Peri-lunate dislocation and fracture-dislocation of the wrist: Retrospective evaluation of 65 cases

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A B S T R A C T

Introduction: Peri-lunate wrist dislocations and fracture-dislocations are related to high-energy trauma. Prognosis is often compromised because of the complexity of the lesions. The purpose of this study was to assess outcomes of acute peri-lunate injuries and correlate them with the type of lesion and management.
Materiel and methods: A monocenter retrospective study has been conducted. Sixty-five patients (65 wrists) were reviewed. According to Herzberg's classification, there were 18 isolated peri-lunate dislocations and 47 peri-lunate fracture-dislocations – 27 with a scaphoid fracture and 20 with an intact scaphoid. The displacement was dorsal in 62 cases. All patients were treated surgically.
Results: At an average follow-up of 8 years (2–16) the average Cooney score was 66 points, quick-DASH score 21 points, and PRWE score 28 points. Pain score was 1.3 out of 10 points at rest and 4.3 out of 10 with effort. The flexion-extension arc was 96° with an average strength of 38 kg (70 ± 23% of opposite side). Radiographic analysis has shown decrease in carpal height, increase in ulnar translation, and DISI. Sign of wrist arthritis was found in 58.5% of the cases. The rate of osteonecrosis was 7.7%. Regional sympathetic painful syndrome was observed in 12%. In 26% of the cases a secondary surgery was needed. No influence has been found with the final results between fracture-dislocation and isolated dislocation, and delay of treatment. Osteochondral lesions observed at surgery ($P = 0.035$), osteonecrosis at follow-up ($P = 0.017$), and modification of the scapho-lunate angle ($P = 0.029$) were correlated with the occurrence of osteoarthritis.
Discussion: Peri-lunate dislocation and fracture-dislocation represent severe wrist trauma with often numerous sequelae with follow-up: pain, stiffness, loss of strength, carpal instability and arthritis. Early diagnosis and anatomic reduction are prerequisite to a satisfactory functional result. Capsulo-ligamentous lesions must be repaired and fractures must be fixed.
Type of study/level of evidence: Therapeutic IV.

1. Introduction

Peri-lunate wrist dislocations and fracture-dislocations are related to high-energy trauma. Few publications have been reported in literature and often multicenter studies have been published [1–16]. Diagnosis can still be missed in the emergency room [1–6]. Prognosis is often compromised because lesions are often complex involving the capsule, the ligaments and the joint cartilage. Even guidelines for treatment have been proposed, results are often unsatisfactory [2,4,6,17]. Our hypothesis was that clinical and radiographic outcome was dependent of the type of lesion and the type of management. A monocenter retrospective study has been conducted to evaluate the incidence of this trauma, to analyze the clinical and radiographic outcome according to the type of lesion and management, and to find prognosis factors.

2. Materials and method

2.1. Study characteristics

A retrospective study has been conducted in our University Hospital with a level-I trauma center. Inclusion criteria were: all patients who sustained a unilateral acute (less than 7 days) peri-lunate dislocation or peri-lunate fracture-dislocation; treated surgically; who agreed to be part of this study; and followed-up a minimum of 2 years. Exclusion criteria were: patients who

Table 1
Classification according to Herzberg et al. [2] classification of the 65 cases.

	Peri-lunate dislocation ($n=18$)	Peri-lunate fracture-dislocation without scaphoid fracture ($n=20$)	Peri-lunate fracture-dislocation with scaphoid fracture ($n=27$)	All cases ($n=65$)
Dorsal displacement				62
Stage I	8	9	19	36
Stage IIA	9	7	6	22
Stage IIB	1	3	0	4
Palmar displacement				3
Stage I	0	0	2 (Fenton syndrome)	2
Stage II	0	1	0	1
Treatment				
Percutaneous	6	3	1	10
Dorsal approach	11	15	16	42
Palmar approach	0	0	7	7
Both approaches	1	2	3	6

sustained a sub-acute or chronic (more than 7 days) peri-lunate dislocation or fracture-dislocation; followed-up less than 2 years.

2.2. Patient demographics

Between 1995 and 2010, 4963 wrists' traumas were operated in our department. A peri-lunate dislocation was found in 234 cases (4.7%). All patients have been contacted, and 148 refused to participate for any evaluation, 12 were lost for follow-up and 9 were excluded because they did not feel the inclusion criteria. Sixty-five patients (65 wrists) were included in this study. There were 62 men (95%) and 3 women (5%) of 33 years on average (range: 17–73) at the initial trauma. The dominant hand was involved in 31 cases. Thirty-two patients were involved in heavy manual labors. In all cases a high-energy trauma was responsible of the wrist trauma.

