Multiple Volar Carpometacarpal Dislocations: Case Report/Review of the Literature

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Abstract

Keywords

- ▶ multiple volar carpometacarpal dislocation
- ▶ metacarpal fracture
- ▶ hand injury
- ▶ median nerve injury

Simultaneous volar dislocations of the second through fifth carpometacarpal joints are rare injuries, usually a result of high-energy trauma to the hand. The literature regarding this topic is sparse and consists primarily of case reports. We present a case associated with median nerve contusion that was treated with open reduction and pin fixation. The median nerve injury resolved without incident, and the pins were removed at 10 weeks without loss of reduction. Three years postoperatively, the patient was without pain and had excellent use of his hand without strength or motion deficit.

Carpometacarpal (CMC) dislocations, excluding the thumb, are uncommon and usually associated with direct high-energy trauma to the hand. The inherent stability of the second and third CMC joints often precludes their involvement; thus, most CMC dislocations involve the fourth and fifth CMC joints. The majority of simultaneous, multiple CMC dislocations have been dorsal.¹ Simultaneous volar dislocations of the second through fifth CMC joints are rare and were first reported by Tricksen in 1872.² Furthermore, treatment of these injuries remains controversial,³ and disabling consequences may arise if treated inappropriately.^{3,4} We present a case of volar fracture-dislocation of the second through fifth CMC joints with an associated median nerve injury and a review of the literature.

Case

A 14-year-old, right-hand dominant boy presented with a complaint of left wrist pain after falling on top of his left hand while participating in tackling drills during football practice. Physical examination of the injured hand demonstrated an obvious deformity of the wrist with diffuse edema and ecchymosis over the palm (▶Fig. 1). He had signs and symptoms of median nerve paresthesias.

Anteroposterior, lateral, and oblique radiographs demonstrated a primary volar dislocation of his left second, third, fourth, and fifth metacarpals at the CMC joints as well as intra-articular fractures at the base of the third metacarpal and distal capitate (▶Fig. 2).

Reduction of the CMC joints was performed under conscious sedation as described by Lattanza and Choi.³ With longitudinal traction, the CMC joints were hyperflexed. Pressure was then applied to the volar base of the dislocated metacarpals, particularly the third metacarpal, in a dorsal direction while the metacarpals were gradually extended until reduction was obtained. Computed tomography was obtained demonstrating intra-articular fractures at the base of the third metacarpal, capitate, hamate, and trapezoid (▶Fig. 3). The patient was monitored for an evolving acute carpal tunnel syndrome but remained stable.

Given the CMC joint subluxations, the patient underwent open reduction and internal fixation (ORIF) with two longitudinal incisions placed dorsally, centered over the third and fifth CMC joint. There were abundant chondral fragments within the CMC joint spaces. After debridement, the CMC joints were reduced and stabilized with K-wires. Anatomic reduction of all four joints was confirmed intraoperatively (▶Fig. 4).

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Fig. 1 Clinical photograph at the time of injury demonstrating obvious deformity at the wrist.

The patient was immobilized for 6 weeks during which his median nerve paresthesias resolved. The K-wires were removed at 10 weeks postoperatively and the patient mobilized as tolerated. Three years postoperatively, the patient had normal use of his hand without pain. His CMC joints were stable and he had equal wrist and digit range of motion to his contralateral side without any signs of malrotation. Grip strength was similar between both hands at 37 kg. He had no signs of any median nerve dysfunction. Review of the patient's X-rays demonstrated congruent CMC joints without evidence of arthritis (—Fig. 5).

Discussion

Simultaneous volar dislocations of the ulnar four CMC joints are rare injuries. Literature regarding these injuries is limited and comes almost exclusively from periodic case reports.^{1,2,5,6} The structural anatomy of these joints has previously been described^{2,4–8} and their inherent stability contributes to the infrequent occurrence of these injuries. The enhanced congruency of the trapeziometacarpal and capitometacarpal joints, the latter of which is often referred to as the “central pillar” of the hand, contributes significantly to this stability. The associated tendino-ligamentous complex consists of strong, thick dorsal capsular ligaments arranged in an “A”-type fashion, with one attachment on the metacarpal base and one attachment on each of two carpal bones, weaker volar ligaments, interosseous ligaments, and intermetacarpal ligaments. With the flexor carpi radialis and extensor carpi radialis longus inserting into the second metacarpal base and the extensor carpi radialis brevis inserting into the third metacarpal base, the dynamic compressive stability is enhanced. This rigid complex allows no more than 1 to 3 degrees of movement at the second and third CMC joints. In contrast, the fourth and fifth CMC joints have less congruent articulations and weaker surrounding ligaments leading to less stability and an expected increased injury rate.

The mechanism of injury usually involves a high-energy force^{6,7} directed volarly at the metacarpal base with the ray in an extended position.^{1,2,9} Bajekal and colleagues⁵ have suggested that an initial injury to the capitometacarpal joint, the strongest of the CMC joints, predisposes the rest of the metacarpals to dislocation. The case presented here would seem to support this mechanism as evidenced by dorsal

Fig. 2 Anteroposterior (A), oblique (B), and lateral (C) injury radiographs demonstrating a volar dislocation of the medial four metacarpals at the carpometacarpal joints. Also note the fracture fragments from the base of the third metacarpal and the capitate (C).

