Compound dorsal dislocation of lunate with trapezoid fracture

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Abstract

We report about a dorsal dislocation of the lunate accompanied by a trapezoid fracture in a 41-year old male patient after a motorcycle accident. The lunate dislocation with no dorsal or volar intercalated segment instability (DISI, VISI) was diagnosed by x-ray whereas the trapezoid fracture was only diagnosable by computed tomography. A closed reduction and internal fixation of the lunate by two Kirschner wires was performed, the trapezoid fracture was conservatively treated. Surgery was followed by immobilization, intense physiotherapy and close follow-up. Even though complaints such as swelling and pain subsided during the course of rehabilitation, partial loss of strength and range of motion remained even after 16 months. In conclusion, a conservative treatment of trapezoid fractures seems to be sufficient in most cases. Closed reduction with K-wire fixation led to an overall satisfactory result in our case. For dorsal lunate dislocations in general, open reduction should be performed when close reduction is unsuccessful or DISI/VISI are observed in radiographs after attempted close reduction.

Introduction

We herein report a case of a trapezoid fracture and dorsal dislocation of the lunate. The carpus is held together by firm ligaments which envelope the carpal bones and protect it from damage. Dorsal and volar extrinsic ligaments connect the carpal bones with the radius and ulna whereas the intrinsic ligaments interconnect carpal bones. Most crucial for the stability of the lunate are the scapholunate, luno-capitate, and radio-triquetral ligaments which may rupture in a sequential pattern during perilunate and lunate dislocations as proposed by Mayfield *et al.*[1] Furthermore, the radio-lunate and radio-scapho-lunate add to the particularly strong fixation of the lunate. Around 18 % of hand fractures involve carpal bones with the scaphoid fracture being most common.[2] Overall, perilunate fracture dislocations are more common than perilunate dislocations with the dorsal dislocation being the most frequent pattern.[3] Carpal fractures and dislocations represent devastating injuries often overlooked, misdiagnosed and inappropriately managed.

Trapezoid fractures and dorsal dislocations of the lunate are extremely rare injuries and to our knowledge we report about the first case of both injuries occurring in one patient. This case provides meaningful insight into carpal injury patterns helping surgeons to more efficiently treat a patient collective with compound dorsal dislocations of the lunate.

Case Report

A 41-year old, right-handed male patient presented in the emergency room after a motorcycle accident. The patient collided with a car while grasping the handlebars with both of his hands but could not remember the exact mechanism of injury. After excluding any life threatening organ injuries the patient was referred to the Department of Plastic Surgery for further evaluation of the left hand. The clinical examination revealed severe swelling and tenderness of the left hand. Tenderness was reported especially over the snuffbox, proximal to the base of the second metacarpal bone and distally to the distal radio-ulnar joint with a skin laceration and superficial abrasions on the dorsum of the hand. Additionally, a skin laceration with a diameter of approximately two centimeters was located at the area above the lunate on the dorsum of the wrist. The perfusion and sensibility were without any pathological finding.

X-ray showed a dorsal dislocation of the lunate with no clear signs of fracture or dislocation of other bony structures (Figure 1).

