Perilunate trans-triquetral fracture dislocation: a case report

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Abstract

We present an unusual case of trans-styloid trans-triquetrum perilunate fracture dislocation, in which the radial-sided carpal bones remained intact but the lunotriquetral (LT) and scapholunate (SL) ligaments were torn. A 28-year-old male presented to our emergency department after sustaining a fall from a height of 2 m on an outstretched hand with hyperextension of the wrist, landing on the ulnar aspect of the palm of his hand. Imaging investigation revealed a dorsal perilunate trans-styloid trans-triquetrum fracture dislocation. We performed open reduction and internal fixation of the radial styloid and triquetral fractures, and repair of the LT and SL ligaments. This report describes a rare trans-triquetral dorsal perilunate fracture dislocation with a concomitant LT ligament rupture. It deviates from Mayfield and Johnson's theory by showing the potential for a reverse greater arc injury, advancing from the ulnar to the radial side, sometimes leaving radial carpal bones unaffected.

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Introduction

Perilunate fracture dislocations are rare high-energy injuries, accounting for less than 10% of all wrist injuries.[1] Among carpal fractures, trans-scaphoid fractures are the most common, representing 61% of cases. In comparison, isolated trans-triquetral fracture-dislocations are even rarer, comprising only about 2% of these cases,[2] further underscoring their infrequency. Perilunate fracture dislocations are initially missed in up to 25% of cases, leading to treatment delays that negatively impact clinical outcomes.[3] We present an unusual case of trans-styloid trans-triquetrum perilunate fracture dislocation, in which the radial-sided carpal bones remained intact but the lunotriquetral (LT) and scapholunate (SL) ligaments were torn. To the best of our knowledge, this is the first case reported in English literature with this injury pattern, emphasizing the rarity of this condition. In accordance with Mayfield and Johnson's theory of perilunate instability,[4] the injury begins radially and extends ulnarly, involving the carpal bones and ligaments. In a true greater arc injury, the scaphoid, capitate, triquetrum, and hamate bones are fractured. Although most perilunate fracture-dislocations combine ligament ruptures and fractures in various clinical forms, it is much less common to have trans-triquetral perilunate dislocation with sparing of the scaphoid, capitate, and hamate bones. This creates further evidence that a reverse greater arc injury may occur.

Case Report

A 28-year-old left-hand-dominant male presented to the emergency department after sustaining a fall from a 2 m height on an outstretched hand with hyperextension of the wrist, landing on the ulnar aspect of the palm of his left hand. On clinical examination, the patient had a swollen wrist, severe tenderness to palpation, decreased range of motion, and slightly decreased sensation within the distribution of the median nerve. No other obvious injuries or deformities were found. Radiographs of his left wrist showed a dorsal perilunate fracture dislocation associated with a nondisplaced fracture of the radial styloid and dorsal rim (Figure 1). An urgent closed reduction under sedation was performed in the emergency department to minimize the risk of median nerve injury and cartilage damage. Computed tomography with 3D reconstruction of the wrist was obtained after closed reduction to

aid the pre-operative planning, revealing a sagittal fracture of the triquetrum (Figure 2). Under general anesthesia, a volar approach was used first for a carpal tunnel release. A dorsal approach to the wrist using Berger and Bishop capsulotomy was used afterwards to inspect the carpus. The triquetral and the radial styloid fractures were fixed using a 2.2 mm and a 3.5 mm cannulated headless compression screw, respectively (Osteonic, South Korea). After anatomic carpal alignment was ensured, two 1.4 mm K-wires were used to stabilize the SL and LT joints. A third K-wire was advanced from the scaphoid into the capitate to address the midcarpal instability (Figure 3). Notably, the SL ligament was avulsed from the scaphoid and still attached to the lunate, whereas the LT ligament was torn off the lunate and still attached to the triquetrum. Reattachment of the SL and LT ligaments was performed with two 2 mm suture anchors (DePuy, USA) (Figure 4). The dorsal radial rim was repaired with transosseous suture fixation. The wrist capsule was closed in a standard fashion, and a splint immobilizing the wrist and the forearm was applied. At 8 weeks postoperatively, the K-wires and the splint were removed, and the patient was referred for physiotherapy. At 1-year follow-up, the wrist joint had a flexion-extension of 106°, radioulnar deviation of 42°, and pronation-supination of 158°. The grip strength was 32 kg. No radiographic signs of osteoarthritis were noted. Moreover, at the latest follow-up, the patient demonstrated excellent recovery, with a Disabilities of the Arm, Shoulder and Hand (DASH) score of 8, indicating minimal disability and near-complete restoration of upper limb function. The patient reported no significant pain or limitations in daily activities, with only mild discomfort during high-demand tasks.