Fig. 3 Sagittal CT sections of the left wrist demonstrating fractures at the base of the third metacarpal (arrow) and distal capitate (asterisk). The fracture pattern suggests that there was a hyperextension moment on the third metacarpal with simultaneous compression at the dorsal aspect of the capitometacarpal articulation.

fractures at the base of the third metacarpal and distal capitate.

Due to the extensive soft tissue damage and edema that follow these high-energy injuries, the true deformity is often obscured and may be overlooked if distracting injuries are present. As such, anteroposterior, lateral, and oblique radiographs are essential. In addition, a careful neurovascular assessment, with particular attention to ulnar and median nerve function, is required. Gore¹⁰ reported an ulnar nerve motor deficit, following a volar

fourth and medial fifth CMC dislocation, that was missed on the initial evaluation due to normal ulnar sensation. Release of the hypothenars resulted in decompression of the motor branch and full recovery of function. Weiland et al⁹ reported an acute carpal tunnel syndrome following volar dislocations of the second and third CMC joints. The patient underwent surgical decompression of the median nerve with subsequent resolution within 24 hours. The patient presented within this report developed a median nerve neurapraxia which presumably was secondary to the

Fig. 4 Anteroposterior (A) and lateral (B) fluoroscopic images taken intraoperatively demonstrating anatomic reduction of all four CMC joints.

Fig. 5 Anteroposterior (A) and lateral (B) radiographs 3 years postoperatively demonstrating congruency of all four CMC joints without evidence of arthritis.

injury or a developing hematoma around the nerve. This completely resolved without incident.

Initial management of these injuries requires timely reduction of the CMC joints, fixation of any associated fractures, and, should a neurological deficit be present, decompression of the median and/or ulnar nerve. Definitive treatment remains controversial³ and may include closed reduction and casting, closed reduction and percutaneous pinning (CRPP), or ORIF. While closed reduction should be attempted in all CMC dislocations, this treatment alone is often unsuccessful secondary to the inherent instability.^{2,3,8} In addition to the capsular damage that inevitably occurs, interposed capsule and/or edema around the CMC joints may contribute to the instability following closed reduction alone.³ Furthermore, as observed in the present case, when the CMC joints are visualized, there is frequently cartilaginous and/or bony debris within them preventing an anatomic reduction. The resulting instability, contrary to previous reports,^{2,6} has been shown to predispose the patient to disability and loss of function, including but not limited to joint stiffness, pain, weakness, recurrent dislocation or subluxation, and/or post-traumatic arthritis.^{1,3} Accordingly, the literature recommends ORIF in cases of multiple dislocations to produce early, stable anatomic reduction^{3,4,7,8} to allow faster mobilization. Due to the rarity of this injury pattern, no comparative outcome studies exist to guide treatment.^{4,7}

While ORIF can be technically challenging with inherently more surgical risk compared with CRPP, it offers important benefits. The primary benefit is the ability to directly visualize the CMC joint, which may involve intra-articular fractures and impediments to anatomic reduction. In addition, transfixation of the extensor tendons that can occur with percutaneous pin fixation^{4,8} can be avoided, thereby allowing early unimpeded active digit motion.⁷

To the best of our knowledge, there have been no studies evaluating the ideal length of time for K-wire fixation of these joints,⁷ and only two studies exist in which K-wire pinning has been used following volar dislocations of the second through fifth CMC joints. Kleinman and Grantham² reported an “excellent” result 10 weeks after open reduction and K-wire pinning. The K-wires were removed after 5 weeks due to the age of the patient, but they recommended removal no earlier than 6 weeks in adults. Fifteen weeks (range, 12–16 weeks) following CRPP, Kumar et al¹ reported one “fair” and two “good” outcomes following K-wire immobilization for 4 to 6 weeks.

In the present case, we left the pins in place for 10 weeks to allow sufficient ligamentous and soft tissue healing. Although referring to multiple *dorsal* CMC dislocations, this longer duration of immobilization is supported by several authors,^{4,7,8} with removal at 12 to 13 weeks on average. Stiffness secondary to immobilization, often a concern with the

metacarpophalangeal joints, is less worrisome in the CMC joints as motion is minimal in the second and third CMC joints and no more than 30 degrees in the fourth and fifth.^{7,10}

In conclusion, we have presented a rare case of volar fracture-dislocation of the medial four CMC joints with an associated median nerve injury. The median nerve paresthesias resolved by the seventh postoperative week without any sequelae. Three years postoperatively, the patient was without pain and had no functional deficits. This injury pattern is potentially disabling if treated inappropriately. Closed reduction is rarely successful and usually requires open reduction and pin fixation. This case noted no adverse effects with prolonged K-wire fixation across the CMC joints. It is also imperative to thoroughly evaluate the status of the median and ulnar nerves which can be susceptible to neurapraxia from the injury itself, hematoma, or the deformity prior to reduction. A low threshold for median and/or ulnar nerve decompression should be maintained if dysfunction remains at the time of surgery or worsens. Further evidence is needed to determine the ideal treatment method and duration of immobilization.

Conflict of Interest
None.

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