Since lunate dislocations often come along

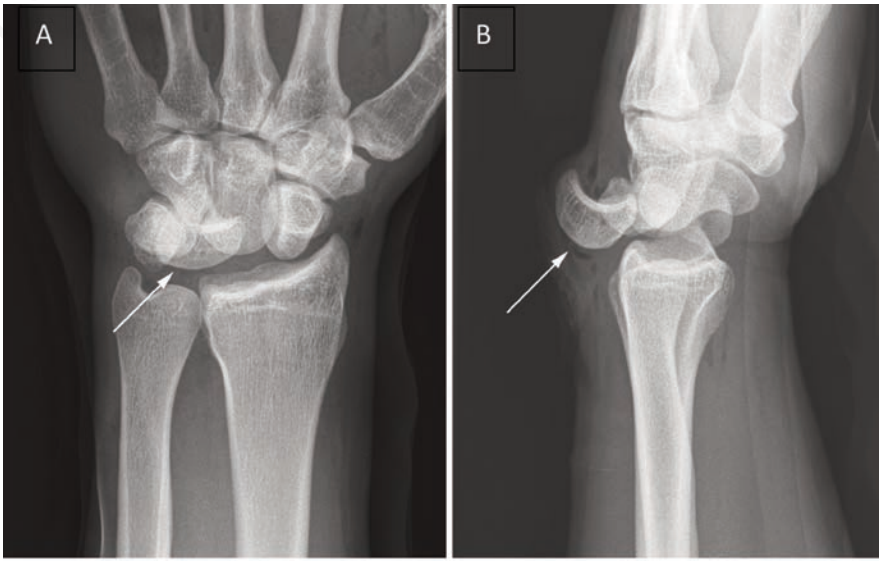

Figure 1. Plain x-ray of the left wrist immediately after the trauma. The arrow shows the dislocated lunate. The trapezoid fracture is not depictable: A) anterior-posterior view; B) lateral view.

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with additional carpal bone injuries and pain over trapezoid persisted, a computed tomography (CT) of the left hand and wrist was carried out immediately. It confirmed a dorsal dislocation of the lunate and interestingly also a compound sagittal fracture of the trapezoid (Figures 2 and 3). Furthermore, air pockets in the dorsal wrist indicated an open trauma.

Under general anesthesia, a closed reduction of the lunate was performed by pushing the lunate to proximopalmar direction while applying longitudinal traction to the fingers with the wrist fixed in a neutral position. The intraoperative x-ray confirmed anatomical reduction of the lunate. Since no tendency of lunate re-dislocation, neither in neutral nor in hyper-flexed or extended wrist position was seen on x-ray image intensifier dynamic screening, no open ligament reconstruction was carried out. Due to slight carpal instability without confirmed by manual testing under high force we decided to perform an intercarpal fixation with two 1.6 mm Kirschner wires (K-wires). The first K-wire connected the lunate with the triquetrum, the second lunate with the scaphoid (Figure 4). After K-wire fixation we did not observe dorsal or volar intercalated segment instability (DISI, VISI) in the intraoperative radiography. The soft tissue damage on the dorsum of the wrist was explored, irrigated and sutured. The trapezoid was not treated surgically. Afterwards, the left wrist was immobilized in a scaphoid cast for 4 weeks.

Post-surgical x-rays three days after surgery revealed a widened scapholunate gap of five millimeters while other carpal bones did not show any abnormalities. An open repair of the scapholunate ligament was suggested but declined by the patient. During the early post-surgical period, the patient complained swelling over the lateral epicondyle of the humerus, pain and loss of strength when extending fingers and wrist.

Follow-up x-rays did not show any further changes and K-wires wires were removed after six weeks (Figure 5). The patient attended physiotherapy one week after the removal of the K-wires. Eight weeks after the initial trauma, the patient underwent a thorough examination (Table 1). Compared to the uninjured right wrist, the range of motion (ROM) of the left wrist was significantly restricted. Active closing of the fist was not possible especially due to incomplete reduction of swelling of the dorsum of the hand. No pain was observed over the trapezoid. In further clinical examinations after 14 weeks and five months (Table 1), the pain over snuffbox and wrist abated completely. Follow-up examinations 12 and 16 months after initial trauma (Table 1, Figures 6 and 7) show a slow improvement of the range of motion and strength. Although the pain completely subsided, a diminished radial deviation with loss of grip strength remained.

