ARAŞTIRMA MAKALESİ / *RESEARCH ARTICLE*

Early Results of Early Intervention in Patients with Perilunate Dislocation and Fractured Dislocation

Perilunat Çıkığı ve Kırıklı Çıkığı Bulunan Hastalarda Erken Müdahalenin Erken Sonuçları

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ABSTRACT

Aim: *Perilunate injuries are rare and often caused by high-energy trauma. Despite surgical treatment, there can still be a high incidence of functional dissatisfaction and post-traumatic arthritis. This study aimed to evaluate the functional and radiological results with early surgical intervention in patients with perilunate injuries.*

Material and Method: *This study included 12 patients who had early surgical treatment for perilunate dislocation and fracture. The patients were evaluated per the Herzberg classification. The Mayo wrist score and DASH score aided in the evaluation of functional results. Grip strength was measured using a Jamar Dynamometer. Radiological evaluations were performed by comparing the wrist radiographs.*

Results: *The mean age of the patients was 37±13.9 years (21–64 years). The mean follow-up period was 26.83±11.26 months (6–44 months). The Mayo wrist score was poor in 2 patients, satisfactory in 3, good in 5 and excellent in 2. The mean Mayo score was 73.7 (55–90), and the mean DASH score was 19.93±17.22 (5–68.3). Radiographic examination revealed post-traumatic arthritis in 3 patients and carpal collapse in 1 patient. The range of motion and grip strength of the wrist joint was statistically different than that of the contralateral extremity.*

Conclusion: *In the long-term follow-up, negative results of perilunate and lunate fractures and dislocations surgical treatment may be improved slightly. In our study and clinical experience, open surgery within the first 24 hours may minimize negative results.*

Key words: *perilunate; fractures; dislocation; wrist; injury; instability*

ÖZET

Amaç: *Perilunat yaralanmalar nadirdir ve yüksek enerjili travmalar ile oluşur. Cerrahi tedavi sonrası bile fonksiyonel memnuniyetsizlikler ve postravmatik artrit görülme insidansı yüksektir. Bu çalışmamızdaki amacımız perilunat yaralanmaların cerrahi tedavi sonrası fonksiyonel ve radyolojik sonuçlarını değerlendirmektir.*

Materyal ve Metot: *2013-2016 süresince perilunat çıkık veya kırıklı çıkık nedeni ile cerrahi tedavi edilen 12 hasta çalışmaya alındı. Hastalar Herzberg sınıflamasında göre değerlendirildi. Fonksiyonel sonuçlar Mayo elbilek skalası ve DASH skoru ile değerlendirildi. Kavrama güçleri Jamar dinamometresi ile ölçüldü. Radyolojik değerlendirmeler ise mukayeseli çekilen elbilek grafileri yardımıyla yapıldı.*

Bulgular: *Ortalama takip süresi 26.83±11.26 (range, 6-44) ay idi. 12 hastanın 11'i erkek (%91.7) 1'i kadın (%8.3) hastadan oluşmakta olup yaş ortalaması 37±13.9 (range; 21-64) idi. Mayo elbilek skalasına göre 2 hasta kötü, 3 hasta yeterli, 5 hasta iyi ve 2 hasta mükemmel olarak değerlendirildi. Ortalama Mayo elbilek skoru 73.7 (range, 55-90), DASH skoru ise ortalama 19.93±17.22 (range, 5-68.3) olarak ölçüldü. Radyografilerde 3 hastada posttravmatik artrit, 1 hastada ise karpal kollaps saptandı. El bileği eklem hareket açıklığı ve kavrama gücü karşı ekstremiteye göre istatistiksel olarak farklıydı.*

Sonuç: *Perilunat ve lunat kırıkları ve çıkıkları cerrahi tedavisinin olumsuz sonuçlarında uzun dönem takiplerde bir miktar daha düzelme sağlanabilir. Çalışmamıza ve klinik tecrübemize göre ilk 24 saat içinde yapılan açık cerrahi olumsuz sonuçları en aza indirebilir.*

Anahtar kelimeler: *perilunat; kırıklar; çıkık; elbilek; yaralanma; instabilite*

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Introduction

Perilunate dislocations are high-energy injuries caused by a fall from a height, motor vehicle accidents or sporting injuries that occur typically in young male patients with an average age of 30 years[1,2]. Notably, 26 %of these injuries are associated with polytrauma, 10 %are open injuries and 11 %are concomitant to other extremity injuries[3]. Because 61 %-65 %of these dislocations are related to scaphoid fractures, they are known as trans-scaphoid perilunate fracture dislocation[4,5]. The alignment of the wrist is impaired, and swelling and crepitation are observed in these cases. The patients most often complain of paresthesia in the median nerve distribution, and the fingers are usually held in a flexed position with severe pain on passive extension. The literature lacks any consensus regarding the modality of treatment. Notably, poor results have been observed with non-operative treatment methods[6,7]. However, several studies have reported acceptable results with open reduction and internal fixation through a dorsal surgical approach, a volar approach or a combination of both[7,12]. This retrospective study aimed to analyse the preliminary radiological and functional outcomes of early surgical intervention in patients with perilunate dislocation and fracture.

