Surgical outcomes of trans-scaphoid perilunate fracture-dislocations

**Background and aim:** Trans-scaphoid perilunate fracture-dislocation (TSPFD) is a rare injury. TSPFD is a fracture-dislocation that severely disrupts the anatomical structure of the carpal bones and may occur as a result of a high energy wrist trauma or fall on an open hand. In this study, the aim was to provide midterm clinical and radiological evaluations of cases diagnosed and treated as TSPFD.

**Materials and methods:** 11 cases diagnosed as TSPFD as a result of wrist trauma were treated surgically were analyzed retrospectively. Clinical and radiological follow-up of the cases was evaluated. The average age of the patient was 34 years. All of the cases were male patients with a dorsal dislocation according to Herzberg’s perilunate fracture-dislocation classification. The average follow-up time was 33 months. All of the cases were evaluated with preoperative and postoperative standard wrist anteroposterior and lateral radiographs. A dorsal approach was used in all cases; however, in 1 case a volar approach was also required. The Green and O’Brien evaluation scale modified by Cooney was used for clinical assessment of pain, wrist range of motion, grip strength, and functional status as excellent, good, moderate, or poor. The wrist range of motion was evaluated goniometrically at the final check-up, and a mid-grade disability was observed compared with the uninjured side. The visual analog scale was used to evaluate pain.

**Results:** Sufficient union was obtained in all cases with open reduction and internal fixation of the fractures. Grip strength was 77.5% compared with the other side. According to the modified Green and O’Brien clinical evaluation scale, 6 cases were evaluated as good, 3 cases were fair, and 2 cases were poor. No median nerve damage
was determined preoperatively or postoperatively and there was no postoperative pin tract infection in any patient.

**Conclusion:** This kind of injury represents complex, biomechanical damage of the wrist anatomy. If it is diagnosed early and treated with open reduction-stable fixation, a functionally adequate and anatomically integrated wrist can be achieved.

**Key words:** Dislocation, open reduction, perilunate, scaphoid.

1. **Introduction**

Trans-scaphoid perilunate fracture-dislocation (TSPFD) is a rare injury. TSPFD is a fracture-dislocation that severely disrupts the anatomical structure of the carpal bones. Perilunate dislocations represent 7% of carpal area injuries [1]. Of acute perilunate dislocations, 65% are dorsal TSPFDs [2]. This injury is characterized by the dorsal dislocation of the capitate head from the distal lunate joint [3]. Palmar dislocations are rare.

This kind of injury typically occurs as a result of a high energy wrist trauma or a fall on an open hand [4]. Due to a missed or incorrect diagnosis, or ignorance of these severe wrist injuries, there is a delay in treatment in one-quarter of the cases [5]. This injury is divided into 3 groups according to the length of time between the trauma and treatment. The first week post injury is the acute phase, 7 to 45 days after the injury is referred to as the neglected phase, and >45 days is the chronic phase [2]. Treatment may consist of closed reduction and cast immobilization, open reduction and internal fixation, ligament repair, limited wrist arthrodesis, or as a final salvage, a proximal row carpectomy, depending on the time of diagnosis and any additional pathological findings [6].
The objective of this study was to provide midterm clinical and radiological evaluations of cases diagnosed and treated as TSPFD.

2. Materials and methods

There were 11 cases diagnosed as TSPFD as a result of wrist trauma and treated surgically at 2 training and research hospitals that were analyzed retrospectively. The clinical and radiological follow-up of the cases was evaluated. All of the cases were male patients with a dorsal dislocation. While all of the cases were the result of falling in terms of trauma etiology, a detailed analysis indicated that 2 cases were occupational accidents, 2 cases occurred during participation in sports activities, 1 case was a suicide attempt by a patient diagnosed with schizophrenia, and 6 cases were a simple fall (Table 1).

The mean patient age was 34 years (range: 23-46 years). Three of the 11 patients had a delayed diagnosis: 2 were first diagnosed as elbow injuries from a simple fall and treated with cast, and later assessed as TSPFD at the first control visit. One patient had multi-trauma; his femur and acetabulum fractures were treated initially, but he subsequently complained about wrist pain and was diagnosed as TSPFD. These delayed-phase patients were respectively treated surgically on the 10th, 11th, and 27th day after the injury. The remaining 8 cases were diagnosed correctly on the first assessment and treated surgically in 1 to 5 days as acute cases (Table 2).