Lesions are summarized in Table 1. A scaphoid fractures were associated in 27 out of 47, whereas other fractures were observed in the 20 other cases: triquetrum (2), capitate (2), radial styloid (10), intra-articular radius (10), and ulnar styloid (17). Delay for reduction of peri-lunate dislocation was 6.6 hours (range: 2–16). Diagnosis was delayed of more than 24 hours in 5 cases, average 3.6 days (range: 1 to 7 days).

2.3. Surgical technique

All patients were treated surgically. Approaches are summarized in Table 1. Cartilage lesions were found in 31 cases of the 48 dorsal open approaches with involvement of the head of the capitate in 14. Chips fractures or fractures avulsions, as described by Herzberg et al. [2], was found in 7 cases. Stabilization of the carpus was performed with 12/10 mm K-wires through the scaphoid and lunate in 40 cases, through the lunate and triquetrum in 50, and through the scaphoid and capitate in 20. Scaphoid fractures were fixed with a Herbert type of screw of 2.0 mm in 22 and with K-wires in 5. Two capitate fractures and one of the two triquetrum fractures were fixed with screws. Radius fractures were fixed with locking plates or with K-wires. Lesion of the scapho-lunate ligament was noted in 32 out of 48 wrists after open dorsal approach. Ligament repair was performed in 29 cases with anchor fixation, whereas it was not possible to repair the ligament in 3. A dorsal capsulodesis was performed in 19 cases. In 8 cases, a median nerve neurolysis was performed because of numbness in the median territory. Average duration of surgery was 80 minutes (range: 20–240). Time of wrist immobilization was 9 weeks (range: 6–24 weeks). Therapy was initiated for an average of 4 months (range: 1–12 months).

2.4. Method of evaluation

An observer independent of the surgeons who performed the procedures reviewed all 65 patients. The results of the postoperative clinical evaluation consisted of analyzing on both wrists, pain level with a visual analogic scale (VAS), range of motion, strength with JAMAR® dynamometer, and stability of the carpus performing the Watson test [18]. Functional evaluation was performed using global functional scores as the Cooney score [4], the quick-DASH score [19] and the PRWE score [20,21]. Postero-anterior views of the wrist in neutral position, ulnar and radial inclinations, and lateral views were performed. The regularity of the arc of Gilula was noted on the postero-anterior views [22]. The Bouman [23] and the Aufauvre [24] indexes were measured to evaluate ulnar translation of the carpus. Finally, a distance of more than 3 mm between the scaphoid and the lunate was considered pathological and correlated with non-functional intra-carpal ligaments. The scapho-lunate angle was calculated on the lateral views. Sign of osteoarthritis, osteonecrosis or modification of bone density, as well as nonunion of carpal bones were also noted.

2.5. Statistical analysis

A univariate analysis of the data was done. The Chi^2 test was used to compare categorical values. ANOVA analyses, in conjunction with Tukey's test, were also used to compare means. The level of significance was set at $P<0.05$.

3. Results

3.1. Overall results

All 65 patients were reviewed with 8 years average follow-up (range: 2–16). All results are summarized in Table 2. Delay to return to work was 5 months on average (range: 0–24 months). Fifty-four out of 65 patients (83%) could return to their previous work whereas 9 had to change their type of work. One patient never return to work, and one went to retirement.

3.2. Clinical results

Clinical results are summarized in Table 2. The Watson test was negative for all wrists.

3.3. Radiographic results

All radiographic results are summarized in Table 3. Sign of arthritis was observed in 38 out of 65 (58.5%) cases. A SLAC wrist

Table 2
Clinical results of the 65 cases.

	Peri-lunate dislocation ($n=18$)	Peri-lunate fracture-dislocation without scaphoid fracture ($n=20$)	Peri-lunate fracture-dislocation with scaphoid fracture ($n=27$)	*P*	All cases ($n=65$)
Cooney (/100 pts)	68 ± 12	70 ± 14	62 ± 19	0,238	66 ± 16 (20–100)
Quick-DASH (/100 pts)	23 ± 19	17 ± 20	23 ± 26	0,581	21 ± 22 (0–88)
PRWE (/100 pts)	28 ± 21	24 ± 21	33 ± 28	0,396	28 ± 24 (0–91)
Return to their previous work	14 (77%)	17 (85%)	23 (85%)	0,304	54 (83%)
Pain at rest/with effort (VAS) (/10 pts)	1.7 ± 1.9/4.3 ± 3	0.7 ± 1.2/3.6 ± 2	1.6 ± 1.9/4.7 ± 3	0,125/0,405	1.3 ± 1.8 (0–8)/4 ± 3 (0–10)
Flexion/extension ROM	127° ± 26	121° ± 33	108° ± 35	0,143	117° ± 34 (35–180°)
Radial/ulnar deviation	39° ± 13	33° ± 16	36° ± 15	0,426	36° ± 15 (0–75°)
Pronation/supination ROM	176° ± 12	175° ± 19	171° ± 21	0,649	173° ± 18 (90–190)
Wrist strength	41kg ± 9	37kg ± 10	36kg ± 13	0,371	38kg ± 12 (10–62)

For all cases results were expressed with the average value and standard deviation, and the minimum and maximum values.

