Closed-Reduction Percutaneous Pinning of a Complex Divergent Carpometacarpal Fracture-Dislocation Involving the 4 Ulnar Carpometacarpal Joints

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Multiple carpometacarpal (CMC) fracture-dislocations are high-energy injuries that are occurring with increasing frequency.[1-8] The amount of displacement depends on the position of the hand and wrist at time of injury and the vector and location of the force applied.[7] Dislocations involving the 4 ulnar CMC joints are uncommon, with associated divergence exceedingly rare.[1-10]

We report the case of a complex divergent fracture-dislocation involving the ulnar 4 CMC joints with divergence occurring between the second and third CMC joints and an associated dorsal fracture fragment of the third metacarpal base. We also describe the technique of closed reduction and percutaneous pinning for this injury. This case highlights the combination of a complex divergent CMC fracture-dislocation, a rare injury that is being seen in trauma centers more often. The authors have obtained the patient's informed consent to publish his case report.

Case Report

A right-hand-dominant man in his early 40s was involved in a single motor vehicle accident. The patient was transported to a regional level I trauma center complaining of neck tenderness and right hand pain. Three radiographic views of the hand and a trauma series of the cervical spine were obtained. Physical examination of the hand revealed a soft, swollen palm with obvious bony deformity with volar fullness. With palpation of the carpus and hand, significant crepitance was noted. A lateral fluoroscopic image of the hand showed volar dislocation of the 3 ulnar metacarpals at their respective CMC joints and dorsal dislocation of the second metacarpal at the metacarpal trapezoid joint. In addition, a dorsal fracture fragment off the third metacarpal base was noted (Figure 1). An anteroposterior fluoroscopic image of the hand showed radial dislocation of the 3 ulnar metacarpal bases with loss of CMC congruity; in addition, the second metacarpal base was noted to overlap the trapezoid (Figure 2). Cervical spine films showed a nondisplaced C6–C7 lamina fracture, which was treated with a cervical collar.

"Our reduction maneuver used the increased mobility of the ulnar 2 metacarpals to reestablish ulnar column stability..."

Closed reduction of the right CMC dislocations was attempted in the trauma bay, and the patient's hand and wrist were placed in a single sugar-tong splint and pillowcase sling in anticipation of further swelling. Postreduction radiographs showed continued divergent dislocation of the second CMC joint and the ulnar 3 CMC joints. The orthopedic hand service was consulted the next morning, and operative intervention

Figure 1. Lateral fluoroscopic image shows dorsal dislocation of second metacarpal and volar dislocation of the remaining ulnar 3 metacarpals.

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Figure 2. Anteroposterior image of radially dislocated ulnar 3 metacarpals with overriding of the articular surface of the second on the trapezoid.

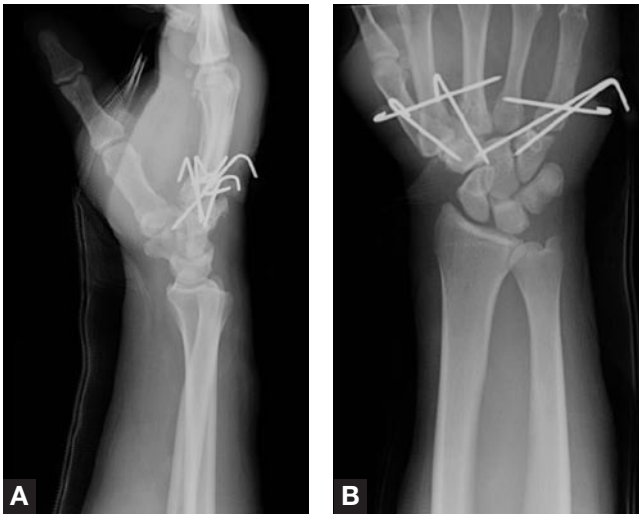

Figure 3. Final (A) lateral and (B) anteroposterior radiographic images show anatomical alignment of carpometacarpal joints after closed reduction and percutaneous pinning.

was planned on an urgent basis. The patient's hand was monitored for compartment syndrome for the duration of his hospitalization.