Only 3 of the cases didn’t have an additional injury; the other 8 cases had various accompanying extremity injuries (Table 1). Eight cases were trans-scaphoid, 2 cases were trans-radiostyloid-transscaphoid, and 1 case was trans-scaphoid-trans-capitate.
All of the cases were evaluated with preoperative and postoperative standard wrist anteroposterior (AP) and lateral (LAT) radiographs. According to Herzberg’s perilunate fracture-dislocation classification [7], all of the cases were of the dorsal type. Four cases were determined to be stage 1 and 7 cases were stage 2. All of the cases were a scaphoid body fracture, and in addition, 2 had a triquetrum fracture, 2 had a distal ulna styloid fracture, 2 cases had a distal radius styloid fracture, and 1 had a capitatum fracture.

A dorsal approach was used in all cases; however, in 1 case a volar approach was also required. In that case, the palmar ligament was repaired as well. For internal fixation of the scaphoid fractures, Kirschner (K) wires were used in 5 cases (Figure 1), headless screws were used in 4 cases, and Herbert screws were used in 2 cases (Figure 2). C-arm fluoroscopy was used to examine instability, and the capito-lunate and luno-triquetral joints were stabilized with K wires. Other fractures were stabilized with 1.8-mm K wires. A graft was not required in any of the cases. The K wires used for scaphoid fractures were removed in 8 to 10 weeks, and the K wires used for other fractures were removed in 5 to 6 weeks. In all cases, a cast with a thumb spica was applied postoperatively. Additional AP, LAT, and oblique radiographs were used to evaluate fracture union. Cross trabeculation was assessed [8]. A goniometer was used to evaluate wrist range of motion, and a dynamometer was used to evaluate grip strength.

Wrist degeneration was evaluated in control X-rays and evaluated as stage 1, mild changes in the radial styloid; stage 2, degeneration in the radial and scaphoid joint surfaces; stage 3, degeneration in radio-scaphoid and capito-lunate; and stage 4, degeneration in radiocarpal and intercarpal joints [9]. The Green and O’Brien evaluation scale modified by Cooney was used for clinical assessment of pain, wrist range of
motion, grip strength, and functional status as excellent, good, moderate, or poor [10]. The visual analog scale (VAS) was used to evaluate pain.

After removal of the fixation materials and cast, patients began a physical rehabilitation program of muscle strengthening and range of motion for the hand and wrist. Participation in sports and other activities was allowed after 5 to 6 months.

As a statistical method, Mean, minimum and maximum values were given for continuous variables. Spearman correlation analysis was used to determine correlational relationships between variables. P <0.05 was considered statistically significant. Analyzes were performed with NCSS 11 (Number Cruncher Statistical System, 2017 Statistical Software) program.

3. Results

Sufficient union was obtained in all of these cases treated with open reduction and internal fixation of the fractures. No reduction loss, pseudoarthrosis, or avascular necrosis was observed.

The average follow-up time was 33 months (range: 19-68 months). In terms of wrist range of motion, a mid-grade disability (average: 38°) was observed compared with the uninjured side. Grip strength was 77.5% compared with the other side (Table 3). Radiological assessment of the wrist degeneration indicated that 2 cases were stage 4, 1 was stage 3, 5 cases were stage 2, and 3 cases were stage 1 (Table 1).

According to the modified Green and O'Brien clinical evaluation scale, 6 cases were evaluated as good, 3 cases were fair, and 2 cases were poor. One of the 2 poor cases was a delayed case, while the other was an acute case.
Nine of our patients returned to their former jobs. One patient who had olecranon and radial head fractures, and 1 patient who had pilon-calcaneus and vertebral fractures had to change job due to wrist and ankle pain. The mean VAS score was 2.9 (range: 2-4) in pain evaluation.

Median nerve damage was not determined in the preoperative or postoperative period in any patient. There was no postoperative pin tract infection in any patient.

Statistically, there was no correlation between wrist degeneration stage and range of motion, VAS score and grip strength. There was a negative correlation between VAS score and wrist degeneration level. (p=0.049, rho=-0.603).

