



Concurrent scaphoid fracture with scapholunate ligament rupture

Chun-Ying CHENG, Kuo-Yao HSU, I-Chuan TSENG, Hsin-Nung SHIH

From Chang Gung University Memorial Hospital, Taoyuan, Taiwan

Various patterns of traumatic carpal injury have been described in the literature. Although the combination of scaphoid fracture and scapholunate ligament rupture in the same injury has been reported and these lesions can no longer be considered mutually exclusive, little information is available on management methods and the long-term results of such seemingly paradoxical complex injuries. This study reviews 11 previously described cases and reports an additional two cases of concurrent scaphoid fracture with scapholunate ligament rupture. This concurrent injury has two presentations; namely perilunate fracture-dislocation, which is the most common presentation, and complex scaphoid fracture. No single mechanism of injury exists that accounts for these complex injuries. High-energy trauma was the only characteristic common to all these cases. Most cases had unsatisfactory radiographic results including scaphoid nonunion, avascular necrosis of the lunate or the proximal pole of the scaphoid and arthrotic wrist changes at an average follow-up of 11 months. Managing these difficult problems needs critical recognition and repair of both bony and ligamentous damage. Early proximal row carpectomy or four-corner midcarpal fusion is another option when these injuries preclude stable reduction and fixation.

INTRODUCTION

A perilunate or lunate dislocation is generally believed to require either a fracture of the scaphoid or disruption of the scapholunate ligament. The combination of these two injuries can be consid-

ered mutually exclusive. Weiss *et al* (15) noted this combination in their 1970 study. Schakel *et al* (11) were first to emphasise the possibility of concurrent scapholunate ligament rupture and scaphoid fracture in the same injury, and several other authors subsequently reported the same condition (8). Herzberg *et al* (4) identified at least five cases of concomitant scaphoid fracture and scapholunate ligament disruption in a large series of 166 perilunate dislocations, but did not detail these cases. Herzberg *et al* also stressed that fixation of the scaphoid alone is inadequate for treating the whole lesion.

In experimental cadaver studies of carpal injury, Mayfield noted the occurrence of concurrent scaphoid fracture and scapholunate ligament disruption, with the ligamentous injury ranging from variable degrees of anterior attenuation to complete rupture (7). The frequency of such concurrent lesions is probably underestimated in clinical settings. The spectrum, management and outcome of these injuries remain unclear. The treatment is

-
- Chun-Ying Cheng, MD, Lecturer.
 - Kuo-Yao Hsu, MD, Orthopaedic Surgeon.
 - I-Chuan Tseng, MD, Assistant Professor.
 - Hsin-Nung Shih, MD, Associate Professor.

Correspondence : Chun-Ying Cheng, Department of Orthopaedic Surgery, Chang Gung Memorial Hospital, Chang Gung University, No. 5, Fu-Hsing St. 333 Kweishan, Taoyuan, Taiwan. E-mail : orthhand@adm.cgmh.org.tw.

© 2004, Acta Orthopædica Belgica.



Fig. 1. — Case 1, (A) Posteroanterior and (B) lateral radiographs of wrist show comminuted scaphoid fracture with displaced proximal pole and nondisplaced capitulunate joint.

based on anatomic reduction of the fracture and restitution of the intercarpal relationship, but the technique for repairing the scapholunate ligament and fixing the scaphoid fracture remains challenging and difficult. To evaluate this condition, this study reviewed 11 previously reported cases (contained in eight studies) and reports an additional two cases of concurrent scaphoid fracture with scapholunate ligament rupture.

MATERIALS AND METHODS

We reviewed the prior reports of carpal injury with this association in the literature and collated all information regarding the roentgenographic presentation, mechanism of injury, and treatment. The essential features, concurrent scaphoid fracture with scapholunate ligament rupture, all presented on the initial films, at surgery, or on the follow-up films. The classification of perilunate fracture dislocation and outcome of the follow-up x-ray films were according to the method of Herzberg (4): in stage I, the lunate remains in place under the radius and in stage II, the lunate is volarly dislocated. A score of 70 or better according to the scoring system of Green and O'Brien (3) was considered a satisfactory result.

