CASE REPORT

Hybrid Axial Ulnar Carpal and Perilunate Dislocation: A Case Report

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the mechanism of the rare pattern in connection with the radiographic information.

Introduction

Axial carpal dislocations and perilunate dislocations are two classifications of carpal disruption. Axial dislocations of the wrist usually occur under dorsopalmar compression force in high-energy trauma [1, 2]. They have been classified into two types: axial-radial and axial-ulnar by Garcia-Elias et al. [1, 2]. On the other hand, with regard to perilunate carpal injuries, Mayfield et al. proposed their mechanism as a 4-stage progressive sequence from radial to ulnar [3]. Both injuries have many variant patterns that are difficult to recognize and diagnose and sometimes these 2 injuries occur in combination [1, 2]. This review article describes that in some cases of axial carpal dislocations, the extreme force which extends to the proximal carpal row can lead to additional perilunate injuries [2].

Recently modification of the classification of perilunate injuries has been proposed to include many complicated variants such as reverse ulnar to radial types [4–6], non-dislocation of the capitate from the lunate [7], or translunate carpal injuries [8].

We report here a case of 42-year-old patient who sustained a wrist injury resulting in transtriquetral axial ulnar dislocation associated with scapholunate (SL) dissociation. We highlight

Case Report

A 42-year-old right dominant handed male injured his left wrist in a motorbike traffic collision. He was referred to our hospital 2 days after the injury. The wrist was moderately swollen with no neurological deficit or skin wound. Radiographs of the injured wrist showed a triquetral fracture and SL dissociation with an increased SL angle (90°) (Fig. 1). In addition, three-dimensional and axial computed tomographic (CT) views demonstrated the capitohamate axial dislocation fracture, 3rd-4th metacarpal base axial subluxation, trapezoid avulsion fracture and the coronal triquetrum fracture line (Fig. 2). A CT sagittal view showed clearly that the triquetral fracture was coronally complete with the line extending down from its distal aperture to the minimally-disrupted proximal cortex (Fig. 2d). The hamate fracture was also demonstrated to be coronally split with a dorsal avulsion fragment attached to the dorsal capitohamate ligament in the sagittal view CT (Fig. 2d).

Through the dorsal ligament splitting approach [9], surgery was performed at 7 days post-injury. The hamate was dislocated palmarly with minimal osteochondral fractures, and the chondral tear at the dorso-ulnar side of the proximal capitate was observed. The SL ligament at its midsubstance was so completely disrupted (Fig. 3). Following the successful reduction of capitohamate and SL joints, temporary intercarpal fixation was secured with one 1.5 mm K-wire at capitohamate joint and two pairs of 1.2 mm K-wires at SL joint. The dorsal portion of the SL ligament was repaired with a nonabsorbable suture. The triquetral fracture was managed with two transverse 1.0 mm K-wires (Fig. 4). Two chip

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Fig. 1 Initial radiographs of the wrist **a)** An anteroposterior view showing a nondisplaced fracture of triquetrum (*thick arrow*) and scapholunate dissociation (*thin arrow*). **b)** A lateral view shows an increased SL angle (90°) (The axis lines of scaphoid and lunate form the angle)

fractures at the dorsal hamate and trapezoid were both left unfixed. Long arm cast immobilization was applied for 3 weeks followed by short arm cast for 3 weeks. At cast removal, all K-wires were removed and the patient was instructed to perform active range of motion (ROM) exercise

of the wrist. Furthermore, passive ROM exercise commenced 8 weeks postoperative. At postoperative 10 weeks, full weight bearing with injured upper extremity was allowed. After the 6 months, wrist ROM was 30/72° (palmar/dorsal flexion, p/d) and 90/90° of pronation/supination(p/s). The grip strength(GS) was 17 kg. The patient complained of dorsal wrist pain at light work. ROM was 32/80°(p/d) and GS was 20 kg at 9 months. The patient was pain free with daily activities. At 14 months postoperative, despite mild erosions at the radial side of lunate and slight SL narrowing, satisfactory carpal relationship was seen in radiographs (Fig. 5). Pain was rated as mild in Modified Mayo Wrist Score(MMWS) [10] with visual analogue scale of 25/100 mm scale. Wrist ROM was 40/85° (p/d) and 90/90° of p/s. The GS was 27 kg (66 % of the contralateral side). The patient complained of minimal discomfort after strenuous work, with MMWS of 70 and DASH score of 20.

Discussion

Axial carpal dislocations and perilunate dislocations are two types of carpal disruption. Axial dislocations have been classified into types of radial and axial path [1, 2]. Perilunate dislocations are staged injuries of the progressive sequence from radial to ulnar [3].

Fig. 2 Initial CT image of the wrist. **a)** Three-dimensional CT image of the wrist showing a capitohamate axial dislocation fracture and 3rd-4th metacarpal base axial dislocation. The hamate and 4th metacarpal base are dislocated in the palmar direction. **b)** Capitohamate axial dislocation with avulsion fracture from the dorsal hamate is best observed in the axial CT view. **c)** Axial CT images view highlight the coronal plane of the

triquetrum fracture line. **d)** Ulnar sided sagittal CT images also demonstrate that the triquetrum fracture line was coronal with the line extending down from its distal aperture to the minimum-disrupted proximal cortex. A sliver-like chip fracture avulsed from dorsal hamate was also confirmed. **e)** Radial sided sagittal CT view shows a chip fracture avulsed from dorsal trapezoid