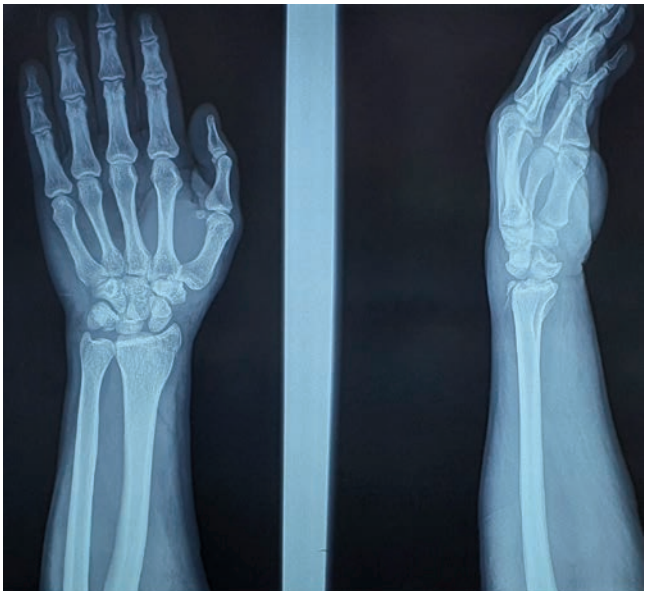

Figure 1. Initial anteroposterior and lateral radiographs of the left wrist.

Discussion

The mechanism of a greater arc injury involves hyperextension, ulnar deviation, and intercarpal supination of the wrist.[5] Initially, the dorsal radial lip of the distal radius impinges on the waist of the scaphoid, leading to a trans-scaphoid perilunate dislocation. When this impact progresses to the capitate, it results in a trans-scaphoid, trans-capitate perilunate dislocation. If the injury advances further, the triquetrum fractures, culminating in a complete greater arc injury characterized by trans-scaphoid, trans-capitate, and trans-triquetral perilunate dislocation. A common misunderstanding about perilunate dislocations is that in Mayfield's stage II, the scaphoid has either sustained a fracture or severed its ligamentous connections to the lunate, but not both. However, Hertzberg *et al.*[6] demonstrated that 3.8% of perilunate dislocations involve both a scaphoid fracture and an SL ligament rupture. Isolated cases of trans-triquetrum perilunate fracture dislocations have been reported previously,[7,8] advocating for a reverse greater arc concept. Our case not only differs but also adds support to this concept due to the concomitant LT ligament rupture. A literature review found no other publications presenting a case of trans-triquetral perilunate dislocation associated with an LT ligament rupture and intact radial carpal bones. Furthermore, a recent systematic review[9] concluded that current evidence on reverse perilunate dislocations remains insufficient, highlighting the need for more high-quality studies on this topic.

Murray *et al.*[10] proposed a three-stage mechanism for ulnar-sided perilunate ligamentous wrist injury, which can lead to subtle forms of perilunate instability. In stage three, the injury progresses to the radial side, disrupting the SL ligament and resulting in dorsal perilunate dislocation, making it difficult to differentiate from