4. Discussion

In this study, clinical and radiological follow-up results of 11 patients with TSPFD, a rare injury, are presented. A perilune injury is rare among wrist traumas [2]. In perilunate dislocations resulting from severe isolated ligament injury, the capitate and remainder of the carpus dislocate around the lunate in a dorsal or palmar direction. A dorsal perilunate dislocation is more common (90%). Rarely, the connection between the lunate and the radius is ruptured and the lunate bone is displaced dorsally or palmarly while the radial connection to the other carpal bones is protected. This is a lunate dislocation. Scaphoid fractures are associated with 60% of perilunate or lunate dislocations; this kind of injury is called a perilunate fracture-dislocation. TSPFD are often accompanied by radial styloid, capitatum or triquetrum fractures [7,10].

Diagnosis of carpal fracture-dislocations is often missed initially [7]. Given that the patient often has other injuries that demand the physician’s immediate attention, if the radiological images are not appropriate, diagnosis may be delayed. Eight of our
patients had injuries to other parts of the body. In 2 cases the TSPFD was not diagnosed until 7 to 10 days after the injury with control X-rays. Another patient who was also treated for other injuries was diagnosed with control X-rays 3 weeks after the injury, and was sent to our hospital as a delayed case.

Wagner (1959) proposed arthrodesis to treat a TSPFD, if closed reduction was not possible. Campbell (1965) recommended proximal row carpectomy, and MacAusland (1944) proposed open reduction if diagnosed within 6 weeks and lunate excision for cases diagnosed later [11]. Green and O’Brien (1978) and Siegert (1988) proposed open reduction and internal fixation even in delayed cases [4,11]. Reduction loss and instability often occur in cases diagnosed with acute TSPFD due to scaphoid fracture even when closed reduction is achieved [12,13].

Adkinson identified a 59% reduction loss in 6 weeks in 55 cases with TSPFD treated with closed reduction and cast immobilization [14]. For pain relief and to obtain the reduction, traction and reduction maneuvers are performed in the emergency room in this kind of case. But this can be very difficult, especially when the lunate is rotated and dislocated palmarly. Such maneuvers may even exacerbate palmar radiolunate ligament injuries [14].

Open reduction allows for better evaluation of the injury, as well as reduction and repair [6]. In terms of the surgical approach, a volar, dorsal, or a combined approach may be used; the decision must be made according to the surgeon’s experience and the type of injury [6,14].

Herbert screws, first used in the early 90s to fix a scaphoid fracture, have become a successful tool to resolve problems of irritation and motionlessness of K
wires. We used headless screws in 4 cases, Herbert screws in 2 cases, and K wires in 5 cases for the fixation of scaphoid fractures. Though the application of headless screws is more difficult than K wires, if the fracture and surgical approach are suitable, headless screws are preferred to fixation [11]. We used different implants for fixation of the scaphoid, and no reduction loss or nonunion was observed.

In all of our cases, we used a dorsal incision and Z capsulotomy, and then achieved reduction. In 1 case, a volar incision was also required for reduction of the lunate. Accompanying triquetrum, radial styloid, and capitate fractures were fixed with K wires under scopy guidance.

Various results have been reported in the surgical treatment of such injuries in the literature. Viegas et al. [15] used open reduction and osteosynthesis with Herbert screws in 5 cases of dorsal TSPFD, and reported 3 excellent, 1 good, and 1 moderate result in the clinical assessment. Ada et al. [4] applied open reduction, ligament repair, and K wires to fix fractures and joints in 6 cases and reported 1 excellent, 2 moderate, and 3 poor results, according to the Green and O’Brien evaluation scale. In our study, 8 patients were treated in the acute phase, and 3 patients were delayed; we obtained 6 good, 3 moderate and 2 poor results.

In final postoperative controls, there was no correlation between advanced degeneration stage with range of motion and there was a negative correlation between VAS score with wrist degeneration level. This suggests that the radiological view will not to be effective alone in the assessment of a wrist complaint [1]. Komurcu et al. [3] reported that acute treatment had more successful results, although there was not always a correlation between radiological and clinical results. Ada et al. [4] evaluated their 8
perilunate fracture dislocation cases and suggested that injury type, severity of the injury, the type of perilunate dislocation, and time to diagnosis were important to the clinical and radiological results.

Postoperative cast immobilization might be needed, depending on additional pathologies. Although the duration of cast immobilization varies for each patient, it generally depends on scaphoid fixation and intercarpal joint stabilization. In the literature, the length of time varies from 6 to 12 weeks. If the stabilization is good, it is recommended to limit the time in the cast to 6 weeks [11]. The cast was in place for 6 weeks for 7 of our patients, 8 weeks for 3, and 12 weeks for 1 patient. In the cases in which K wires were used to fix fractures, cast immobilization was applied for more than 6 weeks (Table 2).