Operative Technique

In the operative suite, under fluoroscopic guidance, closed reduction was achieved in the anteroposterior plane with longitudinal traction on the digits and application of a radially directed force at the metacarpal heads. Reduction was attained in the sagittal plane with a dorsally directed force on the ulnar 3 metacarpal bases and simultaneous application of a volarly directed force to the metacarpal heads of these same digits. The index finger required a volar force on the metacarpal base with a dorsal moment on its distal head. Maintaining this reduction in anticipation of percutaneous pinning was complex and required use of two 0.062-in fully threaded Steinmann pins as reduction levers. One pin was placed in the fifth metacarpal base, the other in the base of the third metacarpal base. With application of these forces, the ulnar column of the CMC complex was reduced, and the fifth metacarpal was pinned to the hamate using a smooth 0.062-in Steinmann pin. A transverse pin was placed from the proximal diaphysis of the fifth metacarpal to that of the fourth.

Once the ulnar column was stabilized, the second CMC joint was addressed by the reduction maneuver, which was followed by pinning the second metacarpal to the trapezoid and transverse-pinning the second to the third metacarpal. Stability was then assessed fluoroscopically, and it was decided that pinning the base of the third metacarpal to the capitate was necessary for ultimate stability. The 2 threaded Steinmann pins were removed, and final radiographic images were obtained (Figures 3A, 3B). Pin caps were placed, and the hand was sterilely dressed and placed in a volar splint. The pins were left in place for 6 weeks. Hand therapy was initiated on postoperative day 3 for edema control and range of motion of the proximal and distal interphalangeal joints of the entire hand. At 6 weeks, the patient's pins were removed, and formal therapy for the entire hand was initiated. A protective, volar splint was used in the interim between therapy sessions for an additional 6 weeks.

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Discussion

The anatomy of the ulnar 4 CMC joints has been well described, with their inherent stability dependent on the extrinsic flexor and extensor tendon expansions, the transverse metacarpal ligaments, and the unique articular union of the carpals and metacarpals.[4,6-8] The base of the transverse metacarpal arch of the hand is formed by this complex arrangement of CMC joints.[4] Stability progressively decreases the more ulnar one goes. The CMC joints are saddle joints, where the metacarpal base is convex and the distal surface of the carpals is concave. This relationship becomes less pronounced as one progresses toward the ulnar column of the hand and is a major contributor to the decreased stability that the fourth and fifth metacarpals exhibit. This becomes a major factor in the relative frequency of CMC fracture-

dislocations, with the fourth and fifth metacarpals being far more commonly involved.[4,6-8]

Our patient's mechanism of injury was consistent with a high-energy incident. Kumar and colleagues[7] described the need to apply a torsional force to achieve a "divergent variant" of multiple CMC dislocations in which divergence is defined as one or more joints dislocating volarly with concomitant dislocation dorsally of one or more joints. Given the number of static stabilizers surrounding the CMC joints, it is far rarer to have pure, multiple CMC dislocations without a simultaneous fracture. As in our patient's case, a fracture of the dorsal lip of the third metacarpal base disrupted both the radial and ulnar columns of the hand. His so-called keystone, the index and middle CMC joints,[4] was disrupted and divergent. Our reduction maneuver used the increased mobility of the ulnar 2 metacarpals to reestablish ulnar column stability, thus serving as a foundation on which to build.

Presentation of multiple complex CMC joint dislocations is rare.[1-10] Most cases are associated with high-energy injuries, so concomitant injuries should be investigated and addressed in a timely manner. The mechanism of the deforming force aids in planning the necessary reduction maneuver. Attempts at closed reduction should be made with the knowledge that in most instances percutaneous pinning or open reduction and internal fixation will have to be performed.

Authors' Disclosure Statement

The authors report no actual or potential conflict of interest in relation to this article.

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This paper will be judged for the Resident Writer's Award.

Guest Editorial

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