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Original Research

Study of Hamate Fractures in a Single Tertiary Hands Unit: A Retrospective Cohort Study and Literature Review

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Purpose: The primary purpose of our study was to investigate hamate fractures at a single tertiary hand surgery unit in Western Australia, particularly comparing operative and nonsurgical outcomes.
Methods: Patients with hamate and/or hamate plus fifth carpometacarpal injury at our hand unit between 2019 and 2022 were identified. All patients had Quick Disability of the Arm, Shoulder and Hand (*Quick*DASH) patient-reported outcome measures recorded post treatment. Patients managed operatively and nonsurgically had a period of splinting with plaster of Paris and/or thermoplastic splint for a minimum of 2 weeks. All patients underwent hand therapy.
Results: Forty-eight patients with hamate and/or hamate plus fifth carpometacarpal injury were included in this study. Thirteen patients had Milch type 1 fractures, and 35 had Milch type 2 fractures. Six Milch type 1 fractures were managed operatively, and seven were managed nonsurgically. The average *Quick*DASH score for the operative group was 0.38. The average *Quick*DASH score for the nonsurgical group was 0.65. Sixteen Milch type 2 fractures were managed operatively, and 19 were managed nonsurgically. The average *Quick*DASH score for the operative group was 1.3. The average *Quick*DASH score for the nonsurgical group was 3.5.
Conclusions: For Milch type 2 fractures, patient-reported outcome measures were better for the operative group compared with the nonsurgical group.
Type of study/level of evidence: Therapeutic IV.

Hamate fractures account for 2% to 4% of all carpal bone fractures, although these rates are likely underestimated as these injuries are easily missed on standard wrist radiographs.[1,2] Computed tomography (CT) is often helpful in evaluating fracture morphology and can be useful for preoperative planning.[3] There are few studies in the current literature with sample sizes greater than 10 patients, and management of hamate injuries and indications for surgery are not well described.

Hamate body fractures were classified by Milch in 1934 as involving either the hook or the body of the hamate (Fig. 1).[3–5] Milch type 1 fractures, or hook of hamate fractures, are usually managed nonsurgically unless symptomatic.[3] Milch type 2 fractures are further subdivided into type 2a, coronal fracture, and type 2b, transverse fracture, which typically occur from high-energy injuries. These have a higher association with carpal and carpometacarpal fracture dislocations.

Successful nonsurgical management of nondisplaced and stable hamate fractures has been reported.[6] Closed reduction and percutaneous pinning or open reduction and internal fixation may be used to stabilize displaced fractures or restore joint congruity.[6] Complications arising from hamate fractures can occur but are generally correlated with the severity of the initial injury, delays in presentation or diagnosis, or noncompliance.[7] However, there is limited literature to guide surgeons on how to manage hamate fractures. Therefore, the primary aim of our study was to investigate hamate fractures managed by our unit.

Materials and Methods

This is a retrospective cohort study investigating outcomes of hamate fractures. This study was approved by our institutional review board (GEKO Quality Activity 50808).

