

Case Report

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Divergent Carpometacarpal Fracture Dislocation-An Uncommon Injury Pattern

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Abstract

Carpometacarpal fracture dislocation of the hand is a relatively uncommon injury pattern. This injury is difficult to diagnose clinically, because of gross hand swelling which may obscure the characteristic deformity. The diagnosis of this unusual injury pattern also requires lateral radiograph of the hand which is essential for making precise diagnosis in suspected cases. We are presenting a case of divergent carpometacarpal joint fracture dislocation of index, middle and ring fingers with associated fracture of base of proximal phalanx of thumb and base of thumb metacarpal bone. Closed reduction supplemented with Kirschner wire fixation restored normal carpometacarpal joint anatomical alignment and achieved excellent clinical result.

Keywords: Carpometacarpal fracture dislocation; Anatomical alignment

Introduction

Traumatic injury to carpometacarpal joints was first described by Bladin (1844) when he noted dorsal dislocation of base of middle and index fingers. In 1918, McWhorter [1] described volar dislocation in 1918. In 1968, Nalebuff [2] noticed volar radial dislocation of 5th carpometacarpal joint.

Carpometacarpal dislocations may occur due to high energy trauma like motor vehicle accident, crushing injuries, fall from height or low energy injury e.g. fist fight or fall on hand. The volar or dorsal displacement of metacarpals is determined by the direction of the force applied to the hand at the time of injury and position of hand [3]. It is rare for multiple carpometacarpal dislocation to occur without associated fracture. Divergent carpometacarpal fracture dislocations are even rarer [4,5]. To achieve a "divergent variant" of multiple carpometacarpal dislocations a torsional force is required [6]. Multiple carpometacarpal fracture dislocations are rare which account for less than 1% injuries of the hand [7]. Lateral radiograph of the wrist has been mandatory to its precise diagnosis, if suspected.

Case Report

A 38-year old, right hand dominant male, presented with complaints of relentless pain and gross swelling of his right hand after he slips and fell from fast running motor cycle (90 km/h). The patient was unable to recall the exact mechanism of the injury and position of hand at the time of injury. On inspection there was an abrasion of size 2 cm × 4 cm present over dorsum of wrist joint which is unrelated to fracture. The antero-posterior diameter of the hand seemed to be augmented. The proximal ends of the metacarpals were not palpable due to gross swelling over the hand and wrist. The movements of the hand and wrist were painfully restricted. No neurovascular compromise was noted. The anteroposterior and lateral x-ray views of hand including wrist were ordered.

The X-rays revealed

- The volar-radial dislocation of right index carpometacarpal joint.
- The volar-radial dislocation of right long finger carpometacarpal joint.

- The dorsal-ulnar dislocation of right ring finger carpometacarpal joint.
- Fracture bases of ring finger metacarpal, index finger metacarpal bones.
- Undisplaced extra-articular fracture of base of thumb metacarpal bone.
- Fracture of base of proximal phalanx of right thumb.
- Scaphoid, trapezium, trapezoid joint (STT) subluxation.

CT-scan also showed a fracture dislocations at the carpometacarpal joint.

Closed reduction and internal fixation with multiple k-wires was done except for fracture of index finger metacarpal base for which, open reduction and internal fixation with k-wires was done where closed reduction was failed due to unreduced displaced intra-articular fracture fragment. Short arm volar wrist splint was applied. After 10 days sutures were removed and below elbow cast was given. The k-wires and the cast were removed during fourth week and vigorous active physiotherapy of wrist and hand was started. A reasonably good range of movements and grip strength was achieved at the latest follow up without any functional limitation. The X-rays at the latest follow-up (3 months) showed a complete healing of the fractures and a normal alignment at carpometacarpal joint (Figures 1-8).

Discussion

There is relatively little information in the literature regarding carpometacarpal fracture dislocation. Divergent carpometacarpal dislocations are even rarer, with only a few documented cases [4,5].

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Figure 1: Clinical photograph showing diffuse swelling over dorsum of hand with increased antero-posterior diameter of the hand and abrasion over wrist.



Figure 2: Preoperative antero-posterior radiograph of wrist and hand showing divergent carpometacarpal fracture dislocation. Note also the fracture of base of thumb metacarpal and proximal phalanx of thumb.

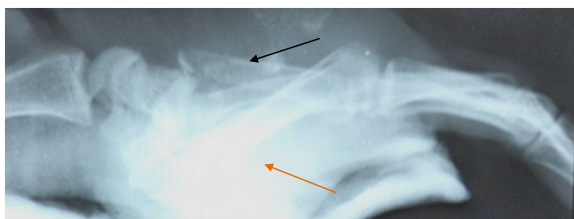


Figure 3: Preoperative lateral radiograph of wrist and hand showing dorsal dislocation of ring finger metacarpal and volar dislocation of index and long finger metacarpals.

