

ผลการรักษา Transscaphoid Perilunate Fracture-Dislocation โดยการผ่าตัด ยึดตรึงกระดูกผ่านบาดแผลขนาดเล็ก; รายงานผู้ป่วยจำนวน 10 ราย

ณัฐดนัย จูสิงห์

หน่วยงานออร์โธปิดิกส์ โรงพยาบาลขอนแก่น อำเภอเมือง จังหวัดขอนแก่น 40000

The Outcome of Percutaneous Fixation of Transscaphoid Perilunate Fracture-Dislocation: A Series of 10 Cases

Natdanai Chusing

Department of Orthopaedics, Khon Kaen Hospital, Khon Kaen 40000 Tel/Fax 043-232555, Thailand.

Email: Natdanai30@gmail.com

วัตถุประสงค์: รายงานผลการรักษาในระยะ 6 เดือนของผู้ป่วยที่เป็น transscaphoid perilunate fracture-dislocation ที่รักษาด้วยวิธียึดตรึงกระดูก scaphoid ด้วย headless compression screw แบบเปิดผ่านผิวหนังขนาดเล็ก ร่วมกับยึดตรึงกระดูกโดยรอบกระดูก lunate ด้วยลวด Kirschner **วัสดุและวิธีการ:** ทำการศึกษาย้อนหลังในผู้ป่วยที่ได้รับการวินิจฉัยว่าเป็น transscaphoid perilunate fracture-dislocation จำนวน 10 รายที่มารับการรักษาที่โรงพยาบาลขอนแก่นในช่วงระหว่างเดือนกรกฎาคม ปี พ.ศ. 2559 – เดือนธันวาคม ปี พ.ศ. 2560 โดยผู้ป่วยทุกรายจะได้รับการดึงข้อ lunocapitate ให้เข้าที่ก่อน จากนั้นทำการผ่าตัดด้วยวิธีเปิดผ่านผิวหนังขนาดเล็ก และทำการประเมินผลการรักษาด้วย Mayo Wrist Score และประเมินภาพถ่ายทางรังสีวิทยาของข้อมือเพื่อวัดค่ามุม scapholunate, lunocapitate, ค่า scapholunate gap และค่า modified carpal height ratio **ผลการศึกษา:** ผู้ป่วยจำนวน 10 ราย เป็นเพศชาย 8 ราย อายุเฉลี่ย 29 ± 7.84 ปี แบ่งการบาดเจ็บเคลื่อนหลุดของกระดูก lunate ตาม Herzberg เป็นแบบ 1 จำนวน 7 ราย แบบ 2a จำนวน 2 ราย แบบ 2b จำนวน 1 ราย ลักษณะการหักของกระดูก scaphoid เป็นที่ตำแหน่งเอวทั้งหมดโดยมีการหักแบบละเอียดหลายชิ้นจำนวน 2 ราย ผลรวมพิสัยการเคลื่อนไหวของข้อมือและแรงในการกำมือเทียบกับข้อมือปกติข้างตรงข้ามเฉลี่ยร้อยละ 76.26 ± 4.42 และ 77.04 ± 1.01 ตามลำดับ Mayo Wrist Score มีค่าเฉลี่ย 74.5 ± 8.64 คะแนน โดยแบ่งเป็นผลการรักษาดีมาก จำนวน 1 ราย ดี จำนวน 3 ราย พอใช้ จำนวน 5 ราย และแย่มาก จำนวน 1 ราย โดยกลุ่มที่ผ่าตัดก่อน 10 วันและหลัง 10 วัน มี Mayo Wrist Score เฉลี่ยเท่ากับ 81 ± 5.47 คะแนน และ 68 ± 5.7 คะแนนตามลำดับ วัดค่าเฉลี่ย scapholunate gap ได้เท่ากับ 1.33 ± 0.16

Objective: To study the short-term outcomes of transscaphoid perilunate fracture-dislocation treated with percutaneous fixation with headless compression screw and Kirschner wires.

Material and Method: A retrospective study of 10 transscaphoid perilunate fracture-dislocation patients who were treated at Khon Kaen hospital between July 2016 – December 2017. All of them, initially were treated with closed reduction of lunocapitate joint, and then underwent surgery with percutaneous fixation of scaphoid fracture and perilunate joints. The outcomes were measured using Mayo Wrist Score and radiographic parameters (scapholunate angle, lunocapitate angle, scapholunate gap and modified carpal height ratios).

