>6 months</b> TAM = 5° lag in 2 (mean range 260°) Grip strength = 81%	
				9 months			n = 11 <b>9 months</b> TAM = 260° Grip strength = 90%	
				1 year			n = 5 TAM = 260° Grip strength = 94%	
Khan and Giddins <sup>15</sup>	Prospective study, n = 30, single or multiple, middle or border, closed spiral metacarpal fractures Sample of convenience	No splint or immobilisation Gradual early mobilisation Participants had to make a fist, up to 2 cm measurement from fingertip to palm, before discharge was allowed	Conservative management	7 days	Malrotation with visual observation ROM Grip strength Functional limitations verbal assessment Shortening of fingers Return to work Bone union through palpation Cosmetic satisfaction	n = 25 <b>7 days =</b> malrotation in 1/3 of participants		Low
				Between 6 and 14 months	ROM Grip strength Hand function Rotation Shortening Union	<b>6 and 14 months =</b> ROM = full and no extensor lag Grip strength = within 10% of uninjured hand Good hand function No clinical malrotation Mean shortening of fingers 4 mm (2–5 mm) Return to work range (2 to 4 weeks, mean 3 weeks) Bone union in 23 participants No cosmetic complaints		
Macdonald et al. <sup>16</sup>	Prospective study, n = 61, non-scissoring spiral metacarpal fractures	Splint individually moulded: wrist 20° wrist extension, affected MCPJ and one adjacent unaffected MCPJ in 30° flexion and interphalangeal joints extended for 1 week  One week splint removed for exercises, shower, at night for compliant participants without pain  Splint on for sleep and demanding activities  Splint removed after 3 weeks	Conservative management	3 weeks, 6 weeks and more than 22 weeks (5 months) after injury was sustained	Grip strength ROM	<b>5 months =</b> Grip strength uninjured hand mean = 36.18 kg Grip strength Injured hand = 36.58 kg No extensor lag		Low
Gulabi et al. <sup>17</sup>	Retrospective record review on a total of 140 participants allocated into 2 groups  Isolated, extra-articular neck of shaft 5th metacarpal fracture with more than 30° of angulation	Group A: Reduction and immobilisation of 4th and 5th fingers in short arm POP: wrist 30° extension, MCPJs 45° flexion, DIPJ and PIPJ in 15° flexion for mean 29.15 days	Conservative	POP removed after a period of 29.15 days (mean)	X-ray assess bone healing Grip strength ROM	<b>1 month</b> after removal POP: Grip strength 90.38% compared to unaffected		Low
				One month after POP removed	Extensor lag	Two participants had 10° extensor lag		
Gulabi et al. <sup>17</sup>	Retrospective record review on 140 participants allocated into 2 groups  Isolated, extra-articular neck of shaft 5th metacarpal fracture with more than 30° of angulation	Group B: Reduction and immobilisation of 4th and 5th fingers in U-shaped gutter splint: wrist 30° extension, MCPJs 45° flexion, DIPJ and PIPJ in 15° flexion for mean 29.15 days	Conservative	U-shaped gutter splint removed period of 29.15 days (mean)	X-ray Grip strength ROM	<b>1 month</b> after removal splint: Grip strength 90.58% compared to unaffected		Low
				One month after splint removed	Extensor lag Rotational deformity clinical assessment	Two participants had 10° extensor lag		

