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CASE REPORTS

Proximal carpal row dislocation: a case report

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Abstract Carpal dislocations commonly occur as the result of high-energy axial loading of the forearm with the wrist extended. There exists several variants of carpal dislocations with the most commonly observed being those about the lunate. Perilunate dislocations and fracture dislocations were first characterized by Mayfield in 1980 and represent a spectrum of traumatic carpal dislocation beginning radial and progressing to the ulnar side of the wrist (Mayfield et al. J Hand Surg [Am] 5:226–241, 1980). The path of energy takes a predictable pattern around the lunate from the scapho-lunate ligament, into the mid-carpal joint and then to the luno-triquetral joint. The final stage is volar dislocation of the lunate into the carpal canal. These complex fracture dislocations are unstable and require operative fixation through open reduction and with internal fixation (Herzberg et al. J Hand Surg [Am] 18:768–779, 1993; Adkison and Chapman Clin Orthop Rel Res 164:199–207, 1982). Other types of carpal dislocations have been described; however, these are much less frequently encountered (Green and O'Brien Clin Orthop Rel Res 149:55–72, 1980; Irwin et al. J Hand Surg [Br] 20B:746–749, 1995; Rosado J Bone Joint Surg 48B:504–506, 1966). These also include mid-carpal instability and longitudinal (axial) instability and have been described extensively in the literature (Norbeck et al. J Hand Surg 12A:509–514, 1987; Primiano and Reef J Bone Joint Surg 56A:328–332, 1974; Garcia-Elias et al. J Hand Surg 14A:446–457, 1989; Taleisnik Hand Clinics 3:51–68, 1987). Carpal instabilities can be characterized as dissociative which disrupt joints within a carpal row, or as non-dissociative which have dislocations or subluxations between carpal rows (Dobyns and Cooney 1998). We report a case of complex carpal injury non-dissociative involving dislocation of the entire proximal carpal row volarly. To our knowledge such a variation of complex carpal dislocation has not been reported. This injury represents yet another possible variant encountered when treating high-energy injuries to the wrist.

Keywords Proximal · Carpal · Perilunate · Dislocation · Proximal row · Instability

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Case Report

A 31-year-old right-hand dominant male was admitted to our Level 1 Trauma center after being involved in a motorcycle collision. The patient was riding a motorcycle at high speed when he collided head-on with an automobile. The patient sustained multiple injuries including a right temporal bone fracture, subdural hematoma, right inter-trochanteric hip fracture, right femoral shaft fracture, open-book pelvic injury, right both bones forearm fracture, a left thumb metacarpal base fracture, and a left complex dislocation of the carpus. Radiographs demonstrating the complex carpal dislocation are shown in Fig. 1. The entire proximal carpal row is dislocated volarly and the head of the capitate is adjacent to the distal radial articular surface.

Emergent treatment of the patient included intubation, life support resuscitation, and appropriate treatment directed to each of his injuries. In regard to his left complex carpal dislocation, a closed reduction was completed with axial traction, a volar force placed on the proximal carpal row and flexion of the hand and distal carpal row. On stability testing the carpus was found to be unstable with obvious

