

## C A S E R E P O R T

# Trans-scaphoid perilunate fracture dislocation. Case series: Clinical and radiological follow up at 2 years

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## ABSTRACT

**Background and aim:** Perilunate dislocations (PLDs) and perilunate fracture-dislocations (PLFDs) are rare, high-energy wrist injuries often associated with diagnostic delays. These complex lesions involve disruption of the carpal bones and ligaments, typically resulting from hyperextension trauma. PLFDs most commonly affect young males and frequently involve the dominant wrist. Early recognition and prompt reduction are crucial to prevent neurovascular compromise and long-term complications.

**Methods:** This retrospective study analyzed 12 cases of surgically treated PLFDs between February 2020 and December 2022. The majority of injuries were due to motorcycle accidents, with scaphoid fractures predominating. Surgical management was tailored to fracture location, employing dorsal or volar approaches, Herbert screw fixation, and strategic K-wire stabilization. Postoperative protocols included immobilization, early physiotherapy, and biophysical stimulation. Clinical outcomes were assessed with PRWE and QuickDASH scores, alongside radiographic monitoring at defined intervals up to 24 months.

**Results:** Most patients achieved fracture union and restored carpal alignment without significant loss of motion or persistent instability. Only one complication—hardware impingement—required revision.

**Conclusions:** The study underscores the importance of early diagnosis, anatomical reduction, and stable fixation to ensure favorable outcomes and minimize the risk of post-traumatic arthritis. Open surgical approaches remain the standard treatment, while minimally invasive techniques require further validation. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** trauma, trans-scaphoid perilunate fracture dislocation, lunate, scaphoid, hand surgery, case series, osteosynthesis



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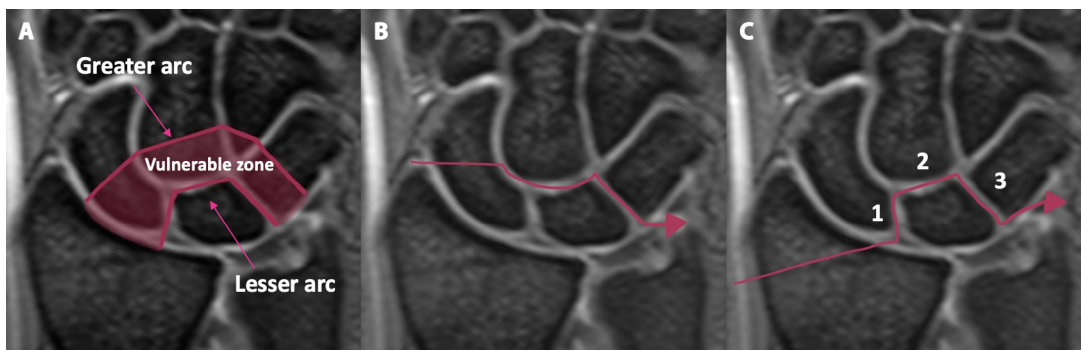
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## Introduction

Carpal traumatic dislocations and fracture-dislocations are a rare group of injuries, often initially missed. They can be classified into five categories: perilunate, radiocarpal, axial, carpometacarpal, and isolated carpal bone dislocations. Among these, perilunate dislocations (PLD) and perilunate fracture-dislocations (PLFD) are the most frequent. They account for 5–7% of all wrist injuries and typically occur in young males in their second to fourth decades of life, usually following high-energy trauma. Fracture-dislocations are approximately twice as common as purely ligamentous dislocations (1). As noted, perilunate lesions involve both bone and soft tissue structures around the lunate, but the lunate itself is almost never directly injured. Regardless of the specific mechanism or subtype, their common hallmark is the loss of articular congruency between the capitate head and the concavity of the distal lunate (2). Depending on the trauma severity, this process may evolve into a complete dislocation of the capitate together with the adjacent carpal bones. The dislocation is dorsal in 97% of cases and palmar in about 3%. Only 10% of these injuries are open. The injury mechanism is three-dimensional. The direction of force transmission can be either from radial to ulnar (direct perilunate disruption—more common) or from ulnar to radial (reverse perilunate disruption—less common). In radial-sided injuries, the mechanism typically involves a fall onto a hyperextended radio-carpal joint, combined with midcarpal supination and

ulnar deviation. On the ulnar side, the energy may be dissipated through midcarpal hyperextension, whereas on the radial side, the scaphoid and dorsal distal radius resist this hyperextension, resulting in ligamentous or bony disruption (3,4) (Figure 1).