Table 3
Radiographic results of the 65 cases at last follow-up.

	Peri-lunate dislocation ($n=18$)	Peri-lunate fracture-dislocation without scaphoid fracture ($n=20$)	Peri-lunate fracture-dislocation with scaphoid fracture ($n=27$)	*P*	All cases ($n=65$)
Scapho-lunate diastasis > 3 mm	3 out of 18 (17.7%)	6 out of 20 (30%)	3 out of 27 (11.1%)	0,123	12 out of 65 (18.4%)
Scapho-lunate angle > 70°	7 out of 18 (38.9%)	2 out of 20 (10%)	5 out of 27 (18.5%)	0,130	14 out of 65 (21.5%)
Height of the carpus < 0.51	6 out of 18 (33.3%)	12 out of 20 (60%)	22 out of 27 (81.5%)	0,166	40 out of 65 (61.5%)
Ulnar translation of the carpus			1		50 out of 65 (77%)
Slip carpus index < 0.27 (0.30 ± 0.03)	4 out of 18 (22.2%)	7 out of 20 (35%)	2 out of 27 (7.4%)	0,137	23 (35%)
Afauvre's index < 0.93 (1.06 ± 0.013)	2 out of 18 (11.1%)	2 out of 20 (10%)	2 out of 27 (7.4%)	0,298	6 (9.2%)
Bouman's index < 0.83 (0.87 ± 0.04)	5 out of 18 (27.8%)	7 out of 20 (35%)	9 out of 27 (33.3%)	0,619	21 (32.3%)
Osteoarthritis					38 out of 65 (%)
SLAC	10	13	13	–	36
SNAC	–	–	2	–	2
Transitory modification of the bone density					7 out of 65 (%)
Lunate	1	1	–	–	2
Scaphoid	–	1	4	–	5
Bone necrosis					5 out of 65 (%)
Lunate					2
Scaphoid					3
Nonunion of the scaphoid	–	–	5		5 out of 65 (%)

was diagnosed in 36 patients (4 stage I, 3 stage II, 24 stage III, 5 stage IV) and a SNAC wrist in 2 (2 stage III).

3.4. Complications and revisions

The complication rate was 38.5% with a revision rate of 26%. Complications are reported in Table 4. Revisions concerned: 7 screws removal, 2 bone graft for scaphoid nonunion, 3 mid-carpal arthrodesis for bone osteonecrosis and 1 for scaphoid nonunion, and 2 complete wrist fusions for advanced osteoarthritis. A total wrist denervation was performed in 2 for painful osteoarthritis and preserved motion.

Table 4
Complications and revisions for the 65 patients.

Complications	25 out of 65 (38.5%)
CRS syndrome	8
Migration of screws	7
Osteonecrosis	
Scaphoid	3
Lunate	2
Nonunion scaphoid	5
Revisions	17 out of 65 (26%)
Screw removal	7
Matti-Russe	2
Arthrodesis	6
Denervation	2

3.5. Prognosis factors

Patient's age and follow-up had no influence on the final results. Degree of displacement of the lunate was correlated to the final results but only in the peri-lunate fracture-dislocation group ($P=0.01$). Cartilage lesions found at surgery ($P=0.0035$), change in bone density ($P=0.0044$), bone necrosis with follow-up ($P=0.0017$), and modification of the scapho-lunate angle ($P=0.029$) had all influenced the occurrence of carpal arthritis.

4. Discussion

Because peri-lunate dislocations are not common, there are few studies in literature reporting the results of more than 50 cases. Most of the series are multicenter studies with a short follow-up analysis [1,2] (Table 5). Diagnosis can be missed and delayed treatment has been reported in 20 to 30% of the cases in most of the series [1–4,6].

Although closed reduction of peri-lunate injuries has been proposed, an anatomical reduction is difficult to obtain and hold with a simple cast [7]. If after closed reduction, a scapho-lunate interval greater than 3 mm wide or a scapho-lunate angle of more than 70 degrees is obtained, a poor result can be expected and an open procedure should be preferred. Surgical treatment with open reduction, ligaments repair, and fixation of the fractures has been reported as the gold standard to treat these lesions [1–6,8,11,12,15,25–30]. Most of the surgeon used the dorsal

Table 5
Peri-lunate and peri-lunate fracture-dislocation: results of literature.

