Volar dislocation of the second and third carpometacarpal joints: A case report and detailed mechanism of injury

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ABSTRACT

Introduction: Carpometacarpal (CMC) joint dislocations are rare injuries that are difficult to diagnose radiographically. The third metacarpal articulates with the capitate bone at the wrist more proximally, and forms the strongest of all CMC joints. Therefore, dislocation of this joint may lead to an increased risk of instability and failed reduction. The present case highlights a unique injury pattern that is frequently overlooked.

Case Report: A 28-year-old man presented for examination of his left hand after a high velocity fall while skateboarding. A video recording provided at the office visit depicted the inciting injury. The converging forces during the fall caused hyperextension of the wrist at the base of the second and third metacarpal bones. Initially after this incident he arrived at the emergency department where computed tomography (CT) scans were interpreted as normal. Two weeks later, he presented in clinic with increased weakness and pain and X-rays showed dislocation of the second and third CMC joint. The following day, open reduction and external fixation (ORIF) was performed. Eight weeks after surgery, the patient presented with excellent range of motion, and X-rays of the hand showed stable articulation of the second and third CMC joints.

Conclusion: Few cases of volar dislocations of the second and third CMC joints have been reported.

Treatment for CMC joint dislocation is controversial. However, early ORIF has shown excellent clinical outcomes for patients with multiple CMC dislocations. Thorough clinical and radiographic examination is necessary to prevent chronic dislocation which may lead to diminished grip strength, nerve damage, and carpal instability.

Keywords: Carpometacarpal, CMC, Dislocation, Volar, Wrist

INTRODUCTION

Carpometacarpal (CMC) joint dislocations are rare injuries that are difficult to diagnose radiographically [1]. These injuries are frequently missed or delayed in diagnosis due to concomitant hand swelling and superimposed hand bones [2, 3]. Most dislocations occur at the fourth and fifth digits, with the fifth digit being reportedly involved in up to 80% of cases [4–6]. Dislocation of the second and third CMC joints is even less common. The third metacarpal articulates with the capitate bone at the wrist more proximally, and forms the strongest of all CMC joints [3]. Therefore, dislocation of this joint may lead to increased risk of instability and failed reduction [7, 8].

The second and third CMC joints at the index and long finger are essentially immobile, allowing only about 1–3 degrees of motion [4, 9]. Volar and dorsal ligaments, as
well as the surrounding hand and wrist muscles provide
dynamic stabilization at this joint [10]. Both dorsal and
volar dislocations have been reported in the literature
based on direction of force. Previous reports suggest
that dorsal CMC joint dislocations occur at higher rates
[3, 10]. Few cases of volar dislocations of the second and
third CMC joints have been reported, with most cases
occurring via high-energy trauma during motor vehicle
accidents [11–14]. However, the present case highlights
a unique and detailed mechanism contributing to a rare
injury pattern that is frequently overlooked.

CASE REPORT

A 28-year-old man presented for examination of his
left hand after a high velocity fall while skateboarding. A
video recording provided at the office visit depicted the
patient riding his skateboard over the length of a grind
rail, in the “regular” skateboard stance, with his left foot
forward (Video 1). His skateboard suddenly slipped from
underneath him during his stunt and he began falling
towards the rail. At that point, he reached down between
his legs to grab the rail with his arm fully extended using
his left hand to brace for impact. As he grabbed the rail
with his left hand, he increased axial compression onto
the wrist extended at 90° while the weight of his body
moved inward and inferiorly onto his wrist below him.
His left leg also came forward and forcefully pushed on
his arm just below the posterior aspect of the elbow. The
converging forces applied to the wrist in this position
caused an abrupt dorsiflexion of the hand leading to
hyperextension of the wrist with slight radial deviation.
The direct, high velocity impact at the CMC joint in the
present case caused the base of the second and third
metacarpal bones to shift volarly.

Initially after his incident he arrived at the emergency
department where CT scans were taken of the left
upper extremity, and interpreted as no acute fracture
or subluxation. Two weeks after the inciting event, he
presented in our clinic with increased weakness and pain.
On physical exam, the patient had diffuse swelling of the
left hand and wrist with tenderness over the second and
third CMC joints. After clinical examination the patient
underwent radiographic evaluation. Anterior posterior
(AP), lateral, and oblique views of the wrist and hand
were taken and reviewed by a board-certified orthopedic
hand surgeon. Lateral view indicated a dislocation of
the second and third CMC joints. Further radiographic
evaluation showed widening of the second and third CMC
joint space, but no accompanying fractures or associated
injuries of the hand or wrist (Figure 1).

