Coronal Hamate Fracture Associated With Carpometacarpal Dislocations of All of the Fingers: Review of the Literature and Case Report

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Abstract

Background: Dislocation of all 5 carpometacarpal (CMC) joints of a single hand is a rare injury. **Methods:** The literature regarding CMC fracture-dislocations was reviewed and a case was presented. **Results:** The relevant literature was consolidated to clinically relevant categories including 'Clinical Presentation and Diagnosis,' 'Management of CMC Fracture Dislocation and Hamate Fractures,' and 'Outcomes.' **Conclusions:** The mechanism associated with this injury is often high energy that causes multiple simultaneous life- or limb-threatening injuries that could distract the examiner from identifying this injury. The case we present involves an axial dislocation of the carpus that resulted in dorsal dislocations of all CMC joints, dislocation of the hamate-capitate articulation, as well as fractures of the first metacarpal and the hamate.

Keywords: carpometacarpal dislocation, hamate fracture, fracture-dislocation, carpal fracture, carpometacarpal fracture-dislocation

Introduction

Dislocation of all 5 carpometacarpal (CMC) joints is rarely reported in the orthopedic literature, with fewer than 2 dozen cases since the first documented case in 1873.^{1,4,5,9} The mechanism of injury is often high energy and involves a direct axial force delivered to a clenched or semiclenched fist or a crush injury to the hand.^{1,4,5,9} The direction of the CMC joint dislocation, dorsal or volar, is determined by the direction of the force that is delivered to the hand.⁸ The carpal and metacarpal bones acquire significant stability from bony congruence, muscles, tendons, and a strong CMC and intermetacarpal ligamentous complex.⁸ The strength of these ligaments often results in dislocations that are associated with fractures of the carpal or metacarpal bones.⁸

The distal carpal row and the middle and index fingers form the stable unit around which the thumb and small finger rotate.⁸ The stable second and third CMC joints allow 1° and 3° of motion with flexion and extension, respectively.^{6,8} In contrast, the fourth and fifth CMC joints, which articulate with the saddle-shaped hamate, have significantly greater mobility, (8°–15° and 15°–40° of motion with flexion and extension, respectively), predisposing these joints to dislocation.⁸

The case we present involves an axial dislocation of the carpus that resulted in dorsal dislocations of all of the CMC joints, dislocation of the hamate-capitate articulation, as well as fractures of the first metacarpal and the hamate. We

will discuss the classification and management of hamate fractures in addition to the diagnosis and management of CMC joint dislocations.

Clinical Presentation and Diagnosis

Given the high-energy mechanisms associated with CMC joint dislocations, including motor vehicle and motorcycle collisions, patients often present with other life- or limb-threatening injuries that could potentially delay detection and diagnosis of CMC dislocations.⁵ As the patient is often unable to report injuries on interview, a thorough exam is particularly important once the patient is stabilized. Hand swelling in the setting of high-energy trauma must be evaluated with radiographs to identifying fractures and/or dislocation as a possible cause of the swelling.

Anteroposterior and lateral radiographs of the hand are needed to assess for cortical irregularities and joint symmetry.⁷ In addition, the oblique view with the hand in 30°

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to 45° of pronation is important in the radiographic evaluation of the ring and small finger CMC joints.^{2,3} McDonald et al performed a careful evaluation and comparison of normal lateral radiographs of the hand with lateral radiographs of patients with known ring and small finger CMC joint dislocations.⁷ Their investigation revealed that the normal angle between the index and small finger metacarpal shaft (I-S IMA) and the normal angle between the long and small finger metacarpal shafts (L-S IMA) averages 6°. In patients with a known CMC dislocation involving the hamate metacarpal joints, the mean I-S IMA was 18° and the mean L-S IMA was 16°. Their analysis revealed that an IMA angle greater than 10° is 92% sensitive and 81% specific for detecting a CMC joint dislocation. In the setting of radiographs that demonstrate a CMC dislocation or those that are equivocal but the clinical suspicion for occult fracture of subtle dislocation is high, computed tomography may help confirm the diagnosis of a CMC dislocation and assist in identifying fractures that are obscured by bony overlap.^{1,7}

Management of CMC Fracture Dislocation and Hamate Fractures

CMC Dislocation

CMC joint dislocations must be reduced to prevent the inevitable complications of degenerative arthritis, decreased grip strength, and decreased range of motion.^{1,7} Reduction should initially be attempted closed, with supplemental Kirschner wire (K-wire) fixation as needed. In cases where closed reduction is unsuccessful, open reduction and internal fixation must be performed.^{1,5} Simultaneous carpal tunnel release should be considered if the patient exhibits any signs or symptoms of acute carpal tunnel syndrome preoperatively.⁹ Postoperatively, the reduction should be protected in a splint for 6 weeks and interval radiographs must be obtained to ensure that the intraoperative reduction is maintained.^{4,9} The pins should be removed at 6 weeks to allow for “early” mobilization in order to prevent stiffness and optimize function.⁴