Discussion and Conclusions

Constituting only 0.4% of carpal fractures, the trapezoid bone represents the least common carpal fracture with only a handful of them reported in the literature.[4] The trapezoid is surrounded by the second metacarpal bone, trapezium, scaphoid, capitate and is thus well protected. Further enveloped by strong ligaments, trapezoid injuries require severe trauma and are often accompanied by fractures of

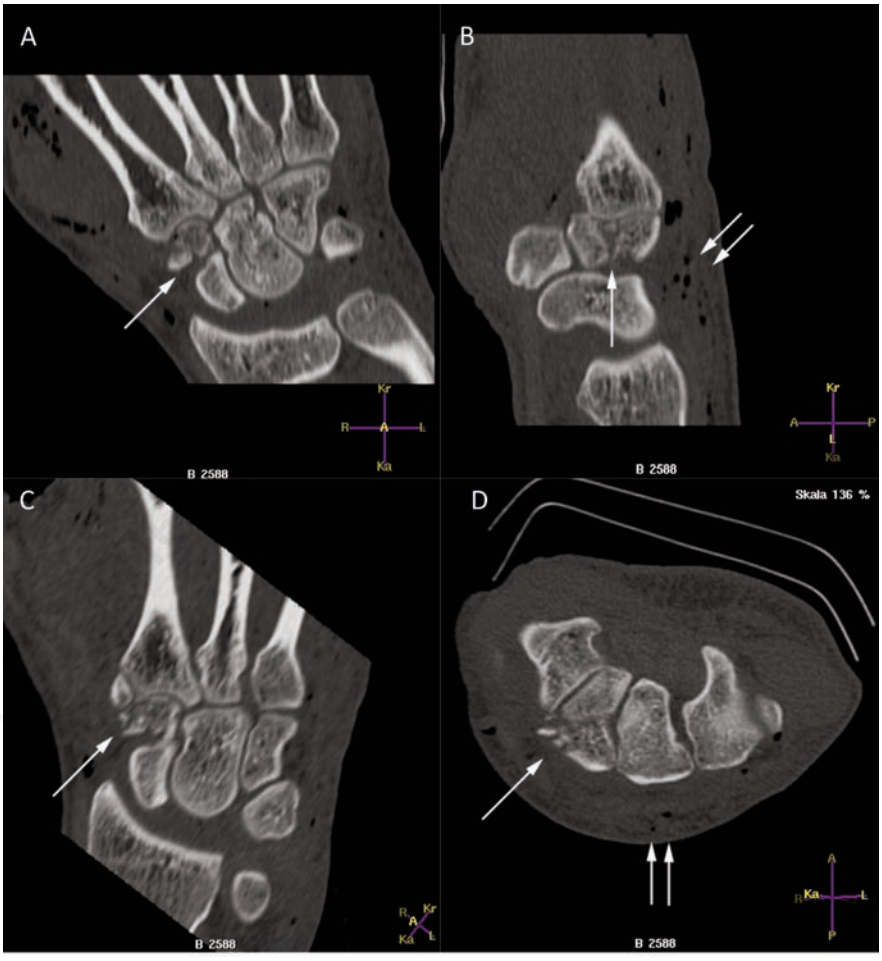

Figure 2. Computed tomographic scan of the left wrist showing the trapezoid fracture (single arrow) and air inclusion in the soft tissue (double arrow). A) Coronal; B) sagittal; C) coronal; and D) axial reformation.

Table 1. Clinical examination of the left hand at different time points.

Hand			Left			Right
Time	8 weeks	14 weeks	5 months	12 months	16 months	
Wrist flexion / extension	30° /10°	30° /45°	45° /50°	45° /50°	50° /55°	70° / 60°
Wrist ulnar- / radial deviation	25° / 0°	30° / 5°	30° / 10°	30° / 10°	30° / 12°	35° / 20°
Active closing of the hand	-	-	+	+	+	+
Grip strength (pound force)	n/n	n/n	36	n/n	83	163

the second metacarpal bone through force transmission by the ligaments.[5,6]