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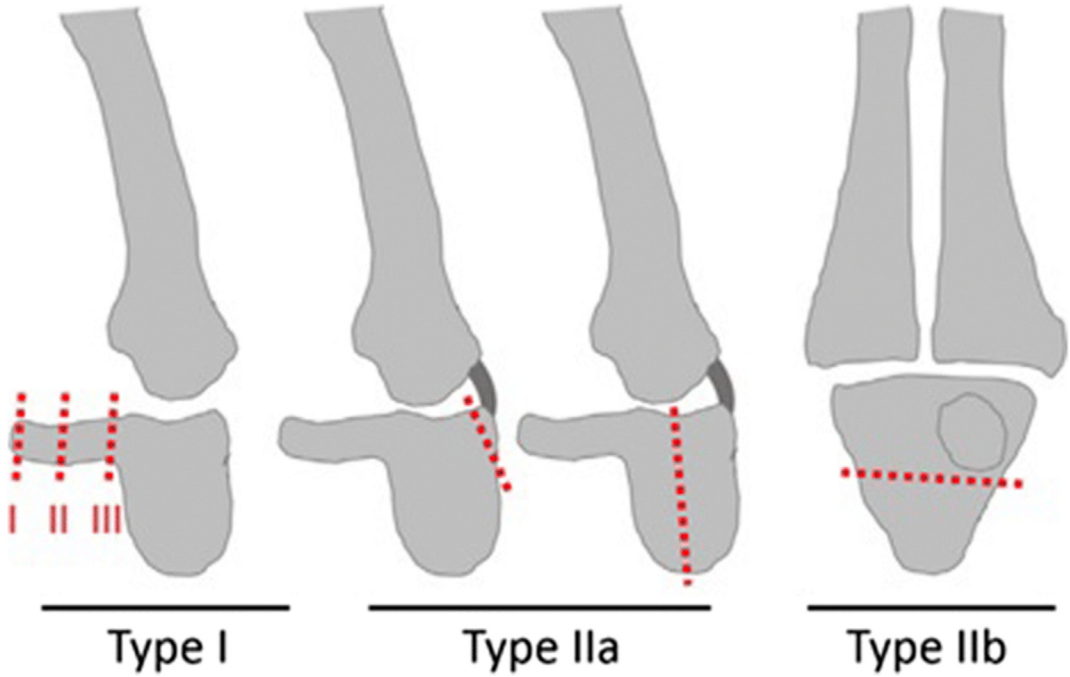

Figure 1. Milch classification.[5]

Adult patients with hamate and/or hamate plus fifth carpometacarpal injury at our hospital hand service (a single tertiary hand unit in Western Australia) between 2019 and 2022 were identified. Patients were referred from multiple centers within Western Australia and reviewed on an outpatient basis. Three hand surgeons were involved in this study.

The method of treatment, duration of hand therapy, and follow-up period were recorded. All patients managed operatively and nonsurgically had a standard period of splinting with plaster and/or thermoplastic splint. The length of splinting ranged from 2 to 8 weeks, depending on the severity of injury and patient compliance. All patients were reviewed in the hand clinic at regular intervals postoperatively with serial X-rays and clinical assessments. The standard postoperative review was performed at 1, 2, 6, and 12 weeks postinjury or postoperatively. The duration of immobilization was determined by the operating surgeon in conjunction with hand therapists. Early splinting was preferred; however, plaster treatment continued with more severe injuries or if compliance was determined to be an issue.

Inclusion criteria for this study required patients to be compliant with their treatment throughout the study period. Exclusion criteria included noncompliance, patients lost to follow-up, multiple injuries, or delays in treatment because of an initially missed injury. All patients had Quick Disability of the Arm, Shoulder and Hand (*Quick*DASH) questionnaire outcomes recorded after treatment. All patients managed operatively and nonsurgically had a period of splinting with plaster and/or thermoplastic splint for minimum of 2 weeks. All patients underwent hand therapy rehabilitation for 4 to 12 weeks depending on patient symptoms.

*Quick*DASH scores were recorded at 6 or 12 weeks postinjury or postsurgery. *Quick*DASH is a commonly used outcome measure after orthopedic surgery and has excellent validity and reliability in patients undergoing upper limb surgery.[8,9]

Decisions regarding whether to treat operatively or nonsurgically were at the behest of the treating surgeon. A combination of clinical examination and history, radiographic evidence of severity of injury, and patient factors were taken into consideration.

For our statistical analysis, we compared the test statistic to a normal distribution with a mean of 0 and a standard deviation of 1 to calculate *P* values. A *P* value of <.05 indicated statistical significance. Two-tailed *t* tests were used for statistical analysis. Descriptive analysis included means, medians, frequencies, standard deviations, and ranges.

Results

Forty-eight patients with hamate and/or hamate plus fifth carpometacarpal injury were included in this study (36 men (76%), 12 women (24%)). Thirteen patients had Milch type 1 fractures (25%), and 35 had Milch type 2 fractures (75%). Of note, we identified three patients from our database whose injuries were attributed to sports trauma. The average age of the patient cohort was 37 years old.