The stability of carpometacarpal joint depends on (1) interlocking saddle joints, (2) volar and dorsal ligaments, and transverse metacarpal ligaments, and (3) protection by the long flexor and extensor tendons and intrinsic muscles. Of these palmar ligaments are weak and dorsal ligaments are strong producing the dorsal dislocations more commonly. Stability progressively decreases from radial to ulnar side as interlocking of joint surfaces reduces from second to fifth carpometacarpal joints allowing more movement at little finger carpometacarpal joint. This becomes a major factor for fourth and fifth metacarpals involvement far more commonly than others [8]. The third metacarpal articulation with the capitate is located more proximally than the carpal articulations of the other metacarpals, producing a “key-stone” relationship. Kumar et al. [9] described the need to apply a torsional force to achieve a “divergent variant” of multiple carpometacarpal dislocations in which

divergence is defined as one or more joints dislocating volarly with concomitant dislocation dorsally of one or more joints.

Direct violence is the most common mechanism of injury for carpometacarpal dislocation. Whether volar or dorsal dislocation occurs, is determined by direction of force. Shorbe [10] demonstrated that carpometacarpal dislocations were not possible unless both the anterior and posterior ligaments are ruptured. Waugh and Yancey [11] opined that these dislocations are a result of direct force applied to the bases of metacarpals and the resulting palmar or dorsal dislocation was determined by the direction of the force. Gunther [12] suspected a rotatory mechanism with the hand firmly fixed and forces causing the carpus to rotate on a fixed metacarpal base.

On the antero-posterior radiograph, the carpometacarpal joints can be evaluated according to the principles of parallelism, symmetry and overlapping structures developed by Gilula [13]. When viewed in profile on antero-posterior view, the opposing margins of 2nd to 5th carpometacarpal joints should be parallel. The cortical rims of the 2nd through 5th carpometacarpal joint spaces should be distinct and uniform, measuring 1-2 mm in width. Drawing lines through the distal cortical surfaces of the trapezoid, capitate, hamate and



Figure 4: Postoperative antero-posterior radiograph of right hand with wrist with good alignment of carpometacarpal joint.



Figure 5: Postoperative 30° oblique radiograph of right hand with good alignment of carpometacarpal joint.

the bases of the 2nd to 5th metacarpals, there should be two parallel zigzag lines approximating the letter M (so-called 'parallel M lines') [14]. On antero-posterior radiograph, with wrist in neutral position, there should not be overlapping of opposing articular surfaces of the carpometacarpal joints. The lateral radiograph is vital in showing direction of dislocation, associated fractures and soft tissue swelling. The key radiographic diagnosis lies in the subtle loss of joint space and the loss of the parallel articular surfaces of the carpometacarpal joints, which are seen on the antero-posterior projections.

This case was reported for the rare injury pattern i.e. divergent carpometacarpal joint dislocation. In the acute state, the hand will often appear grossly swollen. In our patient, there was a very characteristic clinical appearance to the hand. Cain [15] has stated that the force of the injury transmits an axial load through the ring finger metacarpal onto the carpus. Flexion at wrist produces dorsal dislocation of joints. If it is associated with fracture, the load is transferred to the little finger metacarpal resulting in dorsal dislocation of that carpometacarpal joint. If it is associated with torsional force, divergence of carpometacarpal joints occurs. In our case, we hypothesise that the predominant vector of force through the ring metacarpal must have been of "extension" or



Figure 8: Three months postoperative clinical photograph demonstrating near normal grip on the injured side (right) compared to the contralateral (left) side.

"dorsiflexion", thus resulting in volar dislocation of the base of the ring metacarpal associated with fracture followed by torsional dislocation of middle finger and index finger carpometacarpal joint.

Choice of treatment depends upon severity, stability of carpometacarpal joint and experience of attending physician. Hartwig and Louis [16] believed that the base of the middle metacarpal is the key to reduction of the remaining metacarpals. Immediately after injury, closed reduction supplemented with k-wires can be sufficient. Closed reduction is achieved by longitudinal traction and pressure at metacarpal base. However some cases require open reduction and internal fixation.

John and Sharma [7] described that there was no evidence of a relationship between the most recent outcome and grip strength, range of motion of the wrist, mechanism of injury, duration of fixation with wire, or duration of immobilization in a plaster cast and almost all of the patients regained sufficient motion for good function. Our patient recovered almost completely, with grip strength 95% of the contralateral non-dominant hand and there is no functional limitation.

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Figure 6: Antero-posterior radiograph of right hand with wrist with good alignment of carpometacarpal joints after k-wire removal.



Figure 7: Postoperative 30° oblique radiograph of right hand with good alignment of carpometacarpal joint after k-wire removal.

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