Results: Ten patients were recruited in this study. Eight patients were male, and the average age of patients were 29 ± 7.84 years. According to Herzberg's classification, there were type I in 7 patients, type IIa in 2 patients and type IIb in 1 patient. The scaphoid fracture configurations were all waist (two patients had comminution pattern). The total wrist arc of motion and grip strength averaged 76.26 ± 4.42 and 77.04 ± 1.01 , respectively, compared with the contralateral wrist. The Mayo Wrist Score averaged 74.5 ± 8.64 points, classified as 1 excellent, 3 good, 5 fair and 1 poor. The patients that were operated within 10 days and after 10 days had Mayo Wrist Score averaged 81 ± 5.47 and 68 ± 5.7 , respectively. Aver-

มิลลิเมตร , lunocapitate angle ได้เท่ากับ 13.23 ± 5.8 องศา และ modified carpal height ratio ได้เท่ากับ 1.51 ± 0.06 ซึ่งอยู่ในเกณฑ์ปกติ แต่ค่าเฉลี่ยของ scapholunate angle มีค่าค่อนข้างสูงเท่ากับ 58.16 ± 5.62 องศา

สรุป: การผ่าตัดรักษาการบาดเจ็บแบบ transscaphoid perilunate fracture-dislocation โดยการผ่าตัดยึดตรึงกระดูกผ่านบาดแผลขนาดเล็กมีผลการรักษาในระยะสั้นเป็นที่ยอมรับได้

age scapholunate gap, lunocapitate angle and modified carpal height ratio were within normal limits of 1.33 ± 0.16 mm, 13.23 ± 5.8 degrees and 1.51 ± 0.06 , respectively, but scapholunate angle was relatively high with an average of 58.16 ± 5.62 degrees.

Conclusion: The treatment of transscaphoid perilunate fracture-dislocation with percutaneous fixation technique has acceptable short-term outcomes.

Keywords: Transscaphoid perilunate fracture-dislocation, Percutaneous fixation

ศรีนครินทร์เวชสาร 2562; 34(1): 107-114. • Srinagarind Med J 2019; 34(1): 107-114.

Introduction

Perilunate injuries or dislocation of the carpus relative to the lunate, which remains in normal alignment with the distal radius, were relatively uncommon. 25% of those were missed at the initial evaluation. The injuries frequently occurred after severe accident. The transscaphoid perilunate fracture-dislocation was accounted for 61%¹ of those injuries. Initial treatment began in the emergency operating room. The traction immediately applied on wrist joint to restore bony alignment. The reduction maneuver described by Tavernier^{2,3} should be administered. This was followed by the operative treatments: open reduction and internal fixation or percutaneous reduction and internal fixation to restore the bones and joint positions around lunate (scaphocapitate, triquetrocapitate and lunotriquetral joints) with Kirschner wire and fixation of scaphoid fracture with headless compression screw. The open reduction could however result in limited range of motion and limited grip strength as the procedure inevitably causes tissue and ligament damage^{4,5}. The percutaneous reduction and internal fixation of scaphoid could be indicated if the appropriate closed reduction was achieved. This procedure would result in less damage to surrounding tissue and ligaments⁶. Therefore this study aimed to report a series of 10 cases that underwent the percutaneous fixation of transscaphoid perilunate fracture-dislocation.

Materials and Methods

This is a retrospective study reporting 10 patients who were treated at Khon Kaen Hospital between July 2016 and December 2017. Radiographs from all patients were evaluated and classified into different patterns of injuries according to Herzberg's classification 1 which is based on position of lunate (Figure 1). Then under general anesthesia, the traction was applied to the wrist joint. The arm was suspended with 10 lbs when the elbow was flexed at 90 degree for 10-15 minutes. This was followed by the traction on the extended wrist. The surgeon's thumb was placed on the lunate volarly, and then the wrist was flexed, with traction still maintained, to restore position of capitates on lunate. The quick administration of maneuver was recommended as this would ease the reduction. The slow administration may result in failure and may indicate further open reduction. Then the radiographs were examined if the relative positions of the bones were appropriate based on scapholunate gap, scapholunate angle, lunocapitate angle, modified carpal height ratio⁷ and scaphoid fracture. The percutaneous reduction was followed with a small, less than 5 mm incision for internal fixation of scaphoid with headless compression screw (2.4 mm) and internal fixation of lunate: scaphocapitate, triquetrocapitate and lunotriquetral joints with Kirschner wires. In patients with compressive neuropathy of median nerve, the corrective operation

