Postoperative management of carpometacarpal joint fracture dislocation of the hand: A case report

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Injury to the carpometacarpal joints is rare. The strong ligamentous attachments and carpal bone alignment readily resist displacement. To the authors' knowledge, there are no studies evaluating postoperative recovery regimens of carpometacarpal fracture dislocations. The present study describes a postoperative hand therapy regimen that used a novel carpometacarpal brace permitting early mobilization.

Key Words: *CMC joint; Fracture dislocation; Rehabilitation; Splinting*

Prise en charge postopératoire d'une fracture avec dislocation de l'articulation carpo-métacarpienne de la main : Rapport de cas

Les blessures à l'articulation carpo-métacarpienne sont rares. La solidité des ligaments et l'alignement du massif carpien confèrent une résistance à la dislocation. À la connaissance de l'auteur, aucune étude n'a porté sur la prise en charge postopératoire des fractures avec dislocation de l'articulation carpo-métacarpienne. La présente étude décrit un traitement postopératoire de la main ayant fait appel à une nouvelle attelle carpo-métacarpienne permettant une mobilisation hâtive.

Multiple fracture dislocations of the carpometacarpal (CMC) joints are rare injuries. The strong ligamentous structures and intricate alignment of the carpal bones readily resist dislocation (1,2). There are numerous case reports and small retrospective studies (3-6) evaluating the treatment and outcome of concurrent CMC fracture dislocations.

Prokuski and Eglseder (7) produced the largest series of multiple CMC fracture dislocations to date. In their retrospective review at a busy trauma centre, they reported 10 cases of concurrent fracture dislocations of the index through small CMC joints over a six-year period. The majority of these were caused by motor vehicle collisions. Their outcome variables assessed postoperative pain, grip strength, range of motion (ROM) and return to work. Pain responses were available for all 10 patients. Five of the patients were pain free at the time of final follow-up. The remaining patients had mild activity-related pain, controlled with activity modification. Strength testing was available for five patients. Grip strength testing at six months postoperatively ranged from 50% to 90% of the contralateral limb. Testing revealed full ROM in six patients. The remaining four patients had decreased ROM that was not functionally disabling. Three of the 10 individuals required additional surgery; all required late arthrodesis. Finally, five of the patients were able to return to their preinjury occupations. The authors concluded that early open reduction and internal fixation offered adequate functional outcomes. Other studies (8) have noted similar operative outcomes.

Multiple CMC dislocations are uncommon and, to the best of our knowledge, there are no large studies that have examined postoperative rehabilitation for this injury. A recent review by Feehan (9) emphasized the importance of early controlled mobilization for reducing postinjury complications of the hand. Common complications that result because of prolonged immobilization include stiffness of hand joints, tendon adhesions and muscle weakness (10). Dowden (10) emphasized that early controlled motion must be balanced with sufficient immobilization at areas of injury (ie, fractures and dislocations) to ensure that adequate healing occurs.

The purpose of the present study is to describe a novel postoperative rehabilitation regimen in a multiple CMC fracture dislocation patient. In particular, we emphasize the need for early, protected ROM activity and the use of a carpal stabilization splint to achieve adequate hand function.

CASE PRESENTATION

A 28-year-old left hand-dominant man sustained an isolated multiple CMC fracture dislocation injury following a motor vehicle collision (Figure 1). Satisfactory closed reduction was not attainable (Figure 2), and open reduction and internal fixation with Kirscher wires was performed through a dorsal transverse incision (Figure 3). The wrist and hand were immobilized in the neutral position for two weeks in a short arm splint and for an additional four weeks in a short arm circumferential cast. The Kirscher wires were removed at the outpatient clinic at eight weeks. Radiographs confirmed union of the trapezium and metacarpal fracture.

Hand therapy, consisting of protective splinting and active-assisted ROM, was initiated eight weeks following injury (Figure 4). The ROM of the affected wrist, metacarpalphalangeal (MCP) and interphalangeal (IP) joints were significantly diminished as a consequence of the injury and prolonged immobilization in a rigid cast (Table 1).