Hamate Fractures

Nondisplaced hamate body fractures are immobilized in a short arm cast for 6 weeks and are closely observed for loss of reduction.¹⁰ Displaced hamate body fractures should be open reduced and internally stabilized with compression screws, K-wires, or low-profile plates.¹⁰

Outcomes

Patients with CMC joints dislocations that are promptly diagnosed and addressed may be able to return to normal and painless function in their previous labor-intensive occupations.^{1,4,9} In those cases where CMC joint dislocations are

Figure 1. Anteroposterior (a), oblique (b), and lateral (c) radiographs of the wrist revealed dorsal dislocations of all of the carpometacarpal joints, as well as fractures of first metacarpal and hamate.

missed and are not reduced, patients develop degenerative arthritis, decreased grip strength, and decreased range of motion.⁷

Case Report

A 28-year-old male who was involved in a rollover motor vehicle collision and was intubated on arrival to the emergency department was found to have left hand swelling and lacerations about both the volar and dorsal aspects of the wrist. Further examination revealed that the hand was grossly unstable. Due to his condition, no motor or sensory exam could be obtained. Plain radiographs revealed an axial dislocation of the carpus that resulted in dorsal dislocations of all CMC joints, dislocation of the hamate-capitate articulation, as well as fractures of the first metacarpal and the hamate (Figures 1a-1c). Other injuries included bilateral pulmonary contusions and pneumothoraces, scalp lacerations, and a first rib fracture. He received cefazolin and a tetanus shot upon arrival.

Initial Attempted Reduction and Immobilization

While in the trauma intensive care unit (TICU), the wounds were thoroughly irrigated, and closed reduction was attempted. The patient was sedated with midazolam and propofol, his fingers were placed in fingertraps with 2 kilograms of countertraction, and after 10 minutes continuous traction, reduction was attempted. In addition to the distractive forces of the fingertraps, a dorsal force was applied to the metacarpal bases temporarily reducing the CMC joints with a palpable clunk, although they were felt to be highly unstable. Using digital x-ray at the bedside, reduction was confirmed, and the hand and digits were splinted in situ in preparation for surgery later that day.

Operative Management

Once the patient was stabilized, he was transferred from the TICU directly to the operating room. The procedure began with a thorough irrigation and debridement of the large

Figure 2. (a) The thumb CMC joint was close reduced and pinned with a 0.54 Kirschner wire. (b) The coronal hamate body fracture was open reduced and fixed with a 0.54 Kirschner wire and a single 1.3-mm screw. (b-d) Once the hamate was reduced and stable, the remaining CMC joints were easily reduced and the ring, middle, and index fingers were each pinned with a single 0.54 Kirschner wire.

Note. The coronal hamate body fracture was reduced and fixed with a 0.54 Kirschner wire and a single 1.3-mm screw. Fluoroscopy and visual exam revealed excellent reduction of the hamate fracture; however, the hamate itself was still noted to be dorsally dislocated. This was reduced and pinned to the capitate. Once the hamate was reduced and stable, the remaining CMC joints were easily reduced and pinned, and the ring, middle, and index fingers were each pinned with a single 0.54 Kirschner wire.

laceration overlying the thumb CMC joint. The thumb CMC joint was then reduced and pinned with a 0.54 K-wire. Several attempts were made to reduce the CMC joints from radial to ulnar. The index and middle finger CMC joints were found to be very unstable, and attempts of maintaining adequate reduction to allow for percutaneous pinning were unsuccessful. Therefore, we turned our attention to the ulnar digits. We attempted to reduce the fifth CMC, but our efforts were thwarted by a fracture dislocation of the hamate. A small incision was made over the 4/5 CMC joint, and the coronal hamate body fracture was identified. This was reduced and a 0.54 K-wire was used to stabilize the hamate. A single 1.3-mm screw was placed in addition to the K-wire. Fluoroscopy and visual exam revealed excellent reduction of the hamate fracture; however, the hamate itself was still noted to be dorsally dislocated. This was reduced and pinned to the capitate. Once the hamate was reduced and stable, the remaining CMC joints were easily reduced and pinned; the ring, middle, and index finger were each pinned with a single 0.54 K-wire. The fifth finger was found to be well attached to the volar fragment of the hamate and stable enough to not require a K-wire. All wounds were again thoroughly irrigated and then closed using 4-0 Nylon. A sterile dressing and splint were applied. Intraoperative radiographs revealed successful reduction of all the CMC joints (Figures 2a-2d).