The injury occurred in the left hand in 16 cases (33%), with the right hand being more commonly injured (32 cases, 66%). The most common mechanism of injury was striking an unyielding object with a clenched fist (or punching) in 32 cases (66%), followed by a fall onto an outstretched hand in 7 cases (15%).

Six Milch type 1 fractures were managed operatively (46%), and 7 were managed nonsurgically (54%). Milch type 1 fractures were managed operatively with Kirschner wires (K-wires) (Fig. 2). Operative management involved reduction and internal fixation with 1.0 mm K-wires. These were removed at 4 weeks postoperatively in the outpatient clinic. The average *Quick*DASH score for the operative group was 0.38. The average *Quick*DASH score for the nonsurgical group was 0.65. This was not statistically significant ($P = .66$).

Sixteen Milch type 2 fractures were managed operatively (46%), and 19 were managed nonsurgically (54%). Milch type 2 fractures were managed operatively with K-wires, a plate, or a combination of both

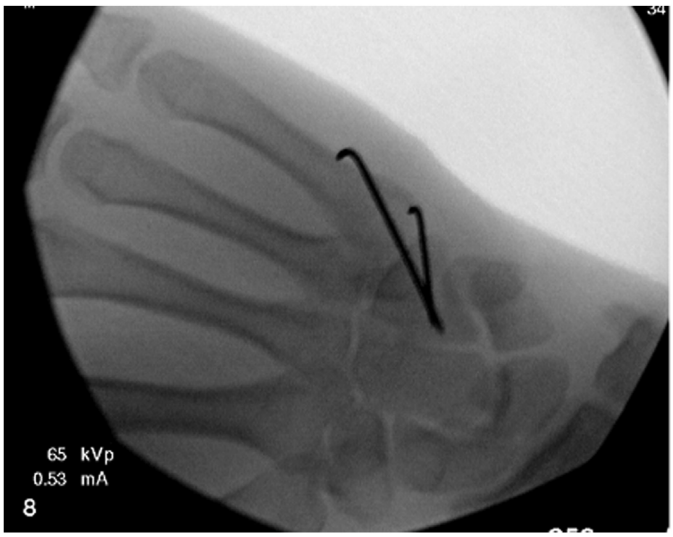

Figure 2. Example of a Milch type 1 patient managed with K-wires.

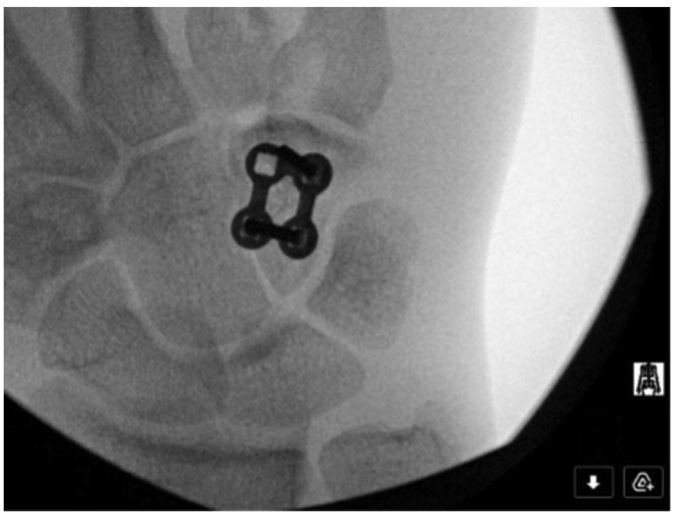

Figure 3. Example of a Milch type 2 patient manage with a plate.

(Fig. 3). The average *Quick*DASH score for the operative group was 1.3. The average *Quick*DASH score for the nonsurgical group was 3.5. This is statistically significant ($P < .04$), although it is not adequately statistically powered to avoid a beta error (it was not adequately powered to avoid incorrectly accepting the null hypothesis).