CASE REPORTS

Case 1

A 38-year-old male consulted, complaining of persistent pain in his right wrist and ankle joint after a traffic accident one month previously. He had collided with a car while driving his motorcycle at high speed. The man was immediately discharged from the emergency depart-

ment, and was diagnosed with a wrist and ankle sprain, facial abrasion of the forehead and chest contusion. Roentgenograms revealed a comminuted fracture of the carpal scaphoid with a displaced proximal fragment, and a fracture of the lateral process of the talus at the right ankle (fig 1). A CT scan revealed a comminuted fracture of the scaphoid with severe dorsal displacement of the proximal fragment, scapholunate dissociation and a non-displaced fracture of the volar pole of the lunate (fig 2).

Primary proximal row carpectomy was arranged owing to the delayed presentation of this complicated scaphoid fracture. The wrist was exposed by a dorsal incision, revealing that the proximal fragment of the scaphoid lay subcutaneously under the ruptured dorsal capsule and was devoid of ligamentous attachments. The scapholunate ligament was ruptured and the radioscaphocapitate, the long radiolunate and the lunotriquetral ligament were intact, as detected during resection of the scaphoid. Before the lunate was resected, an osteochondral defect in the proximal capitate and a nondisplaced fracture in the palmar pole of the lunate with an intact triquetrolunate joint were observed. Wrist reconstruction was switched to midcarpal fusion, which was performed by arthrodesis of the joint adjacent to the capitate, lunate, hamate and triquetrium with cancellous bone graft from the resected scaphoid and intercarpal fixation with four K-wires. The wrist was immobilised in plaster for six weeks, then the K-wires were removed and physical therapy was begun. At the two-year follow-up examination, the patient had 50° extension, 34° flexion, 20° radial deviation and 34° ulnar deviation. Grip strength was 110 lbs on the right side and 100 lbs on the

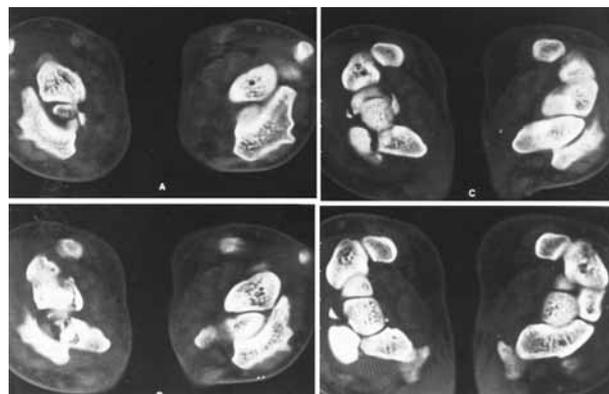


Fig. 2. — Case 1. Axial cut of computer tomogram showing the proximal pole of the scaphoid displaced dorsally, and intact lunotriquetral joint.



Fig. 3. — Case 1. Two years after midcarpal fusion, radiographs show no sign of degenerative change of the radiocarpal joint

left. Radiographs showed correct capitulate alignment with solid union and no evidence of radiocarpal arthrosis (fig 3). The patient was able to resume his previous work and had no complaints of pain or functional limitations.

Case 2

A 28-year-old right-handed male labourer suffered an accident in which his wrist was crushed and caught by a machine. He presented an open perilunate fracture-dislocation with associated fractures of the second metacarpal shaft and third metacarpal neck and an open fracture of the distal ulna (fig 4).

He initially underwent plate fixation of the distal ulna and second metacarpal and soft tissue repair, as well as reduction of the carpal lesion with an external fixator, but the reduction of the carpal fracture was unsuccessful (fig 5). Reduction of the perilunate fracture-dislocation was performed one week after the initial surgery, using a combined dorsal and palmar approach. Severe damage of the dorsal capsule and ligament was found, and the proximal pole of the scaphoid, which was nearly free and had no capsule attached to it, was interposed in the separated midcarpal joint. A variant of trans-scaphoid perilunate dislocation was proved by complete rupture of the scapholunate ligament, the dorsal capitate-hamate interosseous ligament and an undislocated lunotriquetral joint. Following repair of the volar capsular rent, the scapholunate ligament was repaired by direct suture via a drill hole on the scaphoid side with 3-0 nonabsorbable sutures and the scaphoid fracture and scapholunate joint were stabilised with K-wires. Additional K-wires were used to stabilise the lunotriquetral and capitate-hamate joint; the wrist was then kept in the neutral position with an external fixator.