Even though 3 of our patients were delayed cases, we found that after open reduction and stable fixation, the clinical and functional outcomes were similar to acute phase cases.

The small number of cases and the absence of a comparison group are the weaknesses of our study.

As a conclusion, this kind of injury presents complex, biomechanical damage to the wrist anatomy. If TSPFD, which is especially observed in the young population, is diagnosed early and treated with open reduction and stable fixation, a functionally adequate and anatomically integrated wrist can be obtained.
References:


## TABLES AND FIGURES

### Table 1. Trauma etiology, accompanying injuries, and postoperative evaluation results

<table>
<thead>
<tr>
<th>Patient</th>
<th>Accompanying injuries</th>
<th>Etiology</th>
<th>Ext./Flex. (degree)</th>
<th>Normal side Ext./Flex. (degree)</th>
<th>Grip Strenght</th>
<th>Wrist degeneration (radiological evaluation)</th>
<th>Clinical assessment (Modified Green and O'Brien)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>- Acetabulum - Prox. Femur</td>
<td>Work accident</td>
<td>30/35</td>
<td>80/85</td>
<td>70</td>
<td>Stage 4</td>
<td>Good</td>
</tr>
<tr>
<td>2</td>
<td>- Pubis</td>
<td>Fall</td>
<td>50/30</td>
<td>80/70</td>
<td>70</td>
<td>Stage 2</td>
<td>Fair</td>
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<td>3</td>
<td>- Olecranon - Radial head</td>
<td>Fall during sports</td>
<td>20/50</td>
<td>80/80</td>
<td>80</td>
<td>Stage 2</td>
<td>Poor</td>
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<tr>
<td>4</td>
<td>- Calcaneus</td>
<td>Suicide attempt</td>
<td>40/50</td>
<td>80/90</td>
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<td>Stage 1</td>
<td>Good</td>
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<td>5</td>
<td>- Distal radius</td>
<td>Fall</td>
<td>50/30</td>
<td>90/90</td>
<td>70</td>
<td>Stage 1</td>
<td>Fair</td>
</tr>
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<td>6</td>
<td>- Trochanter major</td>
<td>Fall during sports</td>
<td>40/30</td>
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<td>75</td>
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<tr>
<td>7</td>
<td>-</td>
<td>Fall</td>
<td>25/30</td>
<td>85/85</td>
<td>70</td>
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<td>Fair</td>
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<td>8</td>
<td>- Pilon - Calcaneus - Vertebra</td>
<td>Work accident</td>
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<td>80/80</td>
<td>90</td>
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<td>- Mandible - Maxilla</td>
<td>Fall</td>
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<td>90</td>
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<tr>
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<tr>
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<td>40/40</td>
<td>80/80</td>
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Ext: Extension; Flex: Flexion; Prox: Proximal.
<table>
<thead>
<tr>
<th>Patients</th>
<th>Age (years)</th>
<th>Type of perilunate dislocation</th>
<th>Time from trauma to surgery (days)</th>
<th>Surgical approach</th>
<th>Postoperative cast duration (weeks)</th>
<th>Follow-up duration (months)</th>
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<tbody>
<tr>
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<td>Dorsal+volar</td>
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<tr>
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<td>Dorsal</td>
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<tr>
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<td>2</td>
<td>Dorsal</td>
<td>8</td>
<td>13</td>
</tr>
</tbody>
</table>

T-RS-S: Trans-radialstyloid-trans-scaphoid; T-S: Trans-scaphoid; T-S-C: Trans-scaphoid-trans-capitate.
Figure 1. Radiographs of patient 4, a 32-year-old man who is schizophrenic, injured in a fall from a height in a suicide attempt.

a) Preoperative trans-scaphoid perilunate fracture-dislocation lateral X-ray;

b) Anteroposterior (AP) X-ray;

c) Postoperative AP view after open reduction and internal fixation with K wires;

d) Postoperative lateral view;

e) AP X-ray at 26-month control;

f) Lateral view at 26-month control.
Figure 2. Radiographs of patient 3, a 42-year-old man, injured in a fall.

a) Preoperative trans-scaphoid perilunate fracture-dislocation anteroposterior (AP) and lateral X-rays;

b) Postoperative AP view after open reduction internal fixation with Herbert screws and K wires;

c) Postoperative lateral view;

d) AP X-ray at 30-month control;

e) Lateral view at 30-month control.