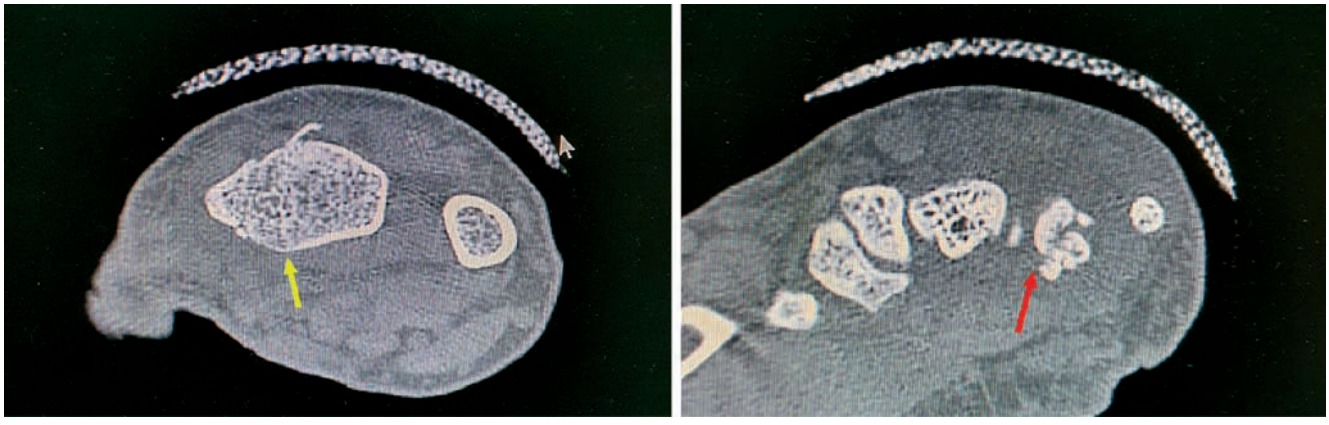

Figure 2. Computed tomography (axial views) imaging of the left wrist. The yellow arrow shows the radial styloid fracture, whereas the red arrow shows the triquetrum fracture.

Mayfield's stage III. Nevertheless, taking into consideration the magnitude of injury on the ulnar side of the carpus and the patient's description of the injury mechanism, we believe that the primary external force was initially applied ulnarly, leading to a comminuted fracture of the triquetrum and rupture of the LT ligament. This force then progressively shifted radially, affecting the SL ligament and extending towards the radial styloid, which remained undisplaced. Although our biomechanical hypothesis cannot be experimentally verified, it is crucial to always fix the triquetrum to maintain the LT joint stability. The triquetrum is a well-vascularized bone, and no cases of necrosis or nonunion have been reported in the literature.

This case describes a rare instance of a trans-triquetral dorsal perilunate fracture dislocation, highlighting two important consid-

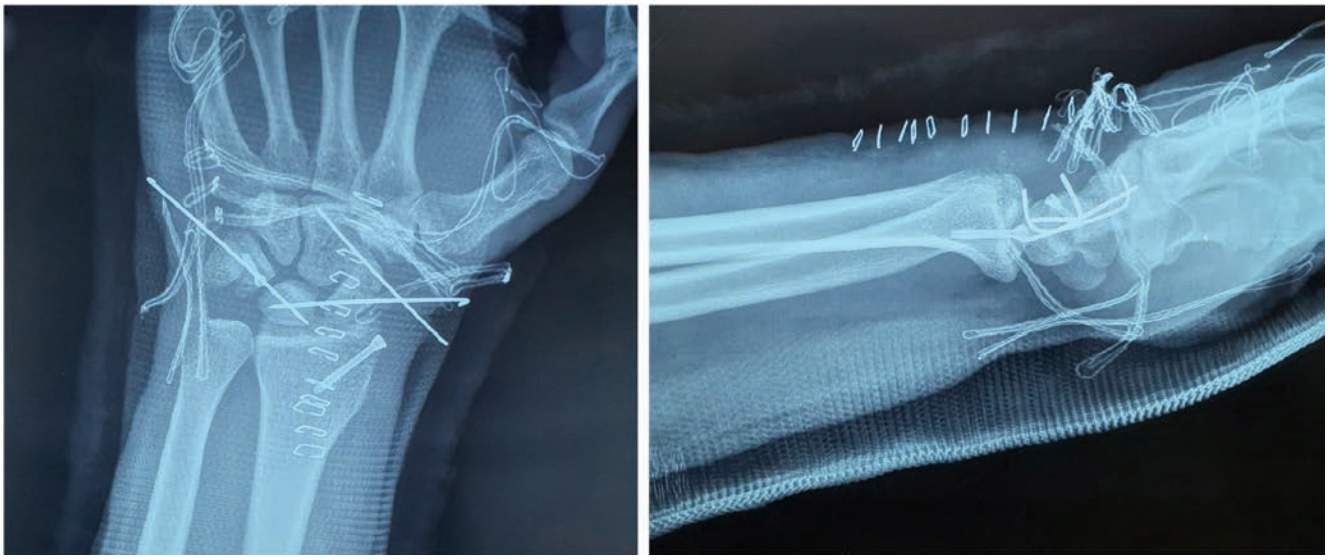

Figure 3. Postoperative anteroposterior and lateral radiographs.