Gamble et al. <sup>18</sup> (no control group)	Retrospective study Purposive sampling  Cohort of 162 patients was collated from a search of the Emergency Department's Information System, Omnis, that identified patients directly discharged from the Emergency Department with a fracture of the fifth metacarpal (neck, shaft or base)	Functional bracing: neighbour strapping (buddy) for 1 week, early active mobilisation with information and no follow-up sessions	Conservative	No follow-up mean 21.6 months (but questionnaire sent out a minimum 1-year post-intervention)	Satisfaction Likert scale  EQ-5D  QuickDASH	<b>Post 1 year</b> (59% response rate): 80.6 % were very satisfied and 84.9% satisfied with the new process of management  Median EQ-5D = 0.87 (IQR 0.74 to 1.00)  Median QuickDASH = 2.3 (IQR 0.6.8)	No other outcomes measured	Low
Van Aaken et al. <sup>19</sup>	Multicentre, randomised controlled trial, n = 68 divided into 2 intervention groups, 5th metacarpal neck/boxer's fracture with ≤ 70° degrees of angulation and no rotational deformities	No reduction with soft palmar wrap and buddy strapping 4th and 5th fingers for 3 weeks With immediate active mobilisation	Conservative (soft wrap and buddy strap)	Baseline 4 months	QuickDASH mean (SD)  Pain mm mean (± SD)  MCPJ ROM  Flexion° mean (± SD)  Hyperextension° mean (± SD)  Grip strength kg mean (± SD)  Jamar position 1 grip strength  Jamar position 2 grip strength  Satisfaction Fully satisfied  Satisfied  Days off work mean (± SD)	n = 37 <b>Baseline</b>  QuickDASH: 45.7 (18)  Pain VAS: 31.9 (19.9)  Flexion° contralat 92 (12.1)  Hyperextension° contralat -7 (9)  Jamar position 1 grip strength contralat @1 month 32 (11)  Jamar position 2 grip strength 42 (19)	n = 20 <b>4 months</b>  QuickDASH: 0.96 (2.7)  Pain VAS: 1.7 (5.8)  Flexion of the 5th MCPJ° 92 (9.90)  Hyperextension of the 5th MCPJ° -5 (11)  Jamar position 1 grip strength (mean) 31 (11.32)  Jamar position 2 grip strength (mean) 41 (20)  Fully satisfied = 13  Satisfied = 7  Days off work: 22 (18)	High
Van Aaken et al. <sup>19</sup>	Multicentre, randomised controlled trial, n = 68 divided into 2 intervention groups, 5th metacarpal neck/boxer's fracture with ≤ 70° degrees of angulation and no rotational deformities	Reduction with forearm wrist POP immobilisation including MCPJ and PIP, MCPJ in extension for 4 weeks	Conservative (POP cast)	Baseline 4 months	QuickDASH mean (SD)  Pain VAS mm mean (SD)  MCPJ ROM  Flexion° mean (± SD)  Hyperextension° mean (± SD)  Grip strength contralat kg at 1 month mean (± SD)  Jamar position 1 grip strength  Jamar position 2 Grip strength  Satisfaction Fully satisfied  Satisfied  Days off work mean (± SD)	n = 27 <b>Baseline</b>  QuickDASH 49.7 (21.8)  Pain VAS: 35.2 (22.7)  Flexion° contralateral 92° (19)  Hyperextension° contralateral -9° (13)  Jamar position 1 grip strength 38 kg (12)  Jamar position 2 grip strength 41 kg (10)	n = 19 <b>4 months</b>  QuickDASH 2.78 (5.1)  Pain VAS: 4.6 (10.7)  Flexion of the 5th MCPJ° 94° (8)  Hyperextension of the 5th MCPJ° -3° (8)  Jamar position 1 grip strength 35 kg (12)  Jamar position 2 grip strength 39.7 kg (11)  Fully satisfied = 12  Satisfied = 6  Days off work 33 days (17)	High
Cepni et al. <sup>20</sup>	Comparative study, n = 24, fifth metacarpal neck/boxer's fracture	Reduction and immobilisation in U-shaped ulnar gutter splint with 4th and 5th MCPJ, PIP and DIP in slight flexion for 4 weeks	Conservative	Prior to treatment 2 days after reduction  7 days after reduction	Palmar angulation (mean, range)  MC shortening (mean range in mm)  TAM measured against the uninjured side  Flexion % (range)  Extension % (range)  Return to work (mean range)  QuickDASH mean (range)	<b>Prior to treatment:</b> 42.6° (27–55°)  MC shortening 5.6 mm (5.3–6.1)	QuickDASH: <b>At 30 days:</b> 69.6 (59.1–79.5)  45 days: 13.5° (10–28°)  MC shortening 2 (0–4)  TAM Flexion 91.25% (75–100%)  Extension 92.5% (80–100%)  Return to work 33.6 days (26–41)  QuickDASH 39.3 (22.7–61.4)	Low

