Hand Therapy 2011; **16**: 19–25. DOI: 10.1258/ht.2010.010026

Original article

Evaluation of an evidence-based patient pathway for non-surgical and surgically managed metacarpal fractures

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Abstract

Introduction. A review of current literature was used to develop an evidence-based pathway, managing surgical and non-surgical metacarpal fractures according to their anatomical location and fracture stability. The aim of this paper is to evaluate functional outcome, splint compliance, range of motion (ROM), residual pain, return to work and patient satisfaction following treatment based on the pathway.

Method. Fifty patients referred for surgical or non-surgical management of metacarpal fracture(s) were selected to participate in the clinical evaluation. Patient demographics, fracture site, management approach, type of splint, number of appointments attended and complications were recorded. A telephone questionnaire was used to evaluate patient satisfaction, compliance with splinting, ROM, pain, return to work and functional outcome. Recorded complications included infection, malunion, nonunion, rotational deformity and angulation deformity.

Results. Thirty-six patients were contactable 10–24 weeks post-injury. A total of 23 metacarpal neck/head, eight shaft and four base fractures were included. Ninety-four percent (34/36) of fractures were treated non-operatively. Patients were compliant with splinting in 17/36 (47%) cases. There were no reported complications. Seventy-two percent reported no pain at follow-up. All employed patients returned to work. Full ROM was reported in all cases. Full functional use of the hand was present in 92% of cases. Patients reported high satisfaction with the service (8/10) and required an average of three therapy appointments.

Conclusion. The metacarpal fracture evidence-based pathway was successful with 92% of patients returning to full function. The absence of complications emphasizes hand therapy's ability to efficiently and cost-effectively manage these fractures following referral. The pathway has been further refined as a result of the clinical evaluation, with alteration of the metacarpal shaft fracture splint, removal of repeat X-rays and reduction of splinting durations. It is recommended that the revised pathway is further evaluated.

Keywords: Metacarpal, fracture, therapy, patient pathway

Introduction

Metacarpal fractures constitute 40% of all hand fractures[1] and are classified according to their anatomical locations – head, neck, shaft and base.[2] The surgical or non-surgical management of these fractures is dependent on fracture location and stability. Treatment should be efficient, cost-effective and evidence-based.

Optimal therapeutic management of metacarpal fractures has not been determined and remains widely varied within the literature.[3–10] Poolman *et al.*[11] conducted a systematic review of little finger neck metacarpal fractures; however, the evidence regarding the most effective therapy modality remains inconclusive. A review of the literature by Toemen and Midgley[12] was used to develop an evidence-based therapy pathway (see Figure 1). The pathway is designed to treat surgical and non-surgical metacarpal fractures according to their anatomical location and fracture stability. This takes into account the deforming forces which may act across each fracture site, bone healing times and complications that may arise from inappropriate management. The aim of this paper is to evaluate the evidence-based metacarpal fracture pathway.