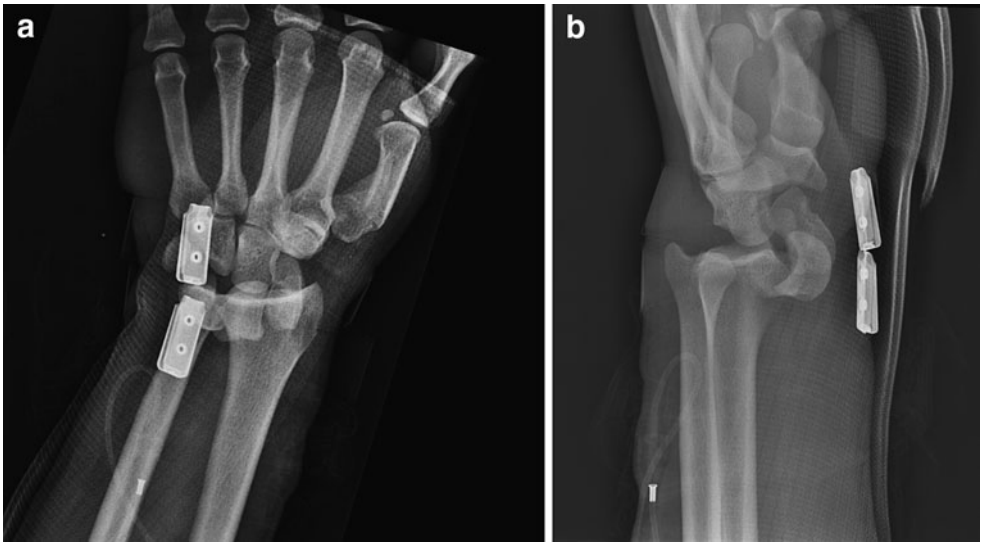

Figure 1 **a** PA and **b** lateral views of the wrist demonstrating complete dislocation of the scaphoid, lunate, and triquetrum from both the radio-carpal and mid-carpal joints.

radio-carpal and mid-carpal instability. The upper extremity was then placed in a sugar-tong splint. Adequacy of reduction was confirmed radiographically (Fig. 2).

Surgical treatment of the patient's complex carpal dislocation was planned pending medical stability. Three weeks elapsed before the patient could be safely taken to the operating room for open reduction and stabilization of his carpal dislocation. In this interval period, serial radiographs were obtained to confirm overall maintenance of the carpal reduction but also showed gradual occurrence of a mid-carpal subluxation, with probable DISI deformity and ulnar translation of the carpus (Fig. 3). The thumb metacarpal base fracture demonstrated acceptable alignment and early healing.

The patient was taken to the operating room for open reduction and internal fixation of his wrist dislocation 21 days following his injury. A standard dorsal approach to the carpus was completed with unroofing of the third dorsal compartment and partial elevation of the second and fourth dorsal compartments from the distal aspect of the radius. The capsule was visualized and incised in a longitudinal fashion. Upon opening the capsule, a partial mid-substance tear of the scapho-lunate interosseous ligament was appreciated. The entire stout distal portion was ruptured but the volar (membranous) portion of the ligament was intact, holding the scaphoid and lunate together as a unit (Fig. 4). The luno-triquetral joint was free of obvious injury. No osteochondral injuries were appreciated.

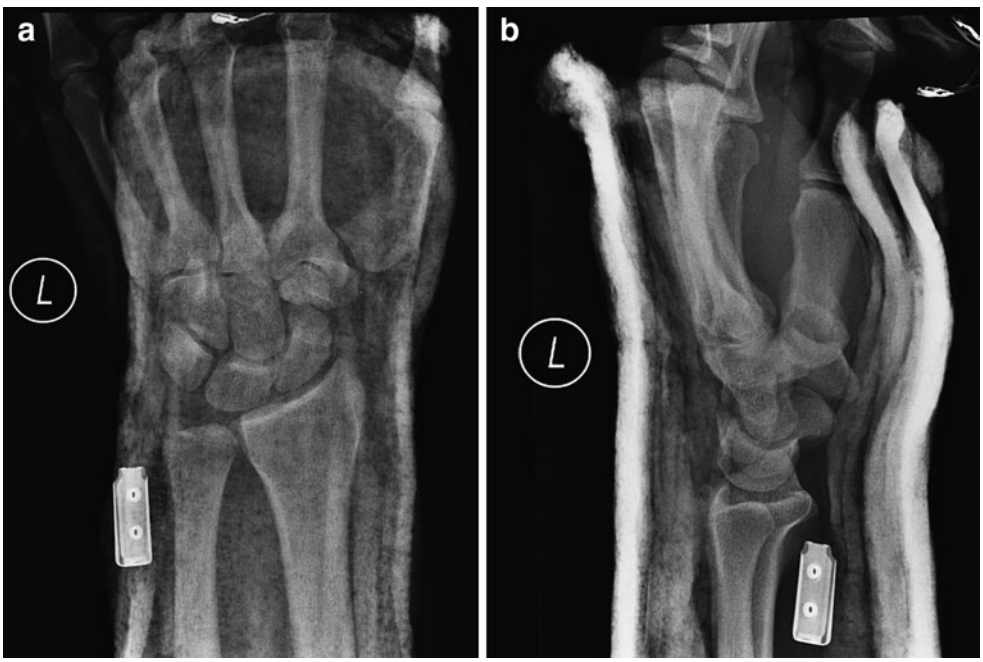

Figure 2 **a** PA and **b** lateral views of the patient after closed reduction and placement of the upper extremity into a sugar-tong splint. The carpus appears to be adequately reduced with no mid-carpal subluxation.

