



# Surgical management and functional outcomes of perilunate dislocations and fracture dislocations through the dorsal approach

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## Abstract

**Background** Perilunate dislocations and perilunate fracture dislocations (PLD/PLFDs) are rare injuries of the wrist, with surgical management leading to acceptable functional results.

**Purpose** The purpose of this study was to assess the functional outcomes of the patients of our department who were treated with surgical management of PLDs/PLFDs through dorsal approach, as well as to report any complications on their follow-up.

**Patients and methods** In this retrospective study, 52 patients with PLD/PLFD, fulfilling the inclusion and exclusion criteria of the study, underwent surgical management of their injury. All patients were followed up at 6 weeks, 12 weeks, 6 months, 1 year postoperatively with radiographic imaging as well as functional scores measured with the modified mayo wrist score and the QuickDASH questionnaire.

**Results** The mean postoperative modified Mayo score was  $76.8 \pm 8.8$  and the mean QuickDASH score was  $1.52 \pm 2.18$ . Of the 52 cases, 20% had excellent results, 42% had good results, 29% had fair results and 9% had poor results as per the modified Mayo wrist score. No patient signed any symptoms of median nerve neuropathy.

**Conclusion** In conclusion, open reduction and internal fixation through dorsal approach is a reliable technique to manage perilunate injuries in spite of radiological evidence of wrist arthritis, as it also provides consistently good results in terms of functional outcomes.

**Level of evidence IV** Retrospective case series study.

**Keywords** Perilunate dislocation · Perilunate fracture dislocation · Hand · Upper limb

## Introduction

Perilunate dislocations and fractures (PLD/PLFDs) are rare injuries of the wrist, comprising only 7% of all injuries of the carpus [1]. PLFDs are more usual than PLDs, in which the scaphoid bone is mainly fractured [2]. Most of these injuries are seen following high energy trauma [3]. The impact of the trauma can propagate through ligaments (perilunate dislocations) and/or bone (fracture–dislocations), creating multiple variations of a basic injury pattern [4]. The typical presentation of an acute perilunate dislocation includes pain and swelling about the wrist. Deformity may be more subtle than expected and this injury can be missed

frequently. The carpus is usually displaced dorsally [5]. In a lunate dislocation, the lunate can come to lie within the carpal tunnel; therefore, a thorough neurovascular assessment of the upper extremity is important. PA, lateral, and oblique radiographs are the key to the diagnosis. Traction radiographs and CT scans may be indicated to further assess the injury pattern [6].

Treatment involves a closed reduction attempt followed by surgical intervention to restore carpal alignment and stability. Although closed treatment was historically advocated for these injuries, the trend has shifted toward anatomic reduction and repair of the ligamentous and osseous structures with early open reduction and internal fixation. Any delay is accompanied with poor outcomes—posttraumatic arthritis, decreased motion and grip strength, median nerve impairment, disability, and attritional rupture of flexor tendons [7]. Both decreased range of motion as well as diminished grip strength are measured in comparison to the

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uninjured wrist from reports of six-months to five years post-injury of PLD/PLFDs [8]. Additionally, poor results have been mentioned regarding the Disability of arm shoulder hand (DASH) scores [4], with even worse functional results stemming from the complicated PLD/PLFD [6]. When ligament ruptures or co-existing fractures are also present, the results are even worse [7]. Outcomes of the specific injury are both bone necrosis as well as posttraumatic arthritis [9]. Prevalence of posttraumatic arthritis following PLD/PLFDs of up to 56% has been reported in six years post-injury, mainly due to soft tissue and ligamentous damage, as well as intraarticular fractures such as scaphoid fractures [10]. As a result, posttraumatic arthritis can lead to a severe downward trend of the functional outcomes, range of motion and grip strength [11]. Return to the previous quality of life is described as decreased because of the inability to manual occupation [12]. The VAS scale pain score or Mayo wrist score are often reported in the current literature, which are highlighted scores of pain, functional status, range of motion and grip strength [13].

There is a need for more light to be shed in long-term outcomes captured in functional outcomes after surgical management of those injuries, leading to the development of more targeted surgical and rehabilitation treatment protocols minimizing long-term consequences PLDs/PLFDs. The purpose of this study was to assess the functional outcomes of the patients of our department who were treated with surgical management of PLDs/PLFDs with dorsal approach as well as to mention any complications on their follow-up.

## Materials and methods

Firstly, approval of the institutional review board of our hospital was obtained for performing this retrospective study. The medical records of all patients from 2014 to 2022 with perilunate injuries were examined. Patients 16 years and above with perilunate dislocation or perilunate fracture–dislocation who underwent open reduction and internal fixation, with a minimum follow-up of at least one year were included in the study. However, patients with open injuries as well as pediatric cases were excluded. Informed consent was obtained from all patients.