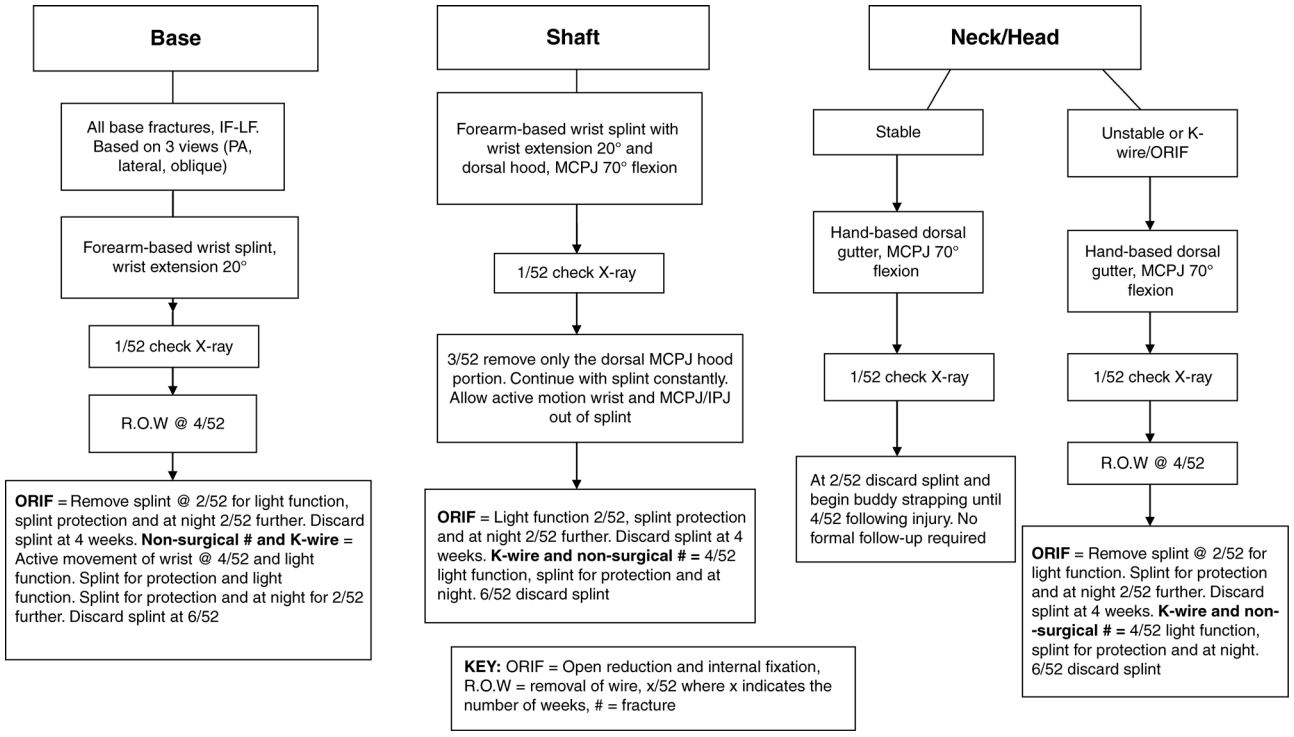

Figure 1 Evidence-based pathway for the management of surgical and non-surgical metacarpal fractures. First published by Toemen and Midgeley[12] and reproduced with permission by the British Association of Hand Therapists Ltd

Methods

Subjects

A consecutive sample of 50 adult patients aged ≥16 years referred for the surgical or non-surgical management of metacarpal fracture(s) were recruited to participate in a prospective clinical evaluation. Patients were diagnosed in the hand trauma clinic or day surgery with one or more fractures to the head, neck, shaft or base of the metacarpal. Patients who sustained thumb metacarpal fractures or concurrent phalangeal fractures were excluded. This clinical evaluation was approved by the trust audit committee. All patients provided written consent to telephone contact at a minimum of 10 weeks following injury.

Procedure

Patients were referred from the hand trauma clinic to hand therapy for management of their fracture(s) according to the metacarpal fracture pathway. Table 1 gives an overview of the type of splint fabricated for each fracture location. Therapists were provided with a one-hour training session on the implementation of the pathway. A patient information leaflet was provided at the initial appointment with details regarding metacarpal fracture management.[12] To reduce bias, patients were contacted by an independent therapist at a minimum of 10 weeks following the date of injury. A telephone questionnaire was conducted to ascertain the outcome of their therapeutic intervention.

Outcome measures

Patients' sex, hand dominance, occupation, employment status, side and date of injury, fracture site, management approach (surgical or non-surgical), type of splint and number of appointments attended were recorded on an Excel data sheet.