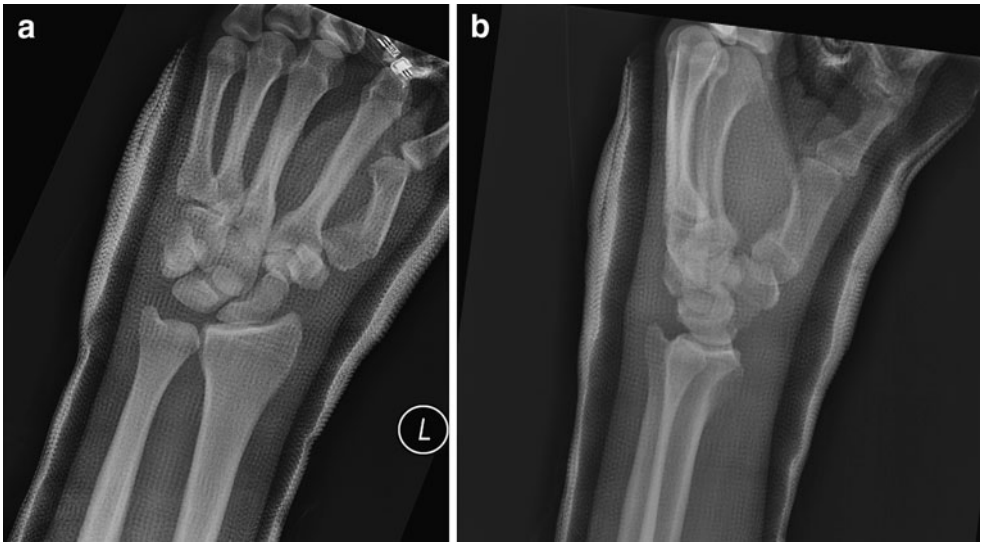

Figure 3 **a** and **b** Lateral views of the wrist at approximately 3 weeks from injury. There has been progressive mid-carpal subluxation with the appearance of a probable DISI deformity.

The carpus was visualized dorsally and the scaphoid and lunate were manipulated using dorsally applied k-wire joy sticks. The scapho-lunate gap was closed and the DISI deformity was corrected. The scaphoid and lunate was stabilized with two wires (0.045″) placed through a 2-cm radial incision just distal to the radial styloid. An additional K-wire was placed from the scaphoid into the capitate and hamate, securing its position relative to the distal carpal row. A final K-wire was placed from the triquetrum into the hamate and capitate to maintain the position of the ulnar aspect of the mid-carpal joint (Fig. 5). The mid-substance tear of the scapho-lunate interosseous ligament was repaired side-to-side with 2-0 ethibond suture, and the dorsal capsule was repaired with non-absorbable suture (Fig. 6). No volar surgical approach was utilized.

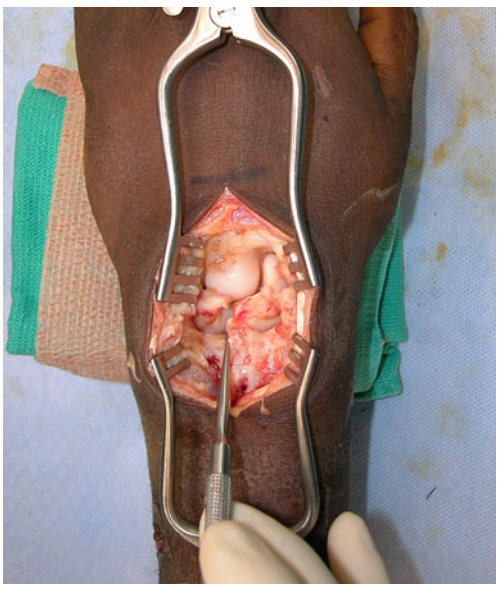

Figure 4 Clinical photograph demonstrating a straight dorsal approach to the carpus through the third dorsal compartment. The scapho-lunate ligament is torn distally but is still intact proximally.

The stability of the construct, as well as the thumb metacarpal fracture, was assessed with C-arm fluoroscopy. The carpus was found to be stable and to move as a unit. The stability of the distal radio-ulnar joint was also tested and found to be stable. All k-wires were cut to lie under the skin. A standard skin closure was performed and the patient was placed in a well-fitting, long-arm thumb spica splint. The patient tolerated the procedure well and was returned to his inpatient bed. He eventually recovered from his multiple injuries and was discharged from the hospital.