Range of motion was measured using a goniometer. Wrist flexion/extension, radial/ulnar deviation and supination and pronation were also determined. Grip strength was measured using a hand dynamometer. During the latest follow-up, subjective scores such as modified Mayo wrist score and QuickDASH questionnaire through direct interview were obtained, as well as their return to their previous occupation. Regarding the imaging examinations during the follow-up, both posteroanterior and lateral radiographs were carried out at six weeks, 12 weeks, six months and one year

postoperatively, respectively. The aim of these studies was the determination of their clinical presentation at the latest follow-up according to the functional scores.

## Surgical technique

Initially, closed reduction of the injury took place at the emergency department and definitive surgery was planned for the next available theater slot. A classic longitudinal dorsal incision was made over the third and fourth extensor compartment. EPL tendon was retracted radially in the standard fashion. Extensor retinaculum and the EDC tendons were retracted medially. Radiolunate joint was inspected for articular cartilage damage. The lunate was identified and reduced anatomically using traction, countertraction along with joystick maneuvers using *K*-wires. Multiple intercarpal *K*-wires were inserted to maintain the reduction. In case of scaphoid fracture, first the open reduction and internal fixation of the scaphoid took place, then the other carpal fractures, if present, were fixed using *K*-wires or screws. The scapholunate ligament was assessed initially intra-operatively and in case of tear, repair with suture anchors was performed. Additionally, in cases where direct suturing was not possible, capsulodesis with suture anchors was also used in the management of the crucial SL ligament. Scapholunate, lunotriquetrate and scaphocapitate articulations were stabilized with *K*-Wires of a diameter of 1.6 mm. Plication with suture anchors was routinely performed. No external fixator was used.

Concerning the postoperative management, all the wrists were immobilized for a period of eight weeks with a palmar cast. Shoulder, elbow and finger mobilization was encouraged during this period. Removal of wrist plaster splint as well as the percutaneous *K*-wires was done at eight weeks postoperatively, with immediate commencement of range of motion exercises and grip-strengthening exercises. Patients were encouraged to return to their previous activity level within four to six months postoperatively. Figures 1, 2 and 3 show the pre and postoperative radiographs of a perilunate dislocation, as well as the intraoperative perilunate dislocation fixation with dorsal approach (Table 1).

## Statistical analysis

Data were collected and analyzed using the ‘SPSS-Version 22.0’. Qualitative variables were reported as frequencies and percentages. Means and standard deviations were reported for quantitative variables. A ‘*p*’ value less than 0.05 was considered to be statistically significant.



**Fig. 1** PA and lateral views of the wrist showing a perilunate dislocation



**Fig. 3** Immediate postoperative radiographs *K* wires have been used to stabilize the carpal bones. A palmar wrist splint has been applied as well. SL: scapholunate ligament, LT: lunotriquetral ligament, SC: Scaphocapitate ligament



**Fig. 2** Intraoperative image of the dorsal approach of the ORIF of the perilunate fracture/dislocation

**Results**

The data of 52 patients (47 males, 5 females) were collected and matched the inclusion criteria for this study. Average age was 32.5 (18–60). Most common mode of

**Table 1** Type of injury of the patients included in the study

Type of injury	<i>N</i> (%)
PLD	10 (19.2)
PLD + scaphoid fracture	37 (36.4)
PLD + radial styloid fracture	3 (5.8)
PLD + other carpal fractures	2 (3.85)

PLD, perilunate dislocation; *N* = number of patients

injury was high energy injury (61.2%) including motor vehicle accidents as well as falls from height. Of the 52 patients recruited in this study, 39 injured their dominant hand and 13 their nondominant hand. Median time to intervention in this study was ten days (1–30 days). Most common associated fracture was a trans-scaphoid fracture (36.4%), while associated radial styloid fractures were seen in three cases (5.8%) and a capitate fracture was seen in two cases (3.85%). None of the cases underwent any additional procedures except for the removal of *K*-wires. No external fixators were placed. During the postoperative period, no cases of infections or complex regional pain syndrome were signed. Mean follow-up period was 22 ± 8 months. Mean Mayo wrist score was 76.8 ± 8.8 and mean QuickDASH score was 1.52 ± 2.18, as shown in Table 2. Regarding the functional outcomes, 20%

**Table 2** Functional outcomes and range of motion at 1-year follow-up

Tool	Mean $\pm$ SD
Mayo wrist score	76.8 $\pm$ 8.8
QuickDASH score	1.52 $\pm$ 2.18
Wrist range of motion	Degrees (range)
Flexion	48.3° (30°–70°)
Extension	9° (24°–69°)
Radial deviation arc	18.3° (10°–30°)
Ulnar deviation arc	30.7° (15°–42°)

**Fig. 4** Postoperative radiograph after 24 months of the intervention with good results regarding the joint congruity

had excellent results, 42% had good results, 29% had fair results and 9% had poor results as per the modified Mayo wrist score. No patient signed any symptoms of median nerve neuropathy. Figure 4 shows the postoperative radiograph of a perilunate dislocation at 2-years follow-up.