The telephone questionnaire included six categories:

(1) *Patient satisfaction:* An ordinal scale of 1 to 10 was devised. Patients were asked to rate their satisfaction with 1 being dissatisfied and 10 very satisfied.
(2) *Splint compliance:* Patients were asked to provide a yes or no response when asked if they wore a splint and to recall the total number of weeks they wore their splint.
(3) *Range of motion (ROM):* To identify flexion deficit patients were asked if the tip of the injured finger could touch the palm equal to the contralateral finger. In addition, an extension lag was identified by asking patients to place their hand on a table, palm facing the ceiling and questioned if the injured finger straightened to the table.
(4) *Residual pain:* Rated on the 0–10 verbal rating scale (VRS). The VRS has been shown to correlate with the visual analogue scale.[13]
(5) *Return to work:* Patients were asked when they returned to work following their injury.
(6) *Functional outcome*. The Upper Limb Functional Index (ULFI-10) questionnaire was utilized.[14] This is a self-reported measure which contains 10 statements related to function. The ULFI limits item redundancy and has confirmed reliability, validity

Table 1 Splint type according to fracture location, stability and fixation

Fracture location	Splint type	Splint example
Base of metacarpal	Forearm-based thermoplastic wrist splint	
Shaft of metacarpal Stable fracture	Three-point fixation splint: a hand-based circumferential splint that provides a three-point pressure to the apex of the fracture dorsally and two volar pressures on either side of the fracture[20]	
Shaft of metacarpal Fixated with ORIF	'Sandwich splint': a hand-based circumferential splint that does not apply any pressure to the fracture site	
Shaft of metacarpal Unstable fracture or K-wire fixation	Forearm-based wrist splint with wrist extension 20° and dorsal hood, metacarpophalangeal joint in 70° flexion	
Neck/head of metacarpal Stable or unstable K-wire or ORIF fixation	Hand-based dorsal gutter, metacarpophalangeal joints in 70° of flexion	

ORIF, open reduction and internal fixation

and responsiveness. It has been shown to correlate with the Disabilities of the Arm, Shoulder and Hand outcome measure (DASH) ($r = 0.85$).[14] Scores produced from the ULFI range from 0 to 100; the lowest score indicates no functional disability and the highest score indicates severe disability.

Complications were documented as infection, malunion, nonunion, rotational deformity or angulation deformity, and were assessed at the final hand therapy appointment. The number of appointments each patient attended was recorded.

Results

Fifty patients consented to participate in the evaluation. Thirty-six patients were contactable by telephone 10–24 weeks following injury. Fourteen patients (38%) were considered lost to follow-up at six months following initial consent. Table 2 summarizes the patient demographics.

The location of the fracture, surgical or non-surgical management and X-ray review are presented in Table 3.

Table 4 shows compliance with splinting results. No patients presented with complications of infection, malunion, nonunion, rotational or angulation deformities. Patients required an average of three appointments and a large percentage (72%) reported no residual pain. Three patients reported pain greater than VRS 5, two had metacarpal base fractures and one had an undisplaced fracture of the fifth metacarpal. Of the two patients who required nine appointments, one patient had sustained a further fracture to the second metacarpal shaft which was treated surgically. The remaining patient had a fifth metacarpal neck fracture treated non-surgically. All employed patients returned to work between 1 and 56 days following injury, of which 16/36 (44%) returned to work immediately (the day following injury).

The results from the telephone questionnaire are presented in Table 5.

Discussion

The primary goal of management following a metacarpal fracture is to regain full hand function. Between 10 and 24 weeks following injury, 92% of patients who had sustained a metacarpal fracture had returned to full function (scoring 0/100 on the ULFI measure), and all employed patients had returned to work, indicating successful rehabilitation. Patient satisfaction with splint comfort, information provided, appointment frequency and contact with the department was rated highly by those evaluated. The majority (66%) of patients required ≤ 3 appointments and only 6% required >6 visits. This indicates efficient therapy input and a reduction in unnecessary hospital visits for the patient. Use of the evidence-based metacarpal pathway enabled the hand therapy department to provide high-quality, efficient and effective care.