Material and Method

This study was performed at the same centre after the approval from the Ethics Committee of Bursa Yüksek İhtisas Training and Research Hospital, Sağlık Bilimleri University. Additionally, informed consent was obtained from all patients. A retrospective evaluation was performed of all early interventions of perilunate dislocations and fractures between 2013 and 2016. Patients with a history of fracture or surgical procedure on the same wrist were excluded. The study included a total of 12 patients—11 (91,7 %) males and 1 (8,3 %) female—with a mean age of 37±13,9 years (range, 21–64 years). The mechanism of injury was motor vehicle accident in 3 cases (25 %) and fall from a height in 9 (75 %). Multiple concomitant injuries were present in 6 cases (50 %) cases. Of the 12 patients, 10 were admitted for surgery on the same day of presentation to the Emergency Department. One patient who came later to the hospital was operated the next day and another one after 7 days. The patient data are presented in Table 1. A dorsal approach was used in the treatment of 4 patients and a combination of dorsal and volar approach in 7 patients. A volar approach alone was used in 1 patient owing to the severe soft tissue loss in the dorsum of the hand during the trauma (Figure 1. a–e). The clinical evaluation of the patients was performed using the Mayo wrist index and the disabilities of the arm, shoulder and hand (DASH) score. Additionally, the joint range of movement was measured with a goniometer and grip strength with a Jamar Dynamometer (Sammons Preston, Bolingbrook, IL, USA) during the clinical evaluation. Radiological evaluations were performed by comparing the degenerative changes in the pre-and postoperative radiographs. Ulnocarpal translation and lunate coverage were evaluated in all cases.

Statistical Analysis

The results were presented as the mean ± standard deviation for continuous variables, and the categorical variables were described as frequency and percentage. The Shapiro-Wilk test was used as the normality test. Normally distributed paired data were analysed using the paired *t*-test. A *p* value of <0,05 was considered statistically significant. All statistical analyses were performed using IBM SPSS ver.23,0 (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23,0. Armonk, NY: IBM Corp.).

Results

Of the 12 patients, 7 had a concomitant scaphoid fracture, and 3 had a radial styloid fracture. Other additional injuries were seen in 6 (50 %) patients. Ten patients were urgently operated, one patient who arrived late was operated a day after the injury and the other on the seventh day. Based on the Mayo wrist score for functional evaluation, 2 patients were evaluated as poor, 3 as satisfactory, 5 as good and 2 as excellent. The mean Mayo wrist score was 73,7 (range, 55–90). Regarding DASH score, which evaluates difficulties in performing daily activities, symptoms (pain, weakness, numbness) and social functional status, the mean score was measured as 19,93±17,22 (range, 5–68,3). The patient data are presented in Table 2. The mean follow-up period of the patients was 26,83±11,26 months (range, 6–44 months). Based on the joint range of movement (ROM) measured at the final follow-up examination, the mean flexion-extension was 103,42° ±17,2° (range, 70°-123°) [79 %in comparison with the mean contralateral side wrist (131,33° ±7°)] and mean supination-pronation was 35,92° ±5,99° (range, 27°-44°) [73 %in comparison with the mean healthy wrist (49,42° ±2,31°)]. The differences between the

Table 1. *Demographic data of the patients*

	Gender	Age (yrs)	R/L	Dominant hand	Mechanism of injury	Type	Herzberg classification	Concomitant injury	Time to intervention (days)	Surgical approach	Follow-up (months)
1	M	30	L	R	Motor vehicle accident	PLD	Dorsal 2A	Acetabulum Fracture	Emergency	Combined	31
2	M	32	L	R	Fall from height	TS-PLD	Dorsal 2A	None	Emergency	Combined	26
3	M	26	R	R	Motor vehicle accident	PLD	Dorsal 2A	None	1	Combined	37
4	M	38	L	R	Fall from height	TS-PLD	Dorsal 2B	Tibia plateau + Calcaneus + FIF	Emergency	Combined	24
5	F	38	L	R	Fall from height	PLD	Dorsal 2A	None	7	Dorsal	44
6	M	67	R	L	Fall from height	TS-PLD	Volar 2	Acetabulum fracture	Emergency	Dorsal	32
7	M	24	R	R	Fall from height	TS-PLD	Dorsal 2B	L2 vertebra	Emergency	Dorsal	20
8	M	54	R	R	Fall from height	PLD	Dorsal 2A	None	Emergency	Dorsal	37
9	M	26	R	R	Fall from height	TS-TRS PLD	Dorsal 2A	None	Emergency	Combined	8
10	M	51	L	R	Motor vehicle accident	TRS PLD	Dorsal 2B	Right Distal Radius fracture	Emergency	Volar	29
11	M	37	R	R	Fall from height	TS-TRS PLD	Dorsal 2A	Femur Neck fracture	Emergency	Combined	6
12	M	21	R	R	Fall from height	TS-PLD	Dorsal 2A	None	Emergency	Combined	28