would be carried out simultaneously. After the surgery, the short arm slab was casted for two-week wearing and it would be re-casted for a total of 6 weeks wearing. The casts and wires were removed at the same visit, 6 weeks after surgery. Then the patients started physical therapy program. The follow-up were appointed at 2 weeks, 6 weeks, 3 months and 6 months after surgery. The measuring outcomes included Mayo Wrist Score 8 (Table 1) and radiographic parameters measured from radiographs at the last follow-up (6 months after surgery).

Surgical procedures

All 10 patients were operated by a principal investigator using percutaneous fixation with headless compression screw (2.4 mm) for scaphoid and Kirschner wires (1.6 mm) for scaphocapitate, triquetrocapitate and lunotriquetral joints. In some patients with compressive neuropathy of median nerve after injury, the procedure would include release of the entrapped nerve using volar standard approach as shown in Figure 2.

Ten patients were recruited for this study. They were 8 males. The average age was 29 ± 7.84 years (range: 20 - 43 years). The mechanism of transscaphoid perilunate fracture-dislocation started with falls from a height (5 cases), road traffic injury (4 cases) and falls (1 case). They were dislocated dorsally. There were associated median nerve injuries in 3 cases. The average duration between time of injury, diagnosis and reduction was 2.6 ± 3.06 days (range: 1 - 11 days). The average duration between time of injury and surgery was 11.8 ± 6.33 days (range: 3 -24 days). The longest duration was when the patient was referred from other province (Bangkok) but the patient had been initially treated with the closed reduction. All patients were classified according to Herzberg’s classification based on lunate dislocation. The scaphoid fracture configurations were all waist (two patients had comminution pattern) as shown in Table 2. There were 3 cases presenting with other associated injuries: 1 case with severe head injury (case #9), 1 case with mild head injury and clavicle fracture (case #8), and 1 case with 4th metacarpal fracture (case #5).

After the surgery, the radiographs from all patients

Result

Mayo Wrist Score

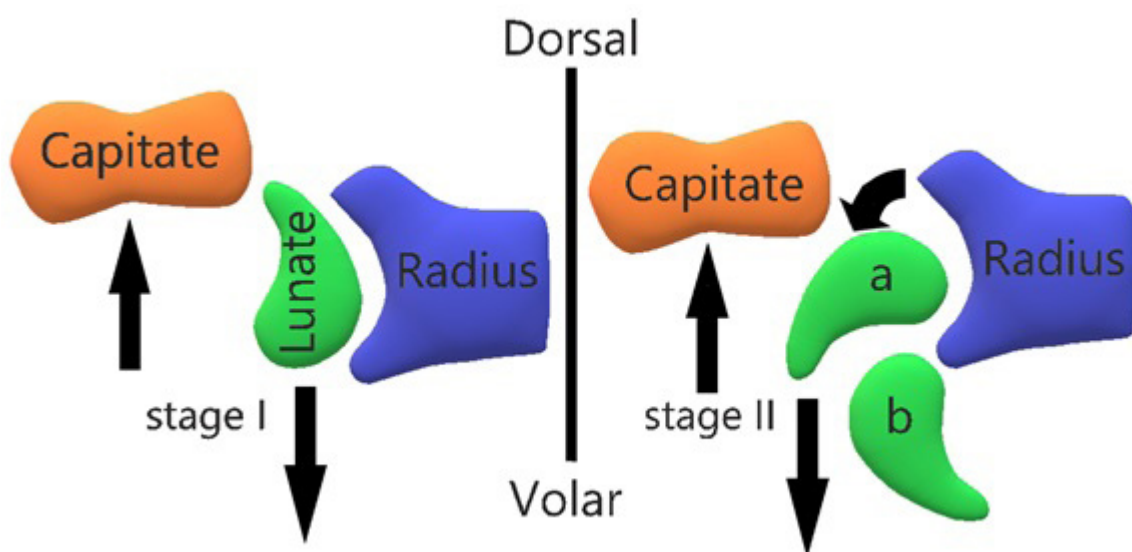


Figure 1 illustrate the pattern and progression of perilunate dislocation and transscaphoid fracture-dislocation. It shows the relative movement/dislocations of lunate, capitates and radius. Stage I: lunate is still maintained its position at radi-us; Stage IIa: lunate is volarly dislocated but rotates less than 90 degree; Stage IIb: lunate is volarly dislocated and rotates more than 90 degree¹.