Fig. 4. — Case 2. (A) Posteroanterior and (B) lateral radiographs of wrist show a variant dorsal trans-scaphoid perilunate fracture dislocation.



Fig. 5. — Case 2. (A) Posteroanterior and (B) lateral radiographs of wrist after reduction with external fixation show concurrent scaphoid fracture and scapholunate ligament rupture and displacement of the proximal pole of the scaphoid.

Ten days later, the patient received further surgery for skin defect with skin graft and redisplaced third metacarpal head fracture with K-wires fixation. He received serial hand therapy after the external fixator and pins were removed at eight weeks; the scaphoid fracture healed by three months, and then the pins for stabilising the scaphoid and scapholunate joint were removed (fig 6). At last examination, three years after injury, the patient had changed to less strenuous work and experienced slight discomfort with heavy use. Dorsiflexion of the wrist was 40° and volar flexion was 30°; grip strength was 50 lbs on the right side and 150 lbs on the left. Radiograph showed union of the scaphoid

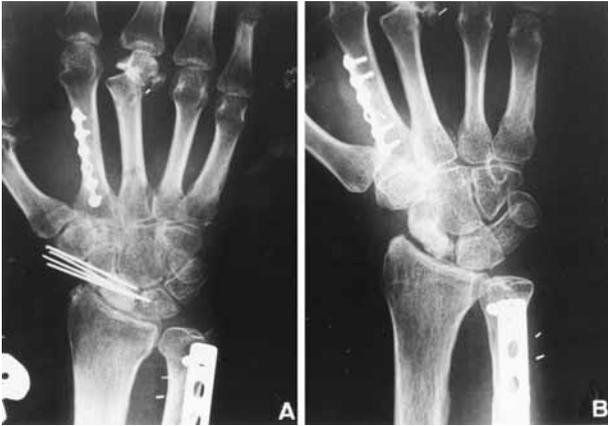


Fig. 6. — Case 2. (A) Three months and (B) one year after surgical open reduction and fixation, radiographs show union of the scaphoid but avascular necrosis of the proximal pole of the scaphoid.



Fig. 7. — Case 2. Three years after operation, radiographs show progressing revascularisation of the proximal pole of the scaphoid without arthritic changes in the radiocarpal or midcarpal joint.

with progressing revascularisation of its proximal pole, and no evidence of radiocarpal or midcarpal arthrosis (fig 7). Moreover, radiograph analysis revealed a carpal height ratio of 1.60, scapholunate angle of 70° and radiolunate angle of 8° .

DISCUSSION

Table I summarises the data of the presented and collated cases (2, 9-15). Three of the eight collated articles emphasised the concurrent scaphoid fracture and scapholunate ligament ruptures, with two of these describing the repair of the scapholunate ligament but not detailing the method or procedures. Moreover, five of the eight collated articles emphasised the variant type of the perilunate fracture and dislocation including scaphocapitate syndrome (in two), severe displacement of the lunate or proximal scaphoid (in three). According to the classification of Herzberg, almost all cases of perilunate fracture dislocation were dorsal stage II. It is the end stage of Mayfield's classification of progressive perilunar instability, namely complete volar displacement of the lunate with or without the proximal pole of the scaphoid, associated with perilunate fracture-dislocation.

Concurrent scaphoid fracture with scapholunate ligament rupture has two presentations. The more

common presentation is perilunate dislocation and fracture-dislocation, while the other is complex scaphoid fracture. At least case 1 and 12 had showed such a complex scaphoid fracture (12). No single mechanism of injury exists that accounts for each lesion. High-energy trauma is the only characteristic common to all of these cases. High-energy trauma is indicated by a high rate of severe displacement of the proximal pole of the scaphoid or lunate, which is devoid of soft tissue attachment. Extension wrist injury is still the most probable pathogenic mechanism of scaphoid fracture or perilunate dislocation and fracture-dislocation, although other mechanisms may also exist.