Blomquist *et al.* reviewed 305 radiological cases of trapezoid fractures found only 4,7% to be solitary.[7] Kain *et al.* reviewed 11 patients with trapezoid fractures and observed concomitant injuries of the hamate, metacarpals, capitates, trapezium, phalanx, carpometacarpal joint, midcarpal joint and scaphotrapezio-trapezoidal joint.[8] Due to the strong ligamentous attachment allowing no considerable displacement as well as the sheer rareness, trapezoid fractures are often overlooked and occult in plain x-rays. Although the injury of our patient was a sagittal fracture, which is more likely to be detected than a coronal fracture, the fracture could not be delineated neither on the initial nor on the follow-up x-ray examinations. Hence, additional imaging should be performed in cases of complex trauma with high force. According to Kain *et al.*,[8] CT presents the diagnostic tool of choice whereas Blomquist *et al.*[7] postulated MRI as a more sensitive and and specific tool for diagnosis of trapezoid fractures. Bone scintigraphy represents another feasible alternative, especially for detection of fracture non-union sites.[8,9] In our particular case, a CT was sufficient for diagnosis. As an additional diagnostic measure apart from CT scans, distraction during radiography may be an easy and inexpensive measure for the diagnostics of carpal injuries.

The radial fragment of the trapezoid fracture reported in this case was not notably displaced showing a displacement of two millimeters. Because of the small fracture gap and the small fragment size, we refrained from internal fixation. Our findings are in accordance with Jeong *et al.* who successfully treated a trapezoid fracture with displacement of two millimeters conservatively.[10] Subsequent clinical and x-ray examinations showed an inconspicuous progress of the trapezoid fracture. As no follow-up CT scan was performed, the bony consolidation of this fracture could not be confirmed precisely. However, seven weeks after the initial trauma, no limitation of the index finger movement or pain at the trapezoid bone was reported. The unproblematic progress of the trapezoid fracture confirms that nonsurgical treatment of trapezoid fractures is recommended for most cases and ultimately lead to good results.[7,8,10,11]

Lunate dislocations and fracture dislocations are more frequent injuries than trapezoid fractures but still rare. The scapho-lunate, radio-lunate, radio-scapho-lunate and luno-triquetral ligaments strongly fixate the lunate and hold it in its position to the distal radial and ulnar bone. To disrupt these strong ligaments and push the lunate out of its natural position, trapezoid fractures and lunate dislocations mostly occur from high-force traumas such as motor vehicle accidents. The lunate

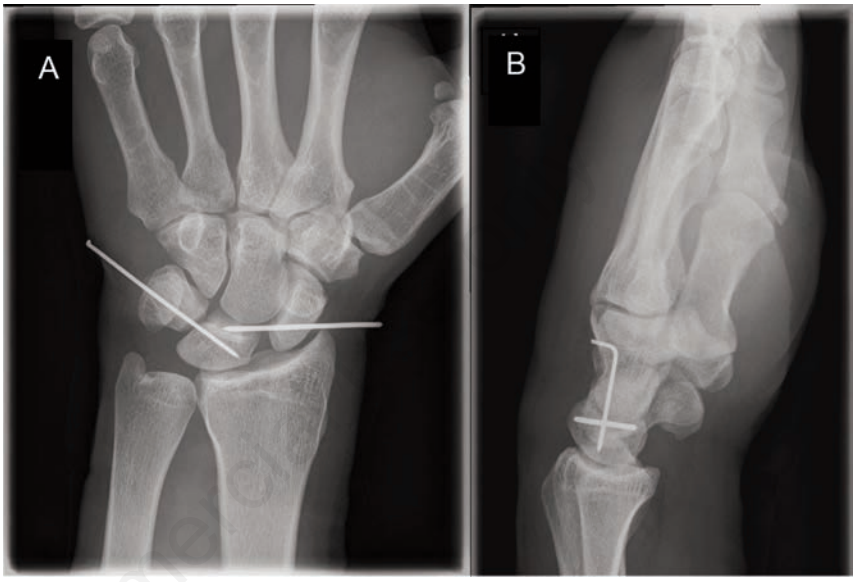

Figure 4. Immediate post-surgicalx-ray after reduction and fixation by two K-wires: A) anterior-posterior view; B) lateral view.