Table 1 shows Mayo Wrist Score

Pain (25 points)	25 points No pain	Range of Motion (25 points) Both hands are examined. (Percentage of contra lateral side range)	25 points 100%
	20 points Mild, occasional		15 points 75-99%
	15 points Moderate, tolerable		10 points 50-74%
	0 points Severe to intolerable		5 points 25-49%
Functional status (25 points)	25 points Returned to regular employment		0 points 0-24%
	20 points Restricted employment	Grip strength (25 points ,percentage of contralateral side range)	25 points 100%
	15 points Able to work, unemployed		15 points 100%
	0 points Unable to work because of pain		10 points 50-75%
			5 points 25-50%
	0 points 0.-25%		

Excellent: 90-100 points, Good: 80-89 points, Fair: 65-79 points, Poor : less than 65 points

Table 2 Demographic information of the study population, clinical presentation, range of motion, grip strength and Mayo Wrist Score.

Case ID	Age	Gender	The averaged duration between time of incidence and surgery	Herzberg classification	Scaphoid fracture configuration	Range of Motion (degree/% of contra lateral side range)	Grip strength (Kg/% of contralateral side range)	Modified Mayo Wrist Score
1	32	Male	10	I	Waist, comminution	130/83.8	35.1/78.0	80
2	26	Male	5	I	Waist	135/81.8	28.4/75.7	80
3	20	Female	15	I	Waist	110/75.8	18.2/75.0	70
4	21	Male	9	I	Waist	110/75.9	46.3/99.3	90
5	29	Male	3	Ila	Waist, comminution	110/75.8	28.3/77.5	80
6	22	Male	14	I	Waist	120/77.4	33.5/78.8	70
7	25	Male	24	I	Waist	105/67.7	18.5/56.57	60
8	40	Male	13	Ila	Waist	105/75.0	29.5/77.0	75
9	32	Male	18	I	Waist	120/78.7	27.5/75.5	65
10	43	Female	7	IIb	Waist	115/76.7	28.4/76.9	75

Table 3 shows treatment outcomes from radiographic examination.

	Scapholunate gap (mm)	Scapholunate angle (degrees)	Modified carpal height ratio (degrees)	Lunocapitate angle (degrees)
Mean	1.33	58.16	1.51	13.23
Range	10.05-1.53	51.48-68.14	1.43-1.61	2.38-18.09
Standard deviation	0.16	5.62	0.06	5.8



Figure 2 illustrates transscaphoid perilunate fracture-dislocation Pattern IIa according to Herzberg’s classification; (Figure A, B) show anteroposterior and lateral X-ray images of the wrist before the intervention; (Figure C, D) show anteroposterior and lateral X-ray images of the wrist after the treatment/intervention (with associated 4th metacarpal fracture).

were examined using measuring outcomes as shown in Table 3 and were evaluated after 6 months follow-up (short term). It was found that the averaged total range of flexion-extension and the averaged grip strength (kg) of the affected side (kg) were $76.26\% \pm 4.42\%$ and $77.04\% \pm 1.01\%$ respectively, of those measured from the contralateral side. The averaged total range of motion was 116 ± 10.22 degrees. According to Mayo Wrist Score, it was found that the averaged point was 74.5 ± 8.64 points and classified as Excellent (n=1), Good (n=3), Fair (n=5) and Poor (n=1).