Hand therapy was then progressed to the use of a novel circumferential carpal stabilization brace that the patient wore at all times (Figure 5). The carpal brace extended from the metacarpal heads to the radiocarpal joint. This permitted movement of the radiocarpal and metacarpal joints, while firmly supporting the CMC articulations. Following removal of the cast, the brace was worn at all times. Hand therapy was undertaken in the brace that consisted of gentle passive wrist, MCP and the IP joint ROM and tendon gliding exercises to overcome the limitations at these joints. A finger flexion

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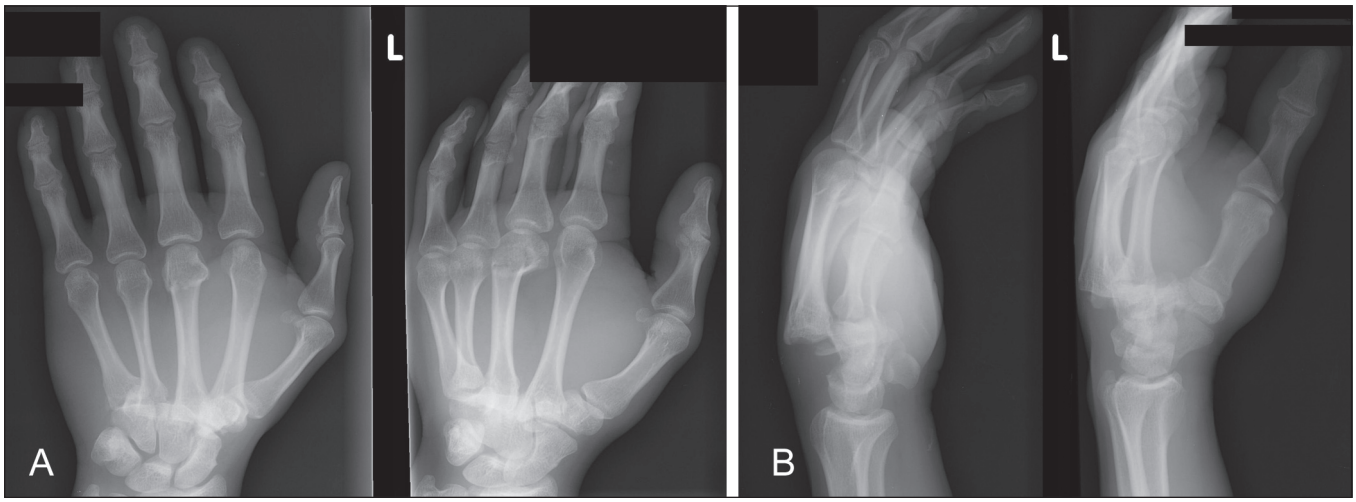

Figure 1) *Posteroanterior and lateral radiographs (***A** *and* **B***) of the left carpus demonstrating dorsal dislocations of the index, middle, ring and small carpometacarpal joint. The fractures of the third metacarpal and trapezium are also visible*

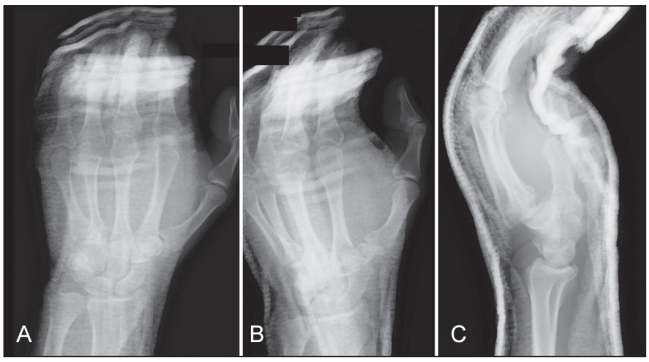

Figure 2) *Postreduction films.* **A** *Posteroanterior view;* **B** *Oblique;* **C** *Lateral*