PLD, perilunate dislocation: 4 (33.3%); TS, trans-scaphoid: 5 (41.7%); TS-TRS, trans-scaphoid, transradial-styloid: 2 (16.7%); TRS, transradial-styloid: 1 (8.3%); FIF, femur intertrochanteric fracture.
[Note: dorsal dislocation: 11 (91.7%); voler dislocation: 1 (8.3%)]

flexion-extension and supination-pronation joint ROM values of the injured and contralateral sides were statistically significant. The left wrist was injured in 5 patients and the right wrist in 7 with 6 injuries on the dominant side and 6 on the non-dominant side. Upon evaluation of the grip strength, the mean Jamar values were measured as 34,83±10,53 kg-force in the operated wrists (80 %when compared with the unoperated side) and 42,92±5,12 in the healthy wrists. This difference was determined to be statistically significant (p=0,008). The grip strengths of the operated and non-operated wrists were calculated separately and compared with consideration of hand dominance. The grip strength of the operated dominant side was 39,17±7,17 (91 %), and that of the contralateral side was 42,83±3,37. The grip strength of the operated non-dominant side was 30,50±12,14 (70 %), and that of the unoperated side was 43,00±6,81. Although no statistically significant difference was observed in the patients who underwent surgery on the dominant hand (p=0,392), a statistically significant reduction was noted in patients operated on the non-dominant side (p=0,002).

Discussion

Despite optimal treatment, perilunate injuries can have relatively poor outcomes with loss of grip strength and wrist movement in most patients besides radiological findings of post-traumatic arthritis and carpal collapse[5]. Closed reduction and immobilisation were the preferred modes of treatment for perilunate injuries in the past[13]. However, the present literature reveals reports of poor results with non-operative methods of treatment owing to lack of anatomic reduction of the injury[1,6,7,14]. Notably, several approaches have been described for the surgical treatment of these injuries.

Several studies have revealed acceptable results with open reduction and internal fixation performed through a dorsal approach, a volar approach or a combination of both[7–12]. The dorsal approach provides excellent visualisation of the proximal row bones and midcarpal joints, whereas the volar approach allows visualisation and repair of the volar ligaments. At the same time, by extending the incision distally when necessary, median nerve decompression can be performed. The combined approaches provide the best possibility

Figure 1. a–e. *Image of the injury* ***(a)*** *Preoperative lateral radiograph* ***(b)****. Intraoperative lateral fluoroscopy image of the wrist* ***(c)****. Preoperative anterior-posterior radiograph of the wrist* ***(d)****. Intraoperative anterior-posterior fluoroscopy image of the wrist* ***(e)****.*

Table 2. *Functional results of the patients*

	Contralateral Wrist F-E	Operated Wrist F-E	Contralateral Wrist S-P	Operated Wrist S-P	Jamar Contralateral Wrist	Jamar Operated Wrist	Mayo Score	DASH Score
1	138	123	53	41	47	39	90 Excellent	5
2	134	117	50	43	46	37	80 Good	7.5
3	125	88	50	32	48	30	55 Poor	68.3
4	135	123	48	44	48	38	85 Good	15
5	140	70	49	27	37	21	55 Poor	27.5
6	115	88	48	30	32	10	60 Satisfactory	30
7	132	113	50	36	41	49	80 Good	11.7
8	132	120	52	42	38	40	90 Excellent	5.8
9	136	90	51	28	44	32	60 Satisfactory	22.5
10	124	94	44	38	48	38	70 Satisfactory	19.2
11	135	112	50	32	44	44	80 Good	12.5
12	130	103	48	38	42	40	80 Good	14.2
mean	131.33	103.42	49.42	35.92	42.92	34.83	73.75	19.93

F-E, flexion-extension range of movement; S-P, supination-pronation range of movement.

of visualisation and repair. However, there is a higher risk of joint stiffness, swelling and wound site problems compared with other approaches[15].