Average wrist flexion/extension range of motion of 48.3°/51.9° and average wrist radial/ulnar deviation arc of 18.3°/30.7° was observed, as shown in Table 2. The average grip strength of the operated wrists was of 70% (range 38–88%) of the unaffected side. During radiological assessment on the latest follow-up, 24 cases (46.2%) had features of wrist arthritis ( $p$ -value = 0.04) on follow-up and three cases (5.77%) had lunate sclerosis on radiographs ( $p$ -value < 0.05).

## Discussion

In this study, the clinical and radiological follow-up results of 52 patients with perilunate dislocations are presented. Scaphoid fractures are associated with 60% of perilunate or lunate dislocations; consisting a perilunate fracture dislocation [14]. These injuries are often accompanied by radial styloid, capitate, or triquetrum fractures. The diagnosis of carpal fracture dislocations is often missed initially. However, as reported in the current literature, the rates of missed diagnosis of perilunate dislocation and fracture dislocation are similar [15]. In the presented study, the rate of injury type diagnosed correctly initially in all the patients. Given that the patient often has other injuries that demand the physician's immediate attention due to the high energy of the initial injury, and if the radiological images are not appropriate, the diagnosis may be delayed [16]. However, in our case study no polytrauma patients were present.

The choice of the surgical approach is still debated among the dorsal, volar or combined approach [17]. In the present study, all the procedures were performed through the dorsal approach. The authors believe that the dorsal approach provides better visualization of the carpal bones, while enabling the anatomic repair of the scapholunate ligament and added stability is provided with lunotriquetral pinning. The dorsal approach, also, enables wrist plication with suture anchors, which can reduce midcarpal instability [18]. In this series, even for the pure ligamentous perilunate dislocations, which translate volarly, the use of the dorsal approach was sufficient for the reduction with joystick maneuvers.

Radiological presence of arthritis during follow-up is very high following perilunate fracture–dislocations. In a case study with 30 patients of perilunate injuries which were followed up for 15 years, postoperative arthritis was signed in 70% of patients [19]. Thus, this evidence of radiological arthritis is not always translated to poor clinical and functional results, or diminished grip strength in comparison with the contralateral hand [20, 21].

It has been shown in the current literature that the age at the time of injury, length of follow-up, and loss of reduction were significantly associated with postoperative wrist arthritis. In this study, we found consistently poor subjective assessment scores with radiological evidence of wrist arthritis [22, 23]. Out of 52 cases, 24 had signs of wrist arthritis on follow-up and three cases had lunate sclerosis on radiographs that could be suggesting lunate avascular necrosis. Radiological evidence of wrist arthritis was identified as a positive predictor of poor functional result as per the modified MAYO wrist score ( $p$ -value  $< 0.05$ ) [24, 25]. Despite deterioration in wrist range of motion and radiological evidence of wrist arthritis, all patients in our study returned to their previous activity level and employment being satisfied with their functional outcome.

Studies with an average follow-up period larger than two years, mention postoperative arthritis rates between 18 and 22%, which tend to increase as the follow-up period increases. Similarly, the presence of avascular necrosis deteriorates also the postoperative functional results, as highlighted in the published series [14, 21, and 26].

Injury patterns detected in this study are heterogeneous and hence difficult to compare. Regarding the limitations of this study, highly variable presentation of this injury means that a much larger case series would be required to obtain statistically significant results. Also, as this is a retrospective study, diversity of presenting injury patterns makes the series inconsistent, although this is counterbalanced by the standardization of the technique. Moreover, there is the absence of a control group which does not allow us to compare the long-term outcomes of our technique with other surgical approaches, such as external fixators or Herbert screws or combined surgical approach.

## Conclusion

Perilunate dislocations and fractures are demanding high energy injuries that require urgent care to achieve the most acceptable long-term postoperative functional outcomes results. In our study, the patients are satisfied with their return to pre-injury activity levels. In conclusion, open reduction and internal fixation through the dorsal approach is a reliable technique to manage perilunate injuries despite of radiological evidence of wrist arthritis, as it also provides consistently good results in terms of functional outcomes.

**Data availability** Data was collected from the patients reported in our hospital.

## Declarations

**Conflict of interest** The authors report no conflict of interest.

**Ethical approval** Ethical standard statement was obtained from the ethics committee and the institutional review board. Informed consent was obtained from all patients.

**Human and animal rights** All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

**Informed consent** All patients enrolled in this study gave informed consent to participate and no identifying factors were used.

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