Table 2 Patient demographics excluding those lost to follow-up

Total number of patients	**36**
Gender	
Male:female ratio	33:3
Age	
Male age range (years)	17–69
Female age range (years)	19–46
Mean age (female and male in years)	31.5
Dominance	
Dominant:non-dominant hand ratio	25:11
Occupation	
Employed:unemployed ratio	25:11
Not working:students:retired ratio	2:7:2
Sedentary:manual work ratio	20:5

Table 3 Categorization of fracture location, management and X-ray review

Fracture location	
Ratio of metacarpal neck/head to shaft to base fractures	22:8:4
Number of patients with multiple metacarpal fractures/total	2/36
Fracture management	
Ratio of surgical to non-surgical management	2:34
X-ray review	
Patients receiving X-ray to assess stability at one week/total	32/36

Patients lost to follow-up

Thirty-eight percent of patients were lost to follow-up. This is higher than other metacarpal fracture prospective studies, which report rates of between 4% and 33%.[4,6–8,15] This could be explained by the patient population, who were predominantly of working age (17–36 years), making contact during working hours difficult.

Surgical and non-surgical management

Barton[16] reported that 5% of hand fractures require internal fixation. This is supported by this evaluation, as 94% of the patients were treated with a non-surgical approach without developing complications. The risk of a fracture losing stability and requiring surgical review was monitored by a repeat X-ray one week following referral and compared with a previous radiographic view. No patients developed complications, including the small percentage of patients who did not attend their repeat X-ray, indicating that the fractures chosen for non-surgical management were appropriate and that the repeat X-ray is unnecessary.

Table 4 Compliance with splinting results

Compliance	**Number**
Number of patients reporting compliance with splinting (subjective compliance)/total	31/36
Number of patients compliant to splinting – audited against pathway (objective compliance)	17/36
Number of patients wearing splint longer than required	9/36
Number of patients wearing splint for less time than required	10/36

Table 5 Results from telephone questionnaire

Outcome variable	Ratio	Number	Percentages	Range	Mean
Patients with full range of motion	–	36/36	100	–	–
Patients reporting no pain:patients reporting pain	26:10	–	72:28	–	–
Pain <5 on VRS:pain ≥ 5 on VRS	7:3	–	19:9	1–7	3
Appointments attended	–	–	–	2–9	3
Patients requiring ≤ 3 appointments	–	24/36	66	–	–
Patients requiring 4–6 appointments	–	10/36	28	–	–
Patients requiring > 6 appointments	-	2/36	6	–	–
Patients scoring 0% on ULFI (0% = no functional disability; 100% = severe disability)	–	33/36	92	–	–
Patients scoring greater than 0% on ULFI (0% = no functional disability; 100% = severe disability)	–	3/36	8%	4–8	5
Patient satisfaction with					
Splint comfort	–	30/36	(8/10) 80%	4–10	8
Information provided	–	33/36	(9/10) 90%	5–10	9
Follow-up appointment frequency	–	33/36	(9/10) 90%	5–10	9
Contact with the department	–	33/36	(9/10) 90%	6–10	9.5

VRS, verbal rating scale; ULFI, Upper Limb Functional Index

Splint compliance and positioning

Patients reported satisfaction with the splint (8/10), although 28% removed their splints earlier than requested. As none of these patients developed complications, the early splint removal may be indicative of reduced pain at the fracture site and therefore a diminished requirement for protection of the fracture. Splinting of a fracture provides pain relief in the initial weeks following injury, with the splint reducing the direct impact of force onto the fracture site. The evaluation shows that wearing a splint for longer than required is not detrimental to final motion provided this period does not exceed six weeks. Modification of splinting durations may be required for a patient's specific functional requirements or pain concerns without compromising motion.

Pain

A hard callous forms across the fracture site at six weeks post-injury indicating clinical union.[17] Therefore it is unsurprising that 72% of patients reported no pain 10 weeks or more following their injury. Two (out of 3) of the patients who reported pain ≥5/10 on the VRS had sustained intra-articular base fractures. Pain at this specific fracture location is well documented with studies reporting ongoing intermittent pain at an average of 4.3 years following injury in 38% of cases.[15,18] These specific metacarpal fractures may require further long-term follow-up.

Functional outcome

The lack of a standardized functional outcome measure is a limitation of previous prospective studies.[3–5,7,8] This evaluation shows 92% of patients returned to full function. The three patients reporting minimal functional limitations (scoring between 4 and 8%/100%) described difficulty with lifting weights greater than 5 kg, and two of these patients reported poor function due to pain, scoring 7 and 5 on the VRS. Further assessment and rehabilitation may be required in this small percentage of the patient population.