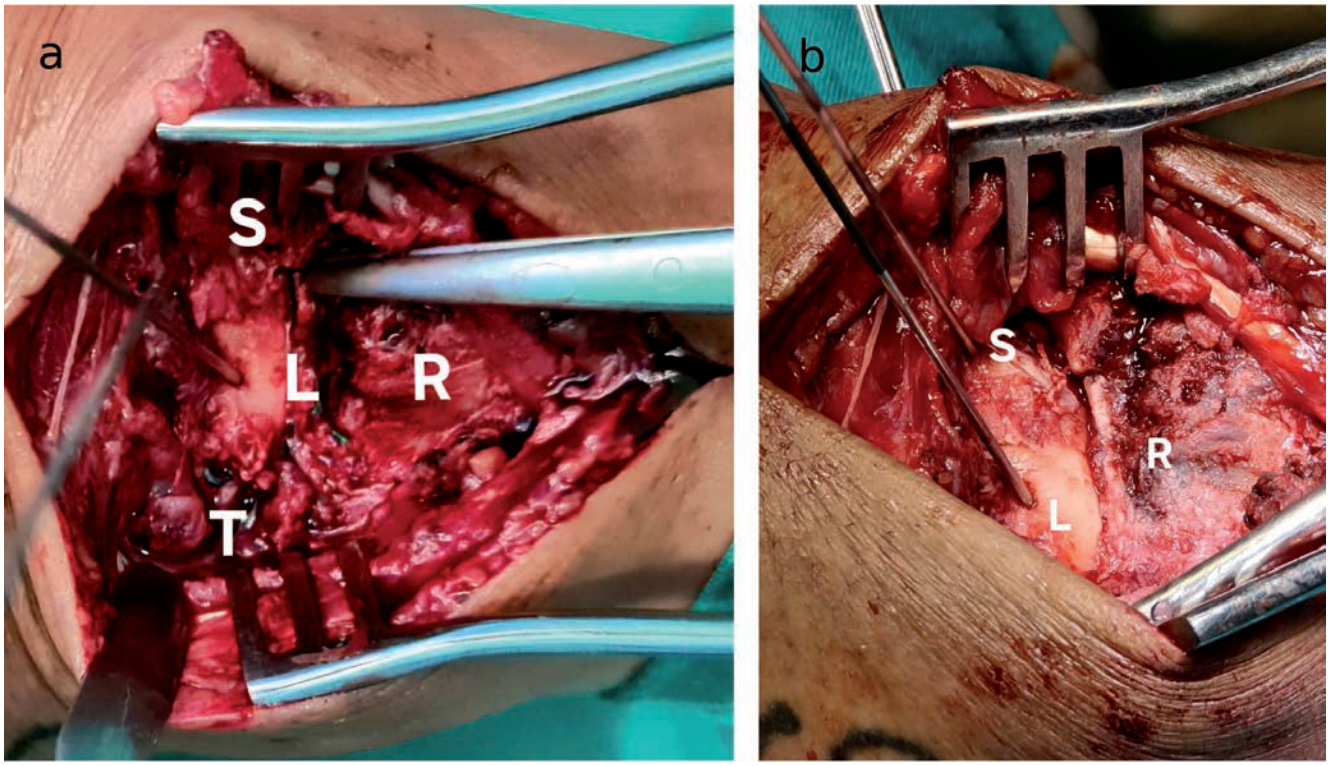

Figure 4. Intraoperative images after reduction and stabilization of the proximal raw. a) Before reattachment of SL and LT ligaments; b) after reattachment of ligaments (S, scaphoid; L, lunate; T, triquetrum; R, radius).

erations. First, an isolated fracture of the triquetrum should raise suspicion for an underlying reverse perilunate dissociation, warranting a thorough assessment of carpal stability. Second, surgeons should be prepared to address potential LT ligament injury intraoperatively, including having appropriate anchors available for repair, even though such an association has not been previously described in the literature.

Conclusions

This report provides further evidence that isolated carpal injuries can occur and progress from the ulnar to the radial side, challenging the traditional Mayfield and Johnson theory of progressive perilunar instability. By demonstrating the potential for a reverse greater arc injury, this case emphasizes the importance of awareness regarding variations in carpal injury patterns**.**

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