In the current study, 4 patients were treated using the dorsal approach, and 7 were treated using both the volar and dorsal approaches. One patient who had sustained severe soft tissue loss in the dorsum of the hand during the trauma, only volar approach was used. No wound problems were encountered in the patients treated using the combined technique. Mayo scoring of patients with dorsal approach was poor in 1 patient, satisfactory in 1, good in 1 and excellent in 1. Mayo scoring of patients with combined approach was excellent in 1 patient, good in 4, satisfactory in 1 and bad in 1. When the clinical results were evaluated, the mean flexion-extension was 103,42° ±17,2° (range, 70°-123°) (79 %compared with the healthy wrist) and mean supination-pronation was 35,92° ±5,99° (range, 27°-44°) (73 %compared with the contralateral wrist). We believe that it is wrong to associate the results with only the type of approach. Poor results can also be related to the severity of trauma. The literature has ambiguity regarding the effects of early or late treatment on the outcome. In the literature, the results are emphasised based on the type of approach. Sotereanos et al. [15] treated 11 patients using the combined approach and measured the flexion-extension ROM as 71 %on the contralateral wrist. Hildebrand et al. [2] used the combined approach in 23 patients and at the end of a 3-year follow-up obtained 57 %flexion-extension ROM of the contralateral wrist. In another study, Trumble and Verheyden. [16] treated a series of 22 patients with the combined approach and reported that at the end of a 4-year follow-up, the flexion-extension was 80 %compared with the contralateral side. Besides wrist ROM, grip strength is another indicator of wrist

functions—a marker of return to work and daily activities. Because of the various surgical approaches and procedures of treatment, the literature reports varying wrist grip strengths from 67 %-81,1 %compared with the contralateral side[2,15,18]. In the current study, upon evaluation of grip strength by using the Jamar device, the grip strength of the operated wrist was measured as 80 %compared with the contralateral side. The studies that have evaluated grip strength in healthy individuals have shown the difference between the dominant and non-dominant wrists to vary between 2 %and 10 %[19–21]. Therefore, in the current study, the grip strengths were evaluated separately for the dominant and non-dominant wrists. In 6 patients who underwent surgery on the dominant hand, grip strength was 91 %compared with the contralateral side, and in 6 patients operated on the non-dominant side, the grip strength was 70 %of the non-operated side. Therefore, whether the operated wrist is on the dominant or non-dominant side is critical and could affect comparative interpretations. Another crucial factor in treatment is the time from injury to surgical intervention. Reportedly, a delay in treatment of 28–45 days is a significant factor of poor prognosis[7].

Better results were reported in patients who were operated early[2,22]. Of the two operated patients, one underwent surgery with a dorsal approach and other with the combined approach. The worst Mayo wrist score and the highest DASH score brings into focus the aspect of timing of surgery. In a study that supported this aspect, it was reported that 16 proximal row carpectomies, 4 lunate excisions and 2 carpal tunnel surgeries had to be performed in 28 delayed cases[23]. However, this issue has not been clarified yet. The rate of carpal arthritis is reportedly 18 %-22 %in the first 3 years postoperatively and can go up to 50 %-100 %during follow-up over 6–13 years[2,6,17,24,25]. However, these clinical measurements and radiological changes are not associated with patient satisfaction or the ability to return to work[5]. Hildebrand et al. [2]reported that although arthritis was seen in 50 %of patients after a 3-year follow-up period, 73 %of the patients had returned entirely to regular activities. Herzberg and Forissier[26] also reported that despite findings of arthritis in the radiocarpal or midcarpal joints in 86 %of patients in an 8-year follow-up period, 57 %of the patients had a good or excellent Mayo wrist score. In the current study, despite the findings of post-traumatic arthritis in 33,3 %of patients, 7 (58 %) patients were evaluated as good or excellent per the Mayo wrist scores, and the mean Mayo wrist score was 73,7 (range, 55–90). Three of our cases had osteoarthritic changes and one had a carpal collapse. The limitations of our study are the limited number of cases and its retrospective nature with no knowledge of capitate cartilage damage. Therefore, a prospective, randomised trial with capitate cartilage injury may be useful. However, for such rare cases, prospective studies may require a long term. The diagnosis of perilunate injuries can often be missed[27], thereby resulting in delayed treatment. In the literature, we have not seen a study involving homogenous cases that were treated with early surgery, probably because these injuries are observed rarely. Therefore, the number of cases was limited in our study. However, our study that included homogenous cases treated at a single centre can undoubtedly provide a valuable contribution.

In conclusion, although there are some functional limitations, clinical symptoms and negative radiological findings in the surgically treated perilunate and lunate fractures and dislocations, an amount may be improved with prolonged follow-up. According to our results and clinical experience in our study, it is suggested that surgical treatment can have a positive effect on the results within the first 24 hours. We therefore recommend open reduction with a suitable surgical approach as soon as possible to minimize negative consequences.

Disclaimer: None

This study was carried out in 2018 after obtaining informed consent from the patients and approval from the local ethics committee.

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