Discussion

The transscaphoid perilunate fracture-dislocation was commonly found in severe high energy trauma such as falls from a height or road traffic accident. The reported rate of missed initial diagnosis was 25% and in some studies the rate could even reach 63.6%^{1,9}. In our study, 9 out of 10 patients were initially diagnosed. The next step of intervention was a closed reduction. 50% of all patients were treated within the first day, 4 patients were treated within 3 days. In one patient, the diagnosis was delayed 7 days after the injury, so the reduction was administered on day 11th, then he underwent surgery. It can be seen that there was considerably delayed surgical preparation (averaged waiting duration 11.8 ± 6.33 days (range: 3 – 24 days)) due to general management of the operating theater.

According to Herzberg and his colleagues, they found that delayed surgery affected the prognosis. Clinical scoring described by Green and O'Brien from a group of patients who had delayed surgery within 7 days after the injury and a group of patients with delayed surgery between 7 and 45 days were 80 and 71 respectively (p value = 0.07). Similarly, the study carried out by Komurcu and colleagues showed Clinical scoring from two groups: a group with early treatment (surgery within 7 days) (n=6) and other group with delayed treatment (delayed surgery within 7-40 days) (n=6) were 89.2 and 72.5 respectively. The study carried out by Gupta and

colleagues showed that treatment outcomes from a group of patients who underwent surgery within 6 weeks was better than those from a group who underwent surgery after 6 weeks. This result was statistically significant (p < 0.05). In this study, similarly, a group with early treatment (surgery within 10 days after injury) (n= 5) showed better measuring outcomes than those from a group with a delayed surgery after 10 days (n=5). The averaged ranges of motion were 120 ± 1.17 degrees and 112 ± 7.58 degrees, the averaged grip strength were 81.49 ± 9.99 และ 72.58 ± 9.07 and Mayo Wrist Scores for both groups were 81 ± 5.47 และ 68 ± 5.7 respectively^{1,9,10}.

Moreover, restoration of bony alignment to their anatomical positions and accurate articulation affects the treatment outcomes. The outcomes were measured from radiographs. In this study, scapholunate gap, lunocapitate angle and modified carpal height ratio were measured and were within normal range. However, the averaged scapholunate angle was 58.16 ± 5.62 degrees. This value is relatively high when compared with other studies e.g. the studies carried out by Chou with his colleagues (49 degrees) and Komurcu with his colleagues (47.5 degrees). The reasons for the differences from previous studies could be the chosen surgical techniques. The surgical techniques described by Chou and colleagues utilized 2 mm Kirschner wire to fix capitates and lunate together. This was to stabilize them for 8 weeks. On the other hand, the study carried out by Komurcu and colleagues chose the open dorsal approach and, if necessary, combined with volar approach as well in order to appropriately restore bony alignment. The open reduction is common in the treatment of transscaphoid perilunate fracture-dislocation because the restoration of bony alignment could be directly visualized but it results in large incision. Therefore, the combined approach is common resulting in 6-8 cm incision with partial retraction of ligaments around the wrist. In this study, the surgical method resulted in less than 5 mm incision. It was expected that the measuring outcomes including the

range of wrist motion and the grip strengths as a result of this technique were better than the conventional open reduction. The averaged range of motion and averaged grip strength were $76.86\% \pm 4.42\%$ and $77.04\% \pm 1.01\%$ respectively, relative to the contralateral side. These values were similar to those reported in Forli and colleagues' study (76% and 87%) but the averaged grip strength was higher than those from studies carried out by Hildebrand and colleagues (57% and 73%) and Kara and colleagues (the averaged grip strength was 63.4%)^{6,10-14}.

Therefore, the outcomes which consists of range of motion, grip strength and Mayo Wrist Score from the treatment of transscaphoid perilunate fracture-dislocation with percutaneous fixation are similar to those outcomes from the open reduction including dorsal, volar and combined approaches. However, the author believe that small incision would minimize damage on surrounding tissue and minimally disturb blood vessels around scaphoid. So, scaphoid could be quickly healed and joint contracture could be minimized. Another option for the treatment is an arthroscopic-assisted surgery. The outcomes from two groups of patients: the patients underwent the arthroscopic-assisted surgery and the patients underwent conventional open reduction were compared. The arthroscopic –assisted surgery resulted in the patients with better range of motion but the grip strength and Mayo Wrist Score were similar to those resulted from the patients underwent the open surgery. Meanwhile, the other study on the arthroscopic –assisted surgery reported range of motion and grip strength 79% and 78% respectively. These are similar to the results from our study. Therefore, the arthroscopic –assisted surgery is likely to be a recommended treatment for transscaphoid perilunate fracture-dislocation^{15,16}.