Treatment of these complex injuries is controversial. Open reduction is indicated when treatment is intended to restore the normal intercarpal relationship, but stabilisation of ligamentous and bony damage in the proximal pole of the scaphoid is difficult and challenging. The authors think it is possible to treat these complex injuries by direct suture of the scapholunate ligament through drilling a hole on the scaphoid attachment side and stabilising the scapholunate joint with K-wires and fixation of the scaphoid fracture with K-wires. Using another compression screw to fix the scaphoid fracture and anchor suture to repair the scapholunate ligament rupture is difficult without impinging

Table I. — Data of reported cases

Case	Time of presentation	Age	Sex/Wrist	Mechanism	Type of injury	Attachment of capsule of Sp	Treatment	Repair of SL ligament	F/U	AVN of carpal bone	Result	Radiological result
1	2003	38	M/R	Motorcycle accident	Scaphoid fracture	Free	Midcarpal arthrodesis	N	24M	N	G	S
2	2003	28	M/R	Crushed by machine	PLFD/DII	Dorsal capsule	OR-K	Y	36M	Y Sp	F	S
3	1998	24	M/R	Fall from 4 stories	PLFD/DII	Free	OR-screw	N/A	32M	Y Sp lunate	N/A	US/arthrosis
4	1994	28	M/R	Fall from ladder	PLFD/DI	Free	PRC	N	18M	N	F	S
5	1992	27	M/R	Fall playing football	PLFD/DII	Volar capsule	OR-screw	N/A	6M	N/A	N/A	N/A
6		22	M/L	Fall from roof	PLFD/DII	Free	OR-K	N/A	N/A	N/A	N/A	N/A
7		32	M/L	Fall	PLFD	N/A	OR-screw	N	7M	N/A	N/A	US/Sca nonunion
8		39	F/R	Fall from horse	Scaphoid fracture	N/A	Cast	N	9M	N/A	N/A	US/Sca nonunion
9	1990	26	F/R	Fall from height	PLFD/DII	Free	OR-K	N	8Y	Y Sp	F	US/arthrosis
10	1988	20	M/R	Motorcycle accident	PLFD/DII	Dorsal capsule	OR-screw	Y	8M	N	N/A	N/A
11	1986	24	M/R	Motor vehicle	PLFD/DII	Free	OR-screw	Y	8M	Y Sp lunate	F	US/arthrodesis
12	1983	18	M/R	Push over backwards	Scaphoid fracture	Free	OR-K	N/A	3M	N/A	N/A	N/A
13	1970	32	M/L	Struck by car	PLFD/DII	Volar R-S ligament	OR-K	N/A	16M	N	N/A	S

M : male ; F : female ; L : left ; R : right ; M : months ; Y : yes ; N : no

PLFD/DII : Perilunate fracture dislocation / Dorsal stage II

N/A : data not available

US : unsatisfactory

S : satisfactory

Sp : proximal pole of the scaphoid

OR-K : open reduction with K wires

Sca : Scaphoid

PRC : proximal row carpectomy.

other implants in these complex injuries. The therapeutic problem of traumatic scapholunate ligament rupture was residual scapholunate dissociation, which had ultimately led to chronic instability and/or scapholunate collapse and arthritis. Combined treatment of scaphoid fracture and scapholunate dissociation seems necessary to obtain a good result.

Six of nine cases had unsatisfactory radiological results including scaphoid nonunion (in two), avascular necrosis of lunate and/or the proximal half of scaphoid (in three) and collapsed radiocarpal or midcarpal arthrosis (in two). The result may depend on initial severe bony and ligamentous damage and inadequate treatment. Hildebrand *et al* (6) reported that nine of 18 (50%) dorsal perilunate dislocations and fracture-dislocations displayed radiographic evidence of arthritis at an average follow-up of 37 months, although all cases were treated within four weeks of injury using similar open reduction and fixation principles at a specialised center. Hildebrand *et al* (6) attributed the 50% rate of midcarpal arthritis to recognised or unrecognised cartilage damage particularly to the head of the capitate. Irreparable cartilage damage, particularly to the head of the capitate, not only affects the choice of treatment (case 1) but also the treatment outcome. Amadio pointed out that early proximal row carpectomy seems worth considering when severe carpal fracture-dislocations preclude stable reduction or fixation (1). Primary midcarpal fusion or wrist arthrodesis is another option for treating this complex injury.