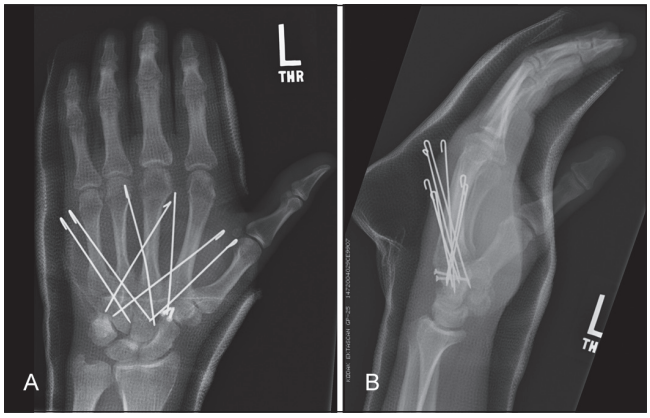

Figure 3) *Postoperative films after open reduction and internal fixation. The trapezoid was fixed with two small screws and reduction of the carpometacarpal was maintained with seven directly placed Kirscher wires*

Figure 4) *Postoperative week 6. The surgical incision is well healed, and the pin sites appear clean*

glove, which provided passive stretching to the digits, was also used for 5 min to 10 min during waking hours. The patient was monitored by the hand therapist on a biweekly basis.

Initially, movements were focused on isolated joints, progressing then to composite movements. Each hand therapy session began with a 10 min period of hydrotherapy followed by active and passive ROM assessments, ROM exercises, resisted extensor and flexor gliding exercises with the brace as the patient progressed.

Full ROM was achieved by 10 weeks postinjury (Figure 6). Wrist and grip strengthening exercises were initiated at 12 weeks, at which point the circumferential brace was discontinued.

Grip strength was evaluated using a hand dynamometer.

DISCUSSION

The CMC joint is a complex joint that readily resists displacement. The bony morphology and the intricate array of ligamentous structures are key in resisting displacement. A recent study by Yoshida et al (2) attempted to model the pathomechanics of ring and small finger CMC injuries. They concluded that dislocation and injury to this joint occurs through a combination of axial loading and shear stresses around the CMC joint. The majority of concurrent CMC fracture dislocations are displaced dorsally and result from high-energy trauma such as motor vehicle collisions (7). Because most CMC dislocations are high-energy injuries, they are not usually amenable to closed reduction. Closed management of multiple CMC fracture dislocations frequently results in redislocation (11). Therefore, surgical treatment is the preferred method of treatment (12).

TABLE 1
Timeline of events and outcome measures

Timeline	Week	Event	Wrist ROM E/F (degrees)	MCP ROM E/F (degrees)	IP ROM E/F (degrees)	Strength, left/right (kg)
May 15	0	Accident				
May 15	0	Surgical fixation				
May 28		Short arm cast in neutral position				
June 31	6	Removed from cast; polyfirm volar splint created	30/40	15/25	Full ROM	
July 5	8	Pins removed; flexion glove and brace applied	45/45	10/65		
July 26	10			Full ROM	Full ROM	
August 9	12	Stopped brace				24/55
Sep 16	16	Strengthening				35/50
Nov 14		Strengthening	Full ROM	Full ROM	Full ROM	46/54

E/F Extension/flexion; IP Interphalangeal; MCP Metacarpalphalangeal; Nov November; ROM Range of motion; Sep September

Prokuski and Eglseder's (7) report is the largest series of multiple CMC fracture dislocations. They found that surgical treatment within four weeks of injury did not seem to affect functional outcome. Kirscher wires are often used to maintain reduction. They provide stable fixation and can easily be removed after fracture and soft tissue healing. Complications of K-wire use include pin breakage, pin track infection and, rarely, nerve damage (13).

Early mobilization of hand injuries remains a controversial topic. Traditional teaching emphasized immobilization of injuries until bony union was achieved (11,14). Patients would then initiate therapy to regain ROM after an extended period of immobilization.