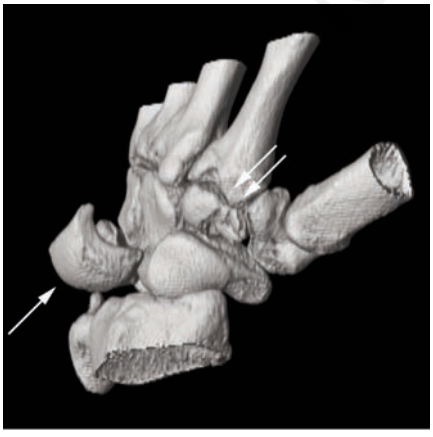

Figure 3. 3D rendering based on computed tomographic data of the left wrist (single arrow: dislocated lunate, double arrow: trapezoid fracture).

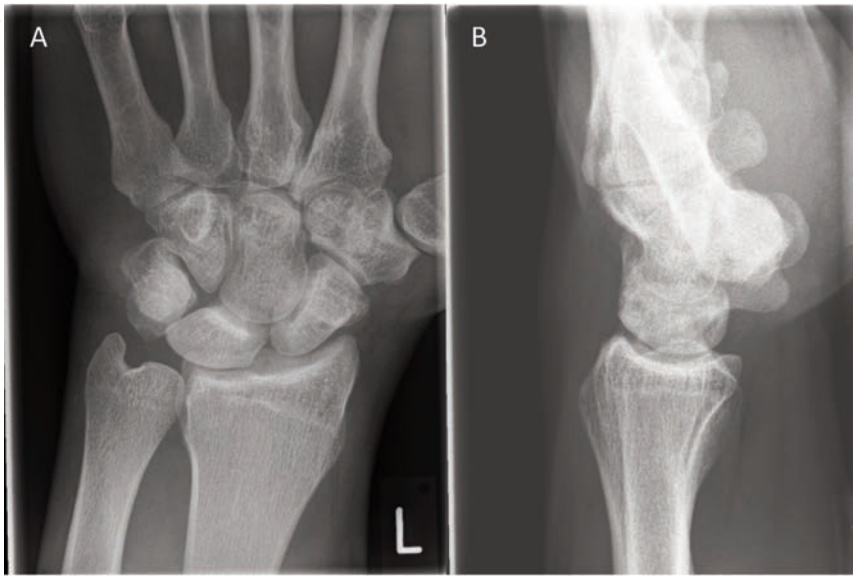

Figure 5. Post-surgical x-ray after 6 months: A) anterior-posterior view; B) lateral view.

commonly dislocates to the palmar site as part of a peri-lunate dislocation with force to the outstretched hand.

Herzberg *et al.* reviewed x-ray images of 166 patients and observed that in only 3% either perilunate dislocation or perilunate fracture dislocations were dorsally.[3] Only few reports of isolated dorsal lunate dislocations as well as injuries with concomitant carpal injuries are documented so far.[12-18] The majority of the documented dislocations were caused by high energy trauma. Siddiqui *et al.* reported about a case of dorsal lunate dislocation after a sudden pull by a dog while the patient was holding the lead. This rather trivial trauma led to an isolated dorsal lunate dislocation that could be sufficiently treated by closed reduction and percutaneous K-wires and only short immobilization. A single K-wire stabilized the lunate in a Kapandji fashion and protected it from re-dislocation. The authors therefore stated that in patients with trivial trauma a simple K-wire stabilization is a feasible therapeutic option. However, the trauma of our patient is not considered trivial so that we stabilized the lunate by two K-wires.