The patient has been seen several times in the outpatient office following his surgery. At 2 weeks the sutures were removed and he was placed in a long-arm thumb spica cast. At 6 weeks he was converted to a short arm thumb spica cast. The k-wires were removed in the operating room at 11 weeks post-surgery. Early ROM was initiated under the guidance of formal occupational therapy. At his most recent follow-up visit at 6 months post-surgery clinical examination shows that he has no pain and the following range of motion: flexion—45°, extension—45°, pronation—90°, and supination—90°. Composite finger flexion was full into the palm and his fingers had full extension. Follow-up radiographs showed no frank dislocations of the wrist but some recurrence of mid-carpal deformity and ulnar translation of the carpus (Fig. 7). On exam the patient had a normal Watson test and had no mid-carpal instability with no “catch-up clunk” on radial-ulnar deviation.

Discussion

This case represents a complex carpal dislocation in which the proximal carpal row is observed to dislocate en bloc

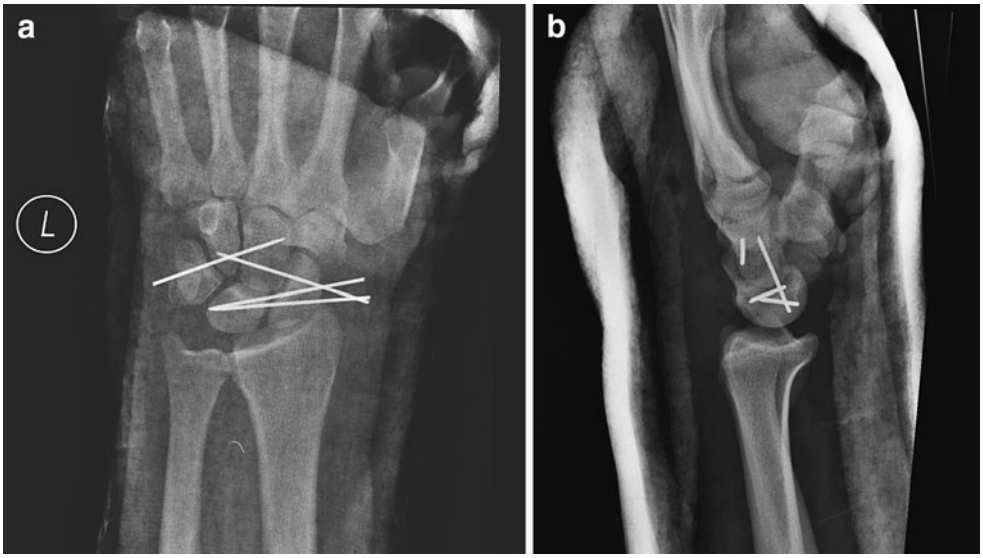

Figure 5 **a** PA and **b** lateral radiographs of the wrist showing pinning of the proximal and distal carpal rows. There is good alignment of the carpal bones to each other but there is widening of the radio-lunate joint.

Figure 6 Clinical photograph showing direct repair of the distal scapho-lunate ligament.

from both the distal radius and distal carpal row. The majority of carpal dislocations seen clinically are perilunate dislocations and have been examined extensively in the literature [2, 3]. Perilunate dislocations occur when an axial load is placed upon the extended, ulnar deviated carpus [1]. These injuries result from high-energy trauma and are seen to progress about the lunate in a predictable manner [1]. Clinical studies have demonstrated that although these are severe injuries, good outcomes may be achieved with early treatment. However, the specifics of treatment have varied in different studies [2–4]. Current treatment of a perilunate dislocation usually consists of closed reduction followed by open ligamentous repair and pin or screw fixation of the carpal bones to each other in an anatomic configuration.