Unfortunately, the traditional approach to rehabilitation is fraught with complications. Tendon adhesions and joint stiffness are major problems associated with prolonged immobilization (11,15). Furthermore, surgical intervention is often required to manage such problems. The radiocarpal, MCP and IP are all immobilized in a traditional short arm cast needed to protect the CMC joint. Intrinsic muscle weakness occurs as a result of disuse and K-wire insertion (15).

Figure 5) *Circumferential carpal brace*

The authors were able to initiate early controlled mobilization of a concurrent fracture dislocation of the CMC joint through the use of a circumferential carpal brace (Figure 5). This device is similar to other functional splints previously described (14,16). Early in the rehabilitation program, the brace minimizes stress at the CMC joints, while motion at the radiocarpal, MCP and IP joints is possible. Later, during the strengthening phase of the rehabilitation, the brace provides circumferential support to the CMC joints during grip strengthening exercises, minimizing translational and/or rotational forces at the CMC joint during exercises.

Unfortunately, we were not involved in the rehabilitation of the patient at the onset of his injury. As a result, the patient was immobilized in a rigid cast for longer than preferred. Nonetheless, active ROM was started at eight weeks (Table 1). Isolated joint motion and composite motion of the MCP and IP joints were the area of focus, as well as radiocarpal flexion and extension.

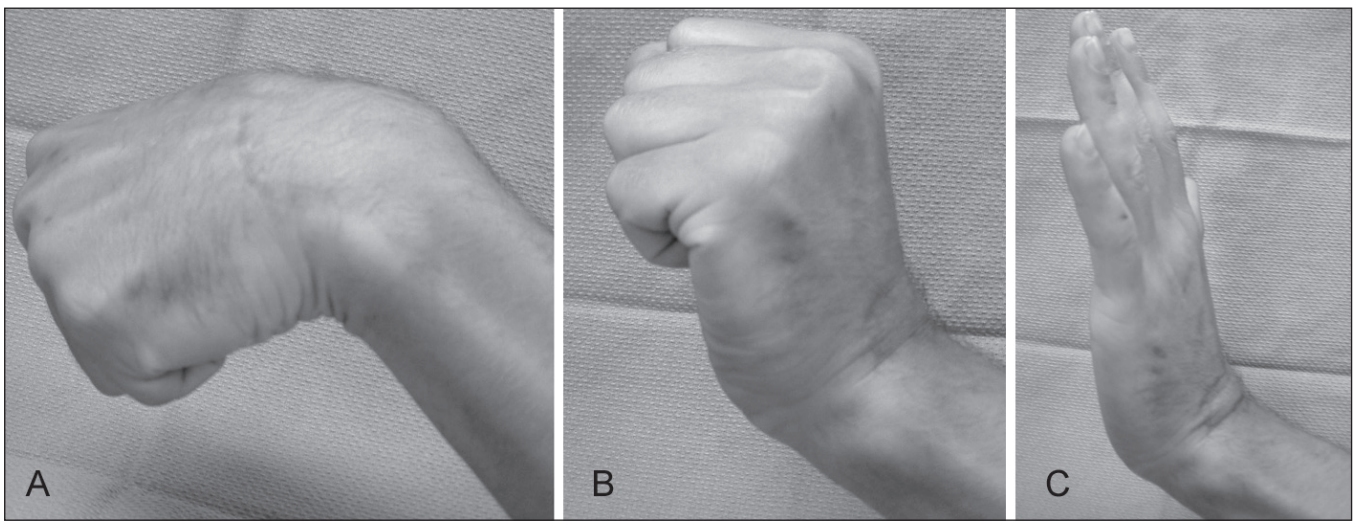

Figure 6) *Range of motion at 10 weeks postinjury.* **A** *and* **B** *Wrist flexion and extension with digits flexed;* **C** *Wrist and finger extension*

CONCLUSION

Multiple CMC fracture dislocations are rare injuries. Complications of prolonged immobilization can be managed by early controlled ROM exercises. The present study describes the use of a novel functional carpal brace that was effective in providing stability to the CMC joints, while allowing early ROM of surrounding joints. Further studies with larger sample sizes are needed to rigorously test the merit of the brace.

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