Bjerregaard *et al.* observed a transstyloid dorsal lunate luxation in a truck driver colliding with a train and stated that a combination of hyperflexion, ulnar deviation and pronation of the wrist might have been the etiology of the injury.[15]

Bilos *et al.* documented two cases of dorsal lunate dislocation.[13] The first patient was an amateur boxer blocking punches with the palm while the second patient fell on the flexed hand. The mentioned injury patterns suggest that a dorsal dislocation of the lunate is possible by either direct force to the palm or by hyperflexion of the wrist. The most common injury patterns for trapezoid fractures are axial load, extension, flexion or direct trauma with severe force often as a result of traffic accidents.[19]

Even though our patient could not remember the exact mechanism of injury, a forced flexion of the wrist is the more plausible etiology for the dorsal lunate dislocation since he grabbed the handlebars at time of the accident and most likely slipped off and punched against the protection of the handlebars with the dorsum of the hand. Additionally, the superficial skin abrasions on the dorsum of the hand undermine the above-mentioned assumption. The trapezoid fracture may be a result of either axial load, forced flexion or direct trauma.

Interestingly, the two cases reported by Bilos *et al.* showed different damage of the ligaments. During open reduction torn radiolunate, lunate-triquetral, anterior scapholunate, and radioscapholunate ligaments were diagnosed in the first patient while the lunate of the second patient merely showed attachment through a two-millimeter tag of the dorsal capsule and parts of the radiocapitate and the ulnotriquetral ligaments. In contrast to other cases, where even neutral wrist position or slightest flexion led to recurrent lunate dislocation, no comparable dislocation tendency was observed in our patient.[12] Patients with scapholunate ligament disruption are in particular danger of developing DISI, the dorsiflexion instability of the lunate with an increase of the scapholunate angle, or VISI, the palmar flexion instability with a reduced scapholunate angle.[20-22] However, we did not observe any DISI or VISI in our patient after K-wire fixation. In addition, closed reduction was performed easily indicating that no severe ligaments interposition was present.

We report a compound injury of dorsal dislocation of the lunate with a trapezoid fracture. As these injuries occur mostly in high force traumas, more than a quarter of the cases are found in polytrauma patients and eleven percent show accompanying trauma to the upper body.[23] Lunate and perilunate dislocations are most commonly accompanied with scaphoid fractures.[23-25] Several other compound injuries of lunate dislocations with other bony injuries such as perilunate fracture dislocations on the

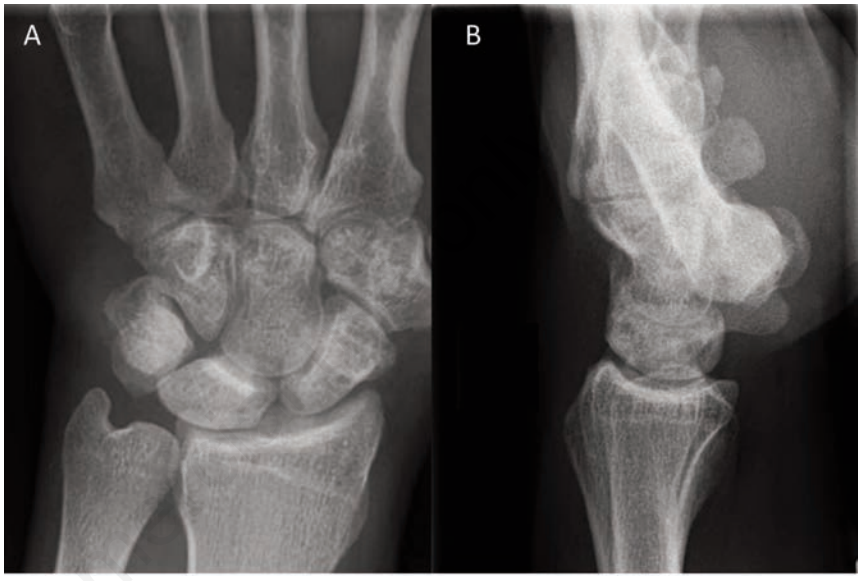

Figure 6. Post-surgical x-ray after 12 months: A) anterior-posterior view; B) lateral view.