	N	F/u (month)	Delay for diagnosis	Approach	Cooney/DASH score (/100 pts)	ROM in flex/ext (% of opposite side)	Strength (% of opposite side)	% of OA
Garcia-Elias et al. (1986) [1]	61	42	23%	Conserv or percutan or mixed	23 satisf 28 unsatisf	–	–	36%
Cooney et al., (1987) [4]	21	50	25%		65/75	76°	–	
Viegas et al. (1987) [25]	8	19	–	Palmar	–	-	68%	0%
Herzberg et al. (1993) [2]	166	75	25%	Conserv or percutan or mixed	63/86	–	–	56%
Apergis et al. (1997) [3]	28	72	15%		77/–	–	–	
Inoue and Imaeda (1997) [26]	14	29	–		–	106° (80%)	85%	–
Sotereanos et al. (1997) [27]	11	30	–	Dorsal + palmar	65/–	(71%)	77%	18%
Hildebrand et al. (2000) [28]	23	37	–	Dorsal + palmar	66/–	82° (57%)	73%	50%
Herzberg and Forissier (2002) [6]	14	103	–	Mixed	79/–	112°	79%	86%
Bellot et al. (2003) [7]	25		20%					
Trumble and Verheyden (2004) [8]	22	49	–	Dorsal + palmar	15 satisf	106° (80%)	77%	–
Knoll et al. (2005) [9]	25	44	–	Dorsal	–	113° (83%)	80%	0%
Souer et al. (2007) [10]	18	44	–	Dorsal	–	73° to 97°	67% to 74%	50%
Martinage et al. (2008) [11]	14	25	0%	Dorsal	72/–	91° (74%)	77%	0%
Lutz et al. (2009) [12]	25	60	–	Dorsal + palmar	82/11 to 14	66%	80%	–
Forli et al. (2010) [5]	18	156	12%	Mixed	76/–	95° (75%)	87%	66%
Kremer et al. (2010) [13]	39	65.5	8%	Mixed	70/23	77° (63%)	71%	51%
Capo et al. (2012) [14]	25	24	–	Dorsal + palmar	–/40	82°	59%	52%
Laporte et al. (2012) [15]	17	26	0%	Percutan or dorsal	63/24	101° (77%)	69%	47%
Chou et al. (2012) [16]	24	45	–	Percutan	83/–	144° (90%)	84%	–
Our series	65	96	7.7%	Mixed	66/21	96° (69%)	79%	58.5%

F/u: follow-up; conserv: non surgical; percutan: percutaneous; mixed: various approaches; ROM in flex/ext: range of motion in flexion and extension; OA: osteoarthritis.

approach to repair all the lesions [26,29,31]. A palmar approach has been advocated by others [25,26,29,32] whereas other preferred a combined palmar and dorsal approach to be able to repair all injured ligaments and capsule tears [3,26,27,29,31,33].

Pain, stiffness and loss of strength are often reported after peri-lunate dislocation in 20 to 30% of the cases (Table 5). Sign of post-traumatic arthritis seems to increase with follow-up with a rate of 58.5% at 8 years average follow-up in our series. In literature, the incidence increases with follow-up with 18 to 22% for series around 24 months follow-up [6,8,28,29], 50 to 56% for studies of 32 to 75 months follow-up, and 50 to 100% for series between 6 and 12 years follow-up [2,4]. Many prognosis factors have been outlined in the literature: [1–5,7,8,11,12,15,17,25–29]. Most of the authors underlined the importance of an earlier reduction and treatment [1,2], although it could be acceptable until 45 days after the trauma [2]. Open injury was for Herzberg et al. [2], a poor prognostic factor. Associated forearm or carpal fractures seem to not influence the long-term results [1]. Peri-lunate fracture dislocation with a scaphoid fracture was the most important group of lesions in our study as numbers series in the literature [1,2,5,15,28]. Even some authors have reported that scaphoid fracture was a poor prognostic factor [17], this fact was not confirmed by others [1,2,28]. There was no difference for Hildebrand et al. [28] between dislocation and fracture dislocation concerning outcomes like in our study ($P = 0.26$). Cartilage lesions seem to induce more carpal height loss than intra-carpal angle modification [28]. In our series, cartilage lesions found at surgery, transitory modifications of bone density, bone necrosis with follow-up, and modification of the scapho-lunate angle had all influenced the occurrence of carpal osteoarthritis.

Weaknesses of the study included the retrospective nature of the analysis and the number patients that refused to participate for any evaluation. Comparison of our study to series published in literature was difficult because of the small number of patients in each series published, the short follow-up and the different classification system used. However, our series was one of the most important with a long follow-up.

5. Conclusion

Peri-lunate dislocation and peri-lunate fracture dislocation are complex wrist trauma with often-significant sequelae. Open reduction and internal fixation with short time delay to reduction must be the rule, mainly trough a dorsal approach. The palmar approach must be preferred if necessary only.

Disclosure of interest

The authors declare that they have no competing interest.

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