Cepni et al. <sup>20</sup>	Comparative study, n = 24, fifth metacarpal neck/boxer's fracture	Reduction and K-wire insertion with U-shaped ulnar gutter splint for 7 days	Surgical	2 days after reduction	Palmar angulation (mean, range)	<b>Prior to treatment:</b> Palmar angulation 43.0° (40–55°)	Low
				7 days after reduction	MC shortening (mean range in mm)	MC shortening 9.3 mm (6–15)	
					TAM % measured against the uninjured side		
					Flexion % (range)		
					Extension % (range)		
					Return to work mean		
					QuickDASH (range)		
				30 days		<b>At 30 day:</b> QuickDASH 2.96 (0–15.9)	
				45 days		<b>45 days:</b> 8.0° (0–17°)	
						MC shortening 0.5 (0–3)	
						Flexion 94% (75–100%)	
						Extension 95.5% (90–100%)	
						Return to work 3.9 days (3–5)	
						QuickDASH 0.69 (0–2.3)	
Strub et al. <sup>21</sup>	Pseudo randomisation, n = 40 (2 groups), fifth metacarpal neck/boxer's fracture with 30° to 70° palmar displacement	No reduction with five days immobilisation in palmar splint including 4th and 5th fingers  Thereafter metacarpal hand-based thermoplastic splint covering dorsal and palmar for five weeks and functional mobilisation encouraged  No hand therapy	Conservative (Group B)	2 weeks	Flexion ROM 5 <sup>th</sup> MCPJ (mean)	Flexion ROM 5th MCPJ = 96°	Moderate
				6 weeks			
				3 months			
				6 months	Total ROM MCPJ (compared to uninjured hand)		
				12 months			
					Pain		
					Time off work		
					Palmar angulation		
					Satisfaction		
					Grip strength (mean)		
					Complications Union		
				3 months		Pain = 0.57 (0–3 range)	
				12 months		Flexion ROM 5th MCPJ = 93° (4)	
						Extension ROM 5th MCPJ = 3° (5)	
						Pain = 0.1 (0–2 range)	
						Time off work = 4.8 weeks (1–8 range)	
						Palmar angulation = from (mean) 39° before surgery to 34° at 1 year	
						Satisfaction = 55% (11) patients very satisfied, 35% (7), 1 undecided	
						Grip strength = 46 kg (8.5)	
						Complications: 2 patients with highly displaced fractures (more than 50°)	
						Union in all fractures	
Strub et al. <sup>21</sup>	Pseudo randomisation, n = 40 (2 groups), fifth metacarpal neck/boxer's fracture with 30° to 70° palmar displacement	Reduction, K-wire insertion with five days immobilisation in palmar 2-finger splint including 4th and 5th fingers  Thereafter metacarpal hand-based thermoplastic splint covering dorsal and palmar for five weeks and functional mobilisation encouraged  No hand therapy	Surgical (Group A)	2 weeks	ROM MCPJ	Total ROM 5th MCPJ = 2 weeks: 62% of (uninjured hand), 6 weeks 80%, 3 months 87%, 6 months, 1 year 95%	Moderate
				6 weeks	Pain		
				3 months			
				6 months	Time off work		
				12 months			
					Palmar angulation		
					Satisfaction		
					Grip strength (mean)		
					Complications Union		
				3 months		Pain = 3 months 0.53 (0–4 range)	
				12 months		Flexion ROM 5th MCPJ = 92° (5)	
						Extension ROM 5th MCPJ = 6° (5)	
						Pain = 0.03 (0–1 range)	
						Time off work = 6.0 weeks (2–10 range)	
						Palmar angulation = from (mean) 44° before surgery to 9° at 1 year	
						Satisfaction = 70% (14) patients very satisfied, 25% (5) satisfied, 1 undecided	
						Grip strength = 51 kg	
						Complications: 2 patients with highly displaced fractures (more than 50°)	
						Union in all fractures	