The evaluation demonstrates that full ROM is not always indicative of a full return to function. All patients achieved full ROM; however, 8% reported functional limitations. This highlights other important variables (such as pain and strength) that can impact on daily activities and must also be closely monitored.

Return to work

More than 50% (21/37) of the evaluated patients returned to work less than two weeks following injury. Early mobilization and function (while splinted) encouraged an earlier return to work, as shown by previous authors.[6,9] The patient population was drawn from a central London hospital and is therefore biased towards office workers. It is expected that light tasks can be resumed much earlier than heavy manual tasks.

Clinical evaluation limitations

Evaluating treatment success subjectively by means of telephone contact has been used in a previous study;[19] however, the inability to clinically assess ROM is an obvious limitation. A functional measure is informative as a final outcome and a self-report measure is important in assessing the patient's perception of their result. Analgesia was not assessed; therefore, we are unable to conclude if pain reduction was exclusively due to splinting. Patients evaluated further from their date of injury are likely to have less pain and improved function compared with those contacted sooner. The large evaluation range (10–24 weeks) may have produced varied results. A longer period of evaluation would determine further changes.

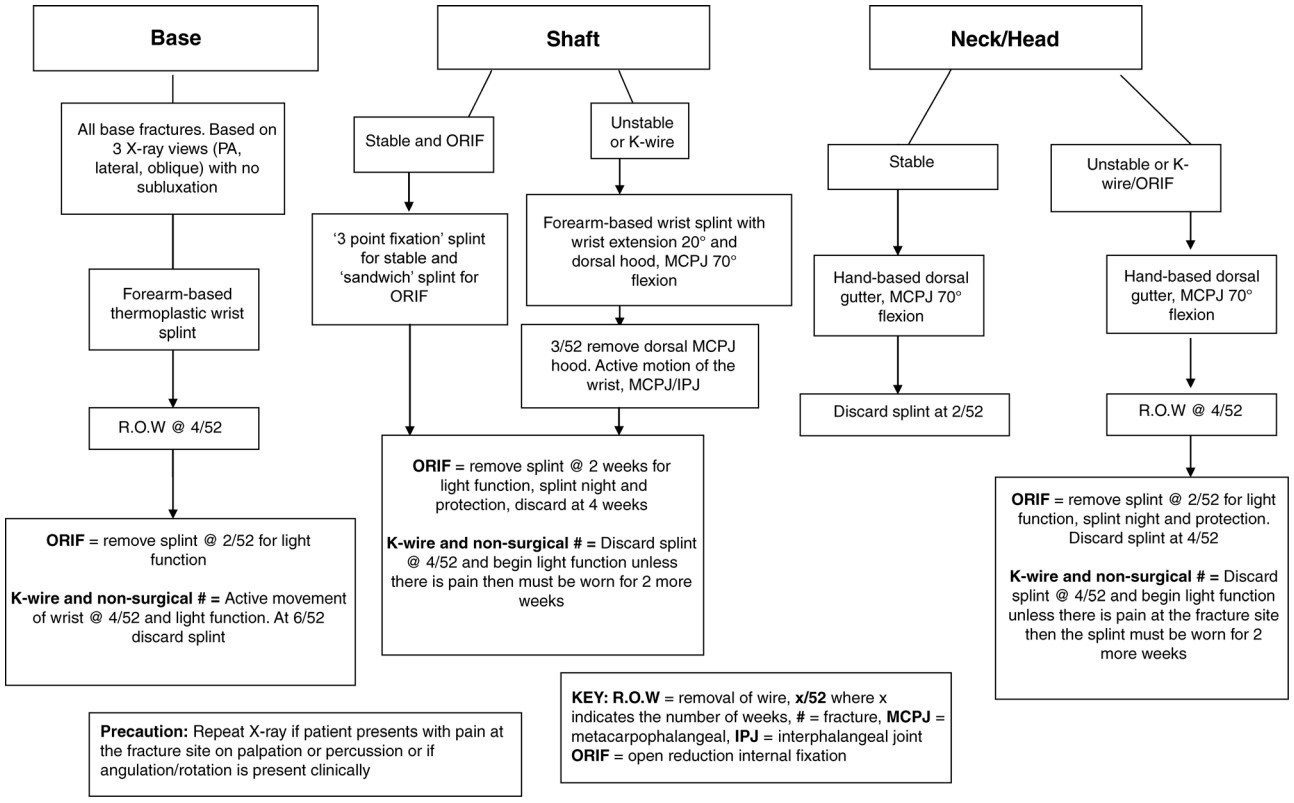

Figure 2 Revised pathway

Pathway evaluation

The following aspects of the pathway were reviewed:

(1) Metacarpal shaft fracture splinting
(2) Splint wearing durations for base, shaft, neck and head fractures that are managed non-surgically or with K-wires
(3) The requirement of a one-week repeat X-ray for all patients.

Metacarpal shaft fractures

Shaft fractures are generally spiral or oblique in nature and therefore prone to displacement with angulation or rotation,[2] which can impair function, as the injured finger will obstruct the adjacent fingers. Maintaining fracture stability is important without risking secondary stiffness. The splint for this fracture classification immobilizes the wrist and the metacarpophalangeal joint, which may overprotect the fracture position. A randomized study comparing a compression glove and early mobilization with immobilization in patients following a metacarpal shaft fracture[5] reports superior ROM in the mobilized patients at the two- and three-week follow-up appointments. A 'three point fixation splint' for the treatment of stable shaft fractures has been introduced into the revised pathway (see Figure 2) to avoid unnecessary immobilization. It is described as using two counter pressure points proximal and distal to the volar fracture site and one pressure point over the dorsal fracture apex.[20] A similar splint ('sandwich splint') without the use of the counter pressure points has been commenced for surgically fixated fractures. The pressure points are not required as fixated fractures are stabilized internally. These splints offer fracture protection while permitting full active ROM of the unaffected joints.