Vascular compromise to the lunate and the proximal half of the scaphoid is expected in this high-energy complex injury, and it affects the result through scaphoid nonunion and avascular necrosis of the lunate and half of the scaphoid. Detailed radiographic reading and distraction radiographic films are helpful for recognising this combined injury before surgery, and care must be taken to avoid unnecessary soft tissue dissection to prevent further devascularisation of the displaced lunate or the proximal pole of the scaphoid, or wrist destabilisation. We agree with reports by other authors (3) that carpal collapse secondary to avascular necrosis rarely occurs if anatomic reduction

has been obtained.

From this clinical study, concurrent scaphoid fracture and scapholunate dislocation presented not only in the case of perilunate fracture-dislocation but complex scaphoid fracture is relatively compatible with the findings of the experimental studies on carpal injuries by Mayfield (7), which showed that virtually all of the scaphoid fractures had some degree of scapholunate interosseous ligament failure; the spectrum stretched from a small tear volarly to complete disruption. This experimental study was supported by other clinical studies: Herzberg *et al* (5) reported that two of 14 trans-scaphoid perilunate fracture-dislocations had rupture of the anterior part of the scapholunate interosseous ligament. All the cases presented in this study fall within a wide spectrum of complex injuries, among which concurrent scaphoid fracture with complete scapholunate ligament rupture may be seen at one end of the spectrum.

REFERENCES

1. Amadio PC. Special update : What's new in hand surgery. *J Bone Joint Surg* 2003 ; 85-A : 389-393.
2. Braithwaite IJ, Jones WA. Scapho-lunate dissociation occurring with scaphoid fracture. *J Hand Surg* 1992 ; 17-B : 286-288.
3. Green DP, O'Brien ET. Open reduction of carpal dislocation : indications and operative techniques. *J Hand Surg* 1978 ; 3 : 250-265.
4. Herzberg G, Comtet JJ, Linscheid RL, Amadio PC, Cooney WP, Stalder J. Perilunate dislocations and fracture-dislocations : a multicenter study. *J Hand Surg* 1993 ; 18-A : 768-779.
5. Herzberg G, Forissier D. Acute dorsal trans-scaphoid perilunate fracture dislocation : medium-term results. *J Hand Surg* 2003 ; 27-B : 498-502.
6. Hildebrand KA, Ross DC, Patterson SD *et al*. Dorsal perilunate dislocations and fracture-dislocations : questionnaire, clinical and radiographic evaluation. *J Hand Surg* 2000 ; 25A : 1069-1079.
7. Mayfield JK. Mechanism of carpal injuries. *Clin Orthop* 1980 ; 149 : 45-54.
8. Melone CP, Murphy MS, Raskin KB. Perilunate injuries : repair by dual dorsal and volar approaches. *Hand Clin* 2000 ; 16 : 439-448.
9. Pandi R. Proximal and palmar dislocation of the lunate and proximal scaphoid as a unit in a case of scaphocapitate syndrom. *J Hand Surg* 1998 ; 23-B : 266-268.

10. **Roger DJ, Williamson SC, Whipple R.** Ejection of the proximal scaphoid in a transscaphoid perilunate fracture dislocation. *Clin Orthop* 1994 ; 302 : 151-155.
11. **Schakel M, Dell PC.** Trans-scaphoid palmar lunate dislocation with concurrent scapholunate ligament disruption. *J Hand Surg* 1986 ; 11A : 653-655.
12. **Shestak K, Ruby LK.** An unusual fracture of the scaphoid. *J Hand Surg* 1983 ; 8 : 952-958.
13. **Stevanovic M, Schnall SB, Filler B.** Trans-scaphoid, transtriquetral, volar lunate fracture-dislocation of the wrist. *J Bone Joint Surg* 1996 ; 78-A : 1907-1910.
14. **Vigeas SF, Hoffman FJ.** Palmar lunate dislocation with a dorsal scaphoid fracture variant. *J Hand Surg* 1988 ; 13-A : 452-455.
15. **Weiss C, Laskin RS, Spinner M.** Irreducible trans-scaphoid perilunate dislocation. *J Bone J Surg* 1970 ; 52-A : 565-568.
16. **White RE, Omev GE.** Transient vascular compromise of the lunate after fracture-dislocation or dislocation of the carpus. *J Hand Surg* 1984 ; 9-A : 181-184.