The following day, open reduction and external
fixation (ORIF) of the left index and long fingers was
performed. The metacarpals were stably reduced, and
fixation was maintained by two 0.045” Kirschner wires
(pins) driven through the third metacarpal, across
the CMC joint, into the capitate and trapezoid bones,
respectively (Figure 2). The patient was placed into a
volar wrist splint immediately after surgery and switched

Figure 1: (A) AP, (B) Oblique, (C) Lateral radiographic views
displaying volar dislocation of the second and third metacarpals
at the CMC joint of the left hand.

Figure 2: (A) AP, (B) Oblique, (C) Lateral radiographic views
after ORIF, displaying reduction and k-wire placement across
the third CMC joint.
into a thermoplastic splint at his first post-operative visit three days later. Active finger movements were started on first postoperative day to prevent stiffness. Sutures were removed after two weeks, and pins were removed at the 4-weeks postoperative visit. At 8-weeks follow-up, the patient presented with excellent strength and range of motion, and X-rays of the hand (3-views) showed stable articulation with no subluxation of the second and third CMC joints (Figure 3).

![Figure 3: (A) AP, (B) Oblique, (C) Lateral radiographic views depicting complete reduction and healing of CMC joint 8-weeks postoperatively.](image)

**DISCUSSION**

Carpometacarpal dislocations have been well characterized in the literature with an incidence of less than 1% of all hand injuries [1, 4, 15]. Previous studies show the fourth and fifth CMC joints are most frequently involved in dislocation injuries due to high mobility and loose ligamentous attachments [4–6]. However, dislocation of the second and third CMC joints are rarely reported [11]. Nonetheless, the index and long finger metacarpals are important pillars of the hand with increased rigidity [9, 16]. Additional insertion of the flexor carpi radialis and extensor carpi longus and brevis muscles allow minimal range of motion around these joints [14]. When the patient grabbed the rail with the wrist radially deviated, the flexor carpi radialis muscle was activated which attaches volarly at the base of the second and third metacarpals. The contraction of this muscle forcefully pulled the metacarpals, while simultaneous hyperextension at the wrist pushed the metacarpals in the same direction, leading to volar dislocation.

The third CMC joint is historically known for its anatomic positioning more proximal than its co-parts [11]. In cases of multiple CMC joint dislocations, previous studies state the third CMC joint is a “key-stone” and must be re-set before others [3]. The third metacarpal articulates with the capitale bone, which is the center piece of the wrist and largest carpal bone [3]. Notably, all the muscles responsible for movement at the wrist cross axes of rotation located at the capitale bone which may lead to greater instability upon dislocation [14].

Treatment for CMC joint dislocation is controversial [15] and may be treated conservatively via close reduction and splint immobilization, or operatively via ORIF with Kirschner wires, as seen in the present case. However, closed reduction has reportedly higher risk of re-dislocation and non-union of accompanying fractures, if present [1]. Operative management is favored due to opportunity for debridement of the joint space, drainage of local hematoma, and repair of damaged tendons [8]. Early ORIF has shown excellent clinical outcomes for patients with multiple CMC dislocations [1, 15].

The present case is representative of the commonly missed emergency room (ER) diagnosis of a CMC dislocation, usually attributed to posttraumatic edema [3]. Radiographic indications for assessment are consistent with AP, lateral, and oblique views being gold standard for identifying CMC dislocations [8, 12]. Computed tomography (CT) may be used for diagnosis in the case of occult X-ray findings or accompanying carpal bone fractures [4]. However, in this case, CT scans were interpreted as normal. Thorough clinical and radiographic examination is necessary to prevent misdiagnosis leading to chronic dislocation, nerve damage, and carpal instability [9, 15].

**CONCLUSION**

We report a rare case of volar CMC dislocations of the index and long finger metacarpals successfully treated with ORIF. This case is of interest as the exact incident was recorded on video, providing a clear understanding of the forces that caused the injury. Due to the rarity of this injury, it is subject to missed diagnosis in the emergency setting. This study highlights a unique mechanism of injury to a key stabilizing joint of the wrist.

**REFERENCES**

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Author Contributions

Nicholas D Thomas – Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Sebastián Frontera Rodríguez – Acquisition of data, Analysis of data, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

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All relevant data are within the paper and its Supporting Information files.

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