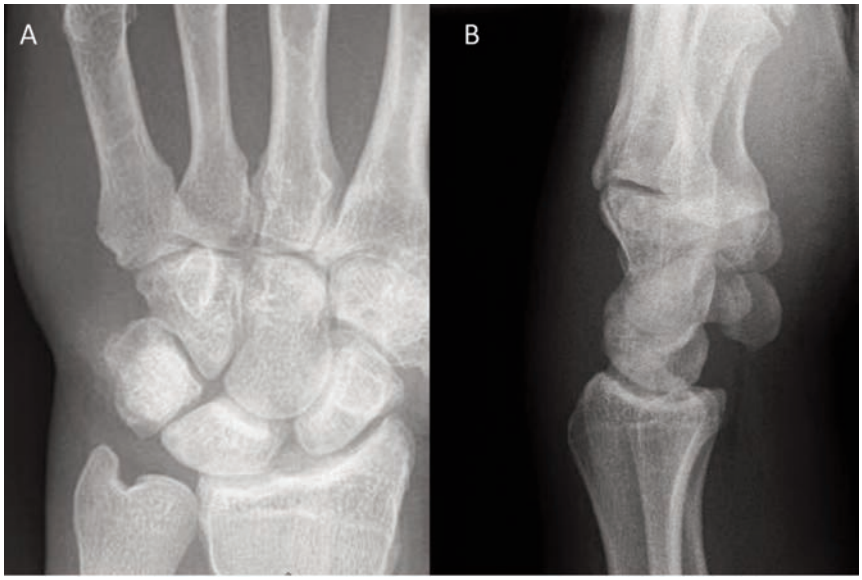

Figure 7. Post-surgical x-ray after 16 months: A) anterior-posterior view; B) lateral view.

contralateral wrist[26] or fracture of the capitate,[27] dislocations of distant joint such as the elbow[28] or radioulnar joint,[29] or soft tissue damage such as extensor tendons rupture[18] are reported in the literature emphasizing the underlying high energy.

The therapy of lunate dislocations and fracture dislocations remains controversial. While simple closed reduction and cast immobilization is not regarded as sufficient, internal fixation such as K-wire fixation, K-wires plus external fixation, minimally invasive procedures or open surgery are discussed in the literature.[30] Literature specifically addressing the therapy of dorsal lunate dislocations is scarce, but an open reconstruction of the ligaments appears to be beneficial in cases with complications such as dislocation tendency. Furthermore, a widened scapholunate gap as seen in our patient indicates an injury to the scapholunate ligament which can be addressed by open repair.[31]

Exceptions are trivial traumas as described by Siddiqui *et al.* where K-wire fixation might be sufficient. Considering the the widened scapholunate gap with impaired range of motion of the wrist and not fully restored strength, an open reduction and reconstruction of the ligaments may have been an even better solution for our patient in the retrospective. K-wires with external fixation represent a feasible alternative.[30] In order to create structured guidelines for the treatment of dorsal dislocations of the lunate, additional studies are required.

In conclusion, wrist injuries after high force trauma require a thorough initial investigation. In case of any uncertainties, a CT or MRI is strictly advocated to rule out further damage to the carpus. In our case, the trapezoid fracture was occult in the plain x-ray and only diagnosed by CT scan. While trapezoid fractures with minor dislocation are treated conservatively, there is no definite consensus about the treatment of dorsal dislocations of the lunate. Our decision to apply a closed reduction combined with two K-wires led to a satisfactory result considering the overall severity of the trauma. However, open surgery including ligament reconstruction may also represent a solution especially in traumas with high force and severe ligament damage.

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