There are a few limitations in this study. This is a retrospective study with small sample size. The follow-up period is short and many patients presented with associated injuries which could affect the outcomes of the intervention in this study.

Moreover, there is only one type of treatment administered without any comparisons which could be other surgical techniques including an open surgery and an arthroscopic –assisted surgery.

Conclusion

The transscaphoid perilunate fracture-dislocation is the severe injury. The early diagnosis and early treatment would be recommended. Recently there has not been any standard surgery recommended as Best Practice. In this study, percutaneous fixation technique had acceptable short-term outcomes. However, an arthroscopic –assisted surgery is likely to be a recommended treatment for transscaphoid perilunate fracture-dislocation in the future.

Reference

1. Herzberg G, Comtet JJ, Linscheid RL, Amadio PC, Cooney WP, Stalder J. Perilunate dislocations and fracture-dislocations: A multicenter study. *J Hand Surg Am* 1993; 18: 768–79.
2. Scalcione LR, Gimber LH, Ho AM, Johnston SS, Shepard JE, Taljanovic MS. Spectrum of carpal dislocations and fracture-dislocations: imaging and management. *AJR Am J Roentgenol* 2014; 203: 541–50.
3. Dobyns JH, Linscheid RL. A short history of the wrist joint. *Hand Clin* 1997; 13: 1–12.
4. Muppavarapu RC, Capo JT. Perilunate dislocations and fracture-dislocations. *Hand Clin* 2015; 31: 399–408.
5. Trumble T, Verheyden J. Treatment of isolated perilunate and lunate dislocations with combined dorsal and volar approach and intraosseous cerclage wire. *J Hand Surg Am* 2004; 29: 412–7.
6. Weil WM, Slade JF 3rd, Trumble TE. Open and arthroscopic treatment of perilunate injuries. *Clin Orthop Relat Res* 2006; 445: 120–32.
7. Yin Y, Gilula LA. Imaging of the symptomatic wrist. In: Watson HK, Weinzeig J, editors. *The Wrist*. Philadelphia: Lippincott Williams & Wilkins, 2001: 61-82.
8. Linscheid RL CW. Difficult wrist fractures. Perilunate fracture-dislocations of the wrist. *Clin Orthop Relat Res* 1987; 214: 136–47.

9. Gupta RK KK. Functional outcome after surgical treatment of perilunate injuries: A series of 12 cases. *J Clin Orthop Trauma* 2016; 7: 7–11.
10. Komurcu M, Kurklu M, Ozturan KE, Mahirogullari M, Basbozkurt M. Early and delayed treatment of dorsal transscaphoid perilunate fracture-dislocations. *J Orthop Trauma* 2008; 22: 535–40.
11. Chou YC, Hsu YH, Cheng CY, Wu CC. Percutaneous screw and axial Kirschner wire fixation for acute transscaphoid perilunate fracture dislocation. *J Hand Surg Am* 2012; 37: 715–20.
12. Forli A, Courvoisier A, Wimsey S, Corcella D, Moutet F. Perilunate dislocations and transscaphoid perilunate fracture-dislocations: a retrospective study with minimum ten-year follow-up. *J Hand Surg Am* 2010; 35: 62–8.
13. Hildebrand KA, Ross DC, Patterson SD. Dorsal perilunate dislocations and fracture-dislocations: questionnaire, clinical, and radiographic evaluation. *J Hand Surg Am* 2000; 5: 1069–79.
14. Kara A, Celik H, Seker A, Kilinc E, Camur S, Uzun M. Surgical treatment of dorsal perilunate fracture-dislocations and prognostic factors. *Int J Surg* 2015; 24: 57–63.
15. Oh WT, Choi YR, Koh IH, Lim KH. Comparative outcome analysis of arthroscopic-assisted versus open reduction and fixation of trans-scaphoid perilunate fracture dislocations. *Arthroscopy* 2017; 33: 92–100.
16. Kim JP, Lee JS, Park MJ. Arthroscopic reduction and percutaneous fixation of perilunate-dislocations and fracture-dislocations. *Arthroscopy* 2015; 4: 81–7.