Splint durations

Twenty-eight percent of patients wore their splints for less time than requested. In the revised pathway, patients who sustain base and/or shaft fractures that are managed non-surgically or with K-wires will wear the splint for four continuous weeks and then discard it. However, if pain is present on palpation or percussion of the fracture site, indicating poor clinical healing, the splint will continue to be worn continuously for an additional two weeks. All stable neck/head fractures will discard their splint at two weeks and will not be provided with buddy strapping as previously prescribed as it offers no fracture stability and can impede digital motion.

Repeat X-rays

The absence of complications in all evaluated patients supports the role of the therapist in managing these fractures following referral. Radiographical review of all patients at one week following injury is therefore not required and places unnecessary demand and cost on the Radiology Department. Consequently, patients will be referred for a repeat X-ray if the fracture is considered unstable or if they present with significant pain, rotation

or angulation with a high suspicion of fracture movement.

The revised pathway (Figure 2) limits unnecessary immobilization of joints, thereby reducing the development of joint stiffness and further hand therapy input. This is cost-effective for the department and less burdensome for the patient. Evaluation of the revised pathway is required.

Conclusions

Toemen and Midgley[12] developed an evidence-based patient pathway for surgically and non-surgically managed metacarpal fractures according to their anatomical location and fracture stability. Treatment based on the pathway resulted in 92% of patients returning to full function without the development of complications at $\geq$10 weeks following injury. Management of these fractures within a hand therapy department provides high quality, efficient and cost-effective care. The pathway has been further refined as a result of the clinical evaluation. It is recommended that the pathway undergoes further evaluation.

Acknowledgements: Sincere thanks are extended to Consultant Plastic Surgeons Matthew James and Catina Bernadis, Associate Specialist Jamil Ahmed, Consultant Orthopaedic Surgeon Sameer Gidwani and Occupational Therapist Jo Hickling for their support and contribution to the development of a new management pathway for metacarpal fractures at Guy's & St Thomas' NHS Foundation Trust.

Competing interests: None declared.

Accepted: 23 September 2010

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