Follow-up

The K-wires were removed 6 weeks postoperatively. At the 4-month follow-up visit, the patient had full painless range of motion of all of his left metacarpophalangeal (MCP) and proximal and distal interphalangeal joints except for his thumb. Unfortunately, the patient did not comply with his

Figure 3. Anterior (a), oblique (b), and lateral (c) radiographs of the left hand at the 4-month follow-up visit.

postoperative hand therapy program. As a result, he developed a thumb adductor contracture (Figures 3a-3c), which limited the motion at his thumb MCP and prevented him from being able to grasp handles on the equipment he used at work. This contracture persisted for total of 6 months despite intensive hand therapy. Therefore, a decision was made to return to the operating room to release his left thumb contracture and CMC joint capsule. The contracture and CMC hyperextension were corrected and pinned with a K-wire. One month later, the pin was pulled. He noticed immediate improvement in pinch strength and subsequently was able to return to work.

Discussion

Dislocation of all 5 CMC joints of a single hand is a rare injury.^{1,4,5,9} The mechanism associated with this injury is often high energy that causes multiple simultaneous life- or limb-threatening injuries that could distract the examiner from identifying this injury.^{5,9} Therefore, the examiner must vigilantly perform a secondary trauma assessment in patients presenting with injuries resulting from a high-energy mechanism, such as a motor vehicle or motorcycle collision. In cases where CMC joint dislocations are missed and are not reduced, patients develop degenerative arthritis, decreased grip strength, and decreased range of motion.⁷

Bergfield et al reported a case of a 20-year-old male whose hand crushed in a motorcycle accident.¹ Examination revealed significant hand swelling and a foreshortened hand that was thickened in the anteroposterior plane. Imaging revealed fracture dislocation of all five CMC joints. Open reduction and internal fixation resulted in excellent cosmetic and functional results at 2 years follow-up.

Edwards et al reported a case of a 27-year-old male involved in a motor cycle collision that resulted in dislocations of all five CMC joints and a closed fracture of the fifth metacarpal neck.⁴ All the CMC joints were closed reduced and percutaneously pinned with K-wires. At 6 months postoperatively, patients had reported no pain and had returned to work; however, they did report decreased grip strength.

Fayman et al reported a case of a 48-year-old female involved in a motor vehicle collision that resulted in a blunt

injury to the hand.⁵ Examination revealed a swollen hand with several lacerations at the palm of the hand. Imaging revealed dislocation of all of the CMC joints, fractures of the middle and small finger metacarpals, and a fracture of the index finger metacarpal. The thumb CMC joint and the index finger metacarpal fracture were closed reduced and percutaneously pinned with a K-wire. The other CMC joints were not reducible by closed means because of soft tissue interposition and had to be reduced via an open dorsal approach. The interposed soft tissue was removed from the joints, and reduction was maintained with K-wire. The patient had an excellent functional result at 8 months follow-up.

Reznick et al reported a case of a 29-year-old male involved in a high-speed motorcycle collision that resulted in multiple organ system injuries, in addition to fracture-dislocations of all of the CMC joints of his right hand.⁹ Closed reduction was unsuccessful because of significant swelling. Open reduction was performed and the dislocations were stabilized with K-wires. The patient also developed acute carpal tunnel syndrome, and his carpal tunnel was released during the case. He had normal hand strength with a 10° extension and flexion deficit at follow-up.

Cain et al reported a series of 17 patients with a fourth metacarpal fracture and fifth CMC joint dislocation.² They classified these injuries into 3 types. They found that CMC fracture-dislocations which included a fracture of the hamate were consistently unstable requiring open reduction and internal fixation of the hamate and the CMC joint.

Our case was unique in that our ability to reduce and percutaneously pin the second to fifth CMC joints was limited by the remarkable instability that resulted from the coronal hamate fracture. Once we identified and fixed the hamate fracture, the reduction and fixation of the second to fifth CMC joints proceeded without difficulty. Therefore, in cases of five CMC joint dislocations in one hand associated with a hamate body fracture, we recommend addressing the hamate fracture with open reduction and internal fixation prior to proceeding with reduction and pinning of the CMC joints.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation

(institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. According to the Lifespan IRB Policy and Procedure Manual, case reports are not considered research and are exempt from IRB approval.

Statement of Informed Consent

We obtained written consent from patient to allow us to publish his case information, clinical pictures, and radiology.

Declaration of Conflicting Interests

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