When stratifying all included patients into operative and nonsurgical groups, regardless of their Milch classification, the mean *Quick*DASH score for the operative group was 1.14, and the mean *Quick*DASH score for the nonsurgical group was 3.35. This is adequately powered and approaches statistical significance ($P = .06$).

Patients managed nonsurgically were immobilized with a Futura splint (N = 4), plaster of Paris (POP), thermoplastic splint (TPS), or a combination of POP and TPS. The average length of immobilization for nonsurgical patients was 4.2 weeks (range 2–6). The average length of clinical follow-up with the treating surgeon for the nonsurgical patients was 5 weeks (range 2–12). The average length of hand therapy rehabilitation for the nonsurgical group was 7.2 weeks (range 2–16).

Patients who were managed operatively were immobilized with POP, TPS, or a combination of both. The average length of immobilization for the operative patients was 5.3 weeks (range 4–8). The average length of clinical follow-up with the treating surgeon for the operative group was 8.25 weeks (range 4–20). The average length of hand therapy rehabilitation for the operative group was 10 weeks (range 4–30).

Standard hand therapy protocols for both groups included one to two in-hospital sessions with a hand therapist per week depending on patient symptoms until resolution.

Discussion

Hamate fractures are rare and most frequently involve the hook of the hamate.[7] Reported rates of hamate body fractures are likely underestimated because these injuries are easily missed on standard wrist radiographs.[2] The mechanism of injury in hamate fractures is attributed to axial loading directed through the fourth and fifth metacarpals or a compressive force through the wrist.[7] Given the limited number of quality studies on hamate fractures, the management of these types of injuries and indications for surgery are not well described.

The current literature suggests that nondisplaced or minimally displaced fractures of the body of the hamate without adjacent joint instability or significant displacement can be treated nonsurgically.[7] In our study, when comparing operative versus nonsurgical management of all patients regardless of Milch classification, the operative group had better *Quick*DASH scores post treatment; however, the difference was not statistically significant. The authors of the current study are of the opinion that patients should be followed up regularly as there is a risk of fracture displacement as well as metacarpal subluxation.[10] Failure to maintain carpometacarpal joint alignment should result in conversion to operative treatment.[11] Finally, patients must be compliant with postoperative weight-bearing instructions as noncompliance has been associated with chronic pain and poorer functional scores.[1,12]

Price et al[7] recently published a systematic review of the literature. They compiled findings from six cohort studies and 33 case reports describing hamate body fractures to summarize the natural history, management, and outcomes of these infrequent injuries.[7] These authors were able to identify a total of 120 hamate body fractures in the current literature. Of these, 96% were men, and the average age was 29 years old. The injury occurred in the dominant hand in 93% of cases, and the most common mechanism of injury was punching. Our study's demographics were consistent with these previous data. In the context of the current literature, this systematic review largely consists of case reports and small cohort studies. The descriptive nature of this systematic review combined with the lack of meta-analysis ultimately provides a broad overview of management and lacks specific recommendations.

Standard plain radiographic images of the wrist frequently miss hamate fractures.[13,14] Price et al[6] reported a 51.5% rate of missed injuries on initial radiographs. Cecava et al[15] described six radiographic signs that indicate hamate body fracture commonly seen on anteroposterior, lateral, and oblique views: distal dorsal hamate avulsion fragment; noncongruent metacarpal alignment; fourth and fifth carpometacarpal joint obscuration; disruption or obscuration of hamate hook ring; hamate double density sign; and ulnar and dorsal hand soft tissue swelling.[5] The presence of any of these findings should necessitate the use of CT evaluation according to Cecava et al.[15] In our study, anteroposterior and lateral plain films combined with clinical awareness when examining patients lead to an accurate diagnosis, such that only a small number of patients required a preoperative CT scan. Furthermore, patients referred to our clinic had already been diagnosed with hamate fracture by the

referring physician. The diagnosis of hamate fractures is difficult to obtain through standard imaging alone. Therefore, it is likely that some fractures have been missed in the community, and patients with a delay of more than 2 weeks were excluded from this study. Additionally, all patients with documented hamate fractures were included during the recruitment of this study regardless of whether the diagnosis was known at the time of referral.