Fig. 3 Operative photograph. Intraoperative findings through the dorsal ligament splitting approach. The hamate was dislocated palmarly with minimal osteochondral fractures (*thick arrow*). The chondral tear at the dorso-ulnar side of the proximal capitate was found. The scapholunate ligament was completely disrupted at its mid substance (*thin arrow*). Scaphoid and lunate were respectively held with a Kirschner wire as a joystick to manage the correction of normal articulation

Both axial carpal dislocation and perilunate dislocation mutually have many combined patterns that are difficult to recognize and diagnose [1, 2]. It has recently been proposed

Fig. 4 Radiographs of the wrist immediately post-operative. **a)** An anteroposterior and **b)** lateral view show that internal fixation and intercarpal joint stabilization was performed using multiple Kirschner wires (1.5 mm K-wire at capitolunate joint, two pairs of 1.2 mm K-wire at SL, and two pairs of 1.0 mm K-wire at the triquetrum fracture site)

Fig. 5 Radiographs of the wrist at 14 months post-operation. **a)** An anteroposterior and **b)** lateral view that demonstrate that union was achieved at the triquetrum site of the fracture. An adequate carpal alignment was observed despite mild erosions at the radial side of lunate and slight scapholunate narrowing

to modify the classification of perilunate injuries to include complicated variants such as reverse ulnar to radial types [4–6], non-dislocation of the capitate from the lunate [7], and translunate carpal injuries [8]. This clarification may enhance the comprehensive understanding of those two combined injuries.

We report a unique case of transtriquetral axial ulnar dislocation associated with SL dissociation in a 42-year-old man. The total appearance of these carpal disruptions lead us to presume that the injury was transtriquetral capitolunate axial ulnar dislocation and transtriquetral reverse non-dislocated perilunate dislocation. The mechanism was speculated to be that anteroposterior crushing force by the motorbike handle caused the carpal arch flattening that led to axial disruption at the 3rd-4th basal metacarpal joint, a capitolunate dislocation associated with dorsal hamate and trapezoid avulsion fracture, and a coronal split-type of transtriquetral fractures. Next, the disruption path with wrist hyperextension and pronation turned and propagated radially from the triquetrum, resulting in the ulnar- to radial-sided transtriquetral perilunate injury (Fig. 6). The intraoperative finding that the dorsal portion of the split triquetrum involved the lunotriquetral ligament while the ulnotriquetral ligament was attached to the palmar portion seems to be compatible with the initial stage of the progressive theory of an ulnar-sided perilunate instability [4]. The presence of a chondral tear at the proximal capitate implies that the injury force traveled through the lesser arc despite no dislocation of the capitate from the lunate, as Herzberg described [7].

Four English language reports concerning combined capitolunate axial dislocation and perilunate dislocation

Fig. 6 Presumed force pathway on **a**) a lateral and **b**) anteroposterior view. Arrow lines indicate the mechanical force crossing the 3rd–4th metacarpal arch, the carpal bone fractures and carpal bones

(fracture dislocation) were found in a literature review; however there was no description about the reverse type of perilunate injury besides the report by Murray et al. [4], and CT was not performed in all cases [4, 11–13] (Table 1). Naam et al. reported a case of a capitolunate transtriquetral ulnar dislocation with a palmar lunate dislocation without scapholunate ligament tear [11]. Murray et al. analyzed the mechanism of ulnar-sided perilunate instability using a cadaver model and reported 6 experienced clinical cases. They described that 2 axial carpal dislocations and one distal radius fracture in addition to 13 reverse perilunate injuries were created in 16 specimens [4]. Zyluk et al. reported

combined capitolunate axial injury and open perilunate fracture dislocation associated with scaphoid and 4th metacarpal fractures [12]. One case with combined capitolunate axial injury and open translunate fracture dislocation associated with radial styloid fracture was reported by Gvozdenovic et al. [13].

The patterns of carpal bone fracture dislocation are often quite complicated. It is important to quickly assess and understand the carpal derangement to determine the optimal surgical plan. Our case will contribute to understanding of the mechanism in hybrid capitolunate dislocation and perilunate injuries.

Table 1 Characteristics of previously reported cases of combined capitolunate dislocation and perilunate dislocation (fracture dislocation), compared to the present case

	Ref. No.	1st author	Year	Sex	Age	Mechanism	Ligamentous injury besides CH	Bony injury		Treatment
								Perilunate site	Perihamate site	
1	4	Murray	2012	Male	25	Fall	Partial dorsal SL,LT	Ulnar styloid	Negative	OR,Kw
2	11	Naam	1992	Male	33	Car collision	Undescribed	Triquetrum	Negative	OR,Kw
3	12	Zyluk	2013	Male	25	Explosion	LT	Scaphoid	Hamate, 4th metacarpal bone	OR,Kw,Screw
4	13	Gvozdenovic	2012	Male	54	Car collision	SL, LT*	Lunate, radial styloid	CM subluxation(2nd, 3rd)	PRC,Kw
5		Present case		Male	42	Motor bike accident	SL	Triquetrum	Avulsion(trapezoid, hamate)	OR,Kw

CH: Capitolunate ligament

SL: Scapholunate ligament

LT: Lunotriquetrum ligament

*: SL and LT tear were considered from the description in Ref.11, which stated that lunate was only attached with short radiolunate ligament

CM: Carpometacarpal joint

OR: Open reduction

Kw: Kirschner wire

PRC: Proximal row carpectomy

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

Research Involving Human Participants Statement of human rights: For this type of study formal consent is not required.

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