Gülke et al. <sup>9</sup>	Prospective cohort randomised controlled trial  Standardised controlled block randomisation	Custom made functional forearm-based wrist included dorsal splint (light cast) fixated with an elastic wrap MPJs = 70° flexion; PIP, DIPJs free movement  Removed post 2 weeks  Physio teaching exercises that can be done at home  After week 8, exercises carried out independently	Open reduction internal fixation	Group 1: 2 weeks post-surgery: 12 units of PT over 6 weeks (week 3–8)  Week 8–12: Independent (group 1 & 2)  Week 2 follow-up Week 6	ROM (neutral zero method)  Jamar dynamometer  DASH	<b>Week 2:</b> ROM MPJ: 42.5° PIPJ: 88.3° DIPJ: 89.1°          <b>Week 6</b> MPJ: 61.7° PIPJ and DIPJ – increased a little  Grip strength 68%  DASH score 30  <b>Week 12:</b> ROM MPJ: 73.3°  Grip strength 91%  DASH score 16	High
Gülke et al. <sup>9</sup> control group	Prospective cohort randomised controlled trial  Standardised controlled block randomisation	Custom made functional forearm-based wrist included dorsal splint (light cast) fixated with an elastic wrap MPJs = 70° flexion; PIP, DIPJs free movement  Removed post 2 weeks  Exercise booklet with pictures, individual exercises  Questions answered by hand surgeon after reading	Open reduction internal fixation	Group 2: 2 weeks post-surgery: independent exercises (week 3–8)  Week 8–12: Independent (group 1 & 2)  Week 2 follow-up Week 6	ROM (neutral zero method)  Jamar dynamometer  DASH  Documenting exercise	<b>Week 2</b> ROM MPJ: 46.5° PIPJ: 86.8° DIPJ: 89.8°          <b>Week 6</b> ROM MPJ: 68.5° PIPJ and DIPJ – increased a little  Grip strength 71%  DASH score 25  <b>Week 12:</b> ROM MPJ: 73.3°  Grip strength 93%  DASH score 14	
Toemen and Midgley <sup>22,23</sup>	n = 23	Evidence-pathway per type and area of fracture: Base of the metacarpal fracture: extra- and intraarticular fractures treated conservatively or with K-wires with a forearm wrist splint wrist at 20° extension, for four weeks. At four weeks from the day of the injury, light function and wrist exercises were encouraged. Splint discarded after 6 weeks. After ORIF, light function was commenced at 2 weeks with the splint discarded at four weeks.  Shaft metacarpal fractures: forearm-based splint wrist 20° extension with affected and one adjacent finger MCPJs positioned in 70° of flexion with a dorsal hood piece of the splint worn for three weeks. After three weeks, the dorsal hood was removed, but the forearm-based splint continued and only taken off for exercise periods. The splint only worn at night for 2 more weeks, discarded at 6 weeks. This timeframe was applied to conservative or K-wire management of MJPJ shaft fractures. After ORIF, light function initiated at 2 weeks, and splint discarded at four weeks.  Neck and head metacarpal fractures: hand-based splint position affected MCPJ and an adjacent finger's MCPJ in flexion of 70° worn for 2 to four weeks. After this period, the splint was removed, and the fingers buddy strapped for another 2 weeks. In conservative or K-wire management, light function was commenced at four weeks, splint intervention continued at night and for protection during activities and discarded at 6 weeks. In the ORIF managed fractures: splint intervention continued at night and for protection during activities and discarded at four weeks.		10–24 weeks	Pain Complications Return to work  Satisfaction with service  Hand function per telephonic interview	Pain = 72% no pain No complications All previously employed patients return to work  Satisfaction score 8/10  92% of participants full function	Low