Price et al[7] published that failure to maintain carpometacarpal joint congruity with nonsurgical management should prompt conversion to operative management.[1,6] Although the present study did not identify any subluxation or resubluxation in operative patients, such complications may have gone unnoticed given the limitations of plain film radiographs.

There is no consensus in current literature regarding fixation techniques for hamate fractures. From this study we observed that plastic surgeons were more likely to manage operative patients with K-wires in contrast to orthopedic surgeons who were more likely to manage operative patients with open reduction and internal fixation with a plate. This was anecdotal and observational from our database.

Complications are infrequent

The current literature shows that most hamate body fractures are managed operatively with open reduction and internal fixation.[16] Postoperative complications are infrequent and include pain, stiffness, decreased grip strength, ulnar nerve dysfunction, and nonunion.[7,12,17] The published literature has shown very low rates of these complications.[18] Such complications are exacerbated by delayed diagnosis or noncompliance.[7] For our cohort, the goal of surgery was to improve the alignment, especially in subluxations, to reduce the risk of future arthritis. Arthritis is a potential long-term complication following hamate fracture.[18] The propensity for hamate fracture patients to develop arthritis is not well described given the lack of long-term cohort analyses. We suspect there is a reasonably high incidence of carpometacarpal joint osteoarthritis after hamate fracture, but that it is well tolerated by most patients, who therefore rarely present. Anecdotally, our unit has seen a small number of patients present with carpometacarpal joint osteoarthritis post hamate fracture; however, none of these patients required operative management or fusion. These patients have not been included as their injuries predate the current study.

Timing of immobilization lacks consensus

The postoperative period of immobilization has a wide range in the current literature. Eder et al[16] immobilized their cohort for 5 weeks on average. All our patients experienced a period of splinting after injury or postoperatively. There is no consensus in the current literature regarding postoperative management with hand therapy or splinting versus plaster.

At our unit, we recognize the importance of hand therapy for patients with hand and wrist injuries, and this study certainly emphasizes that. Patients who were allowed to move early with the hand therapists as tolerated in a thermoplastic splint postinjury or less than 2 weeks postoperatively had better ranges of movement compared with those immobilized for longer periods. However, it should be noted that patients with higher impact injuries or more comminuted fractures or for whom compliance was determined to be an issue were immobilized for longer. These factors could reasonably bias the treating clinician against early immobilization. Furthermore, we feel there may be an inherent subconscious bias in management as surgeons may be less likely to operate on patients they feel may not be compliant with postoperative treatment and instruction.

Study limitations

Although this is one of the largest studies of hamate fractures to be described, our study has some limitations. First, we are a single unit. Second, we did not have an adequate population for a meaningful comparison of fixation techniques; because of limited numbers, we have not compared fixation methods within the operative group. There are currently no clear guidelines for conservative or surgical treatment; thus, the treatment plans may have been determined subjectively by surgeons. Lastly, when stratifying patients according to Milch type 1 or Milch type 2, the statistical analyses are not adequately powered to avoid type II errors.

This study facilitates further research with a larger patient population and a longer follow-up period. However, this may be difficult as these injuries are underdiagnosed. and patients are frequently lost to follow-up.

Conclusions

There has been few studies performed analyzing hamate fractures. We have added to this literature with one of the largest sample sizes of hamate fractures to date. Our findings support the use of nonsurgical treatment for nondisplaced fractures and operative treatment for displaced fractures. This is reflected in our patient population.

It is noteworthy that hamate fractures are difficult to diagnose and can be difficult to treat. In keeping with previous studies, patients who sustain hamate fractures have minimal functional deficits whether managed operatively or nonsurgically.

Longer follow-up is required for hamate fracture outcomes and to compare long-term outcomes between operative and nonsurgical management. Further research including prospective randomized controlled trials comparing operative and nonsurgical management of hamate fractures and comparing fixation methods is required.

Conflicts of Interest

No benefits in any form have been received or will be received related directly to this article.

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