Green and O'Brien [4] provided a classification for carpal dislocations; however, that schema does not specifically address the injury seen in our case. The Mayo

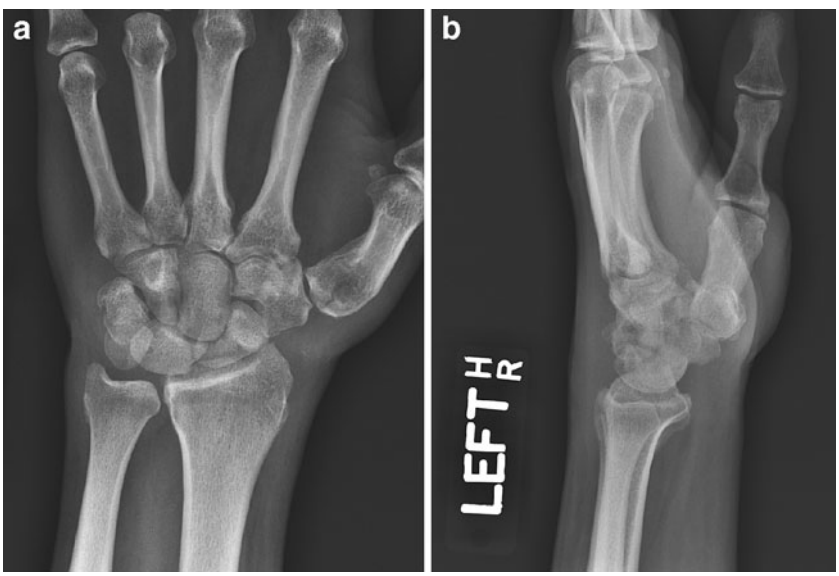

Figure 7 **a** PA and **b** lateral views of the wrist at 6 months post-surgery. There is increased ulnar translation of the carpus, dorsal subluxation of the capitate, and volar flexion of the lunate.

classification of carpal instability [11] divides instability into carpal instability dissociative, carpal instability non-dissociative, carpal instability complex and the adaptive carpal changes, following malunion or nonunion of the distal radius. The complex carpal dislocation reported here represents a combined radio-carpal–mid-carpal instability non-dissociative pattern, as the ligamentous disruption occurs between the distal radius and the proximal carpal row and also between the proximal and distal carpal rows. These injuries are considered exceedingly rare.

A review of the literature reveals that isolated cases of unusual complex carpal dislocations have been reported, however, owing to their rarity they are few in number [7–10]. Rosado described an unusual complex carpal dislocation in which the entire carpus dislocated volar to the distal radius [6]. The injury was isolated to the radio-carpal articulation, as there was no instability demonstrated between the proximal and distal carpal rows. The author theorized that a dorsiflexion, shearing stress applied in the line of the carpal-metacarpal bones oblique to the radius resulted in such a dislocation. After reduction the carpus was found to be stable and the patient was managed with cast immobilization.

Irwin et al. reported another unusual complex carpal dislocation that involved an extension, internal rotation, and supination mechanism [5]. The radial side of the carpus dislocated dorsally while the ulnar side of the carpus dislocated in a volar direction. The lunate in this case remained reduced within its fossa on the distal radius, acting as an axis about which the carpus rotated. The dislocation was closed, reduced, and managed with cast immobilization. The patient had a satisfactory outcome.

In the case presented here, the proximal carpal row, or intercalated segment, became “unlinked” from its articulations with the distal radius and distal carpal row. Following closed reduction the carpus was found to be unstable and the decision to provide surgical fixation was made. Our fixation was limited within the carpal bones and this may have led to the observed subluxation seen on follow-up films. The patient is doing well clinically but is seen to have a partial recurrence of his dorsal mid-carpal instability pattern and ulnar translation of the proximal carpal row. In retrospect, the closed reduction films at 3 weeks (Fig. 3) showed ulnar translation of the carpus, and the initial post-op films (Fig. 5) demonstrated adequate alignment of the carpal bones to each other, but some increased gapping of the radio-lunate joint. This was not appreciated intra-operatively on fluoroscopic views and the carpus appeared stable to exam. Stabilization of the proximal carpal row to the radius in an anatomic position with either external fixation or radio-carpal pinning may have prevented this progressive carpal subluxation. In addition, a volar approach to the wrist may have revealed torn radio-carpal ligaments that could have been repaired.

We speculate that the mechanism that resulted in such an injury was likely a combination of pure wrist extension and axial load, without ulnar or radial deviation. It is uncertain exactly the nature of the mechanism that resulted in the injury observed, and this provides a topic for future investigations. The partial scapho-lunate ligament tear may have allowed mid-carpal subluxation with an associated DISI deformity. Transcarpal pin fixation combined with direct ligament repair from a dorsal approach, used in the care of this patient, did not provide a sufficiently stable construct to re-establish and maintain anatomic carpal alignment.

Conflict of Interest The authors declare that they have no conflict of interest with the subject of this report.

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