For descriptive purposes, the anatomical structures involved in perilunate instability are located within the so-called *vulnerable zone* (Figure 1A). This area is delineated by the lesser and greater arcs. Lesions that follow the lesser arc are purely ligamentous, whereas those involving the greater arc are predominantly osseous. All structures within this vulnerable zone can be variably affected, leading to mixed lesions such as fracture-dislocations. These may present as trans-scaphoid perilunate (Figure 1B) or trans-styloid perilunate (Figure 1C) injuries, where the perilunate ligamentous disruption is associated with a fracture of either the radial styloid or the scaphoid. Trans-scaphoid and trans-styloid patterns are typically associated with a radially originated mechanism of injury (5). Perilunate dislocations (PLDs) progress through four sequential stages. In direct lesions (Figure 1C), stage 1 is disruption of the scapholunate (SL) ligament, followed by lunocapitate (LC) dissociation (stage 2), lunotriquetral (LT) ligament disruption (stage 3), and ultimately luno-capitate dislocation (stage 4). In reverse PLDs, the sequence begins with LT ligament disruption (stage 1), progresses toward the SL ligament (stage 3), and culminates in LC dislocation (stage 4) (6). Being due to high energy traumas, these lesions are often found in polytraumatized patients.



**Figure 1.** A) Vulnerable zone, delimited by the lesser arc proximally and the greater arc distally. B) Trans-Scaphoid-Perilunate fracture-dislocation. C) Trans-Styloid-Perilunate fracture-dislocation. The first 3 stages of PLD are illustrated in this image: after passing through the styloid, the force vector disrupts SL ligament (stage 1), then the LC ligament (stage 2), and finally the LT ligament (stage 3).

In these cases, definitive surgery for PLDs treatment is deferred after life-saving procedures (7). At the clinical evaluation, wrist swelling and acute pain at any attempt of movement are always present. Neurological deficits, due to Median nerve compression, are diagnosed in almost 25% of cases, especially in stage 4 dorsal dislocations, with palmar dislocation of the Lunate into the carpal tunnel. At AP XRray examination, Gilula lines are altered, and a “crowded carpal sign” is often evident, due to the overriding of proximal and distal carpal rows. In LL projections, the main finding is the displacement of the head of the Capitatum. There is no point in measuring carpal angles in acute lesions. The restoration of the correct carpal angles must be evaluated in post-interventional and follow-up Xrays (8,9). Our purpose is to retrospectively analyze our case series of treated PLDs with a 24-months clinical and radiological follow-up.

**Materials and Methods**

Between February 2020 and December 2022, 12 patients with peri-lunate fracture dislocation were surgically treated at our institution (Orthopaedics and Trauma Department “Vito Fazzi”Hospital -Lecce). Demographic characteristics including age, gender, pre-operative comorbidities and the American Society of Anesthesiologist’s (ASA) physical status were collected from medical records. Isolated scaphoid fractures and pure midcarpal dislocations without associated fractures were excluded from the study. All the patient signed an informed consent. The injuries were caused by motorcycle accidents in 9 patients and by falls on an outstretched hand during work activities in 3 patients. The dominant wrist was involved in 10

cases. Eleven patients received acute treatment, while one patient was treated after 13 days due to a missed diagnosis at another hospital. The mean interval between injury and surgery was 2.6 days (Table 1). Perilunate fracture-dislocation was diagnosed in the Emergency Department by radiographic assessment (standard anteroposterior and lateral views of the wrist). Following sedation and local anesthesia, all fractures were reduced and immobilized with a plaster cast. A CT scan with 3D reconstruction was subsequently performed to evaluate the scaphoid fracture. The MRI was not performed because it would provide additional diagnostic information. The images would likely contain artifacts due to acute post-traumatic edema. Timing for urgent surgery was priority and did not allow for scheduling such an examination. Radiographic follow up was performed at 3 month, 6,12 and 24 months after surgery. Fracture union was confirmed when bony trabeculae were observed to cross the fracture sites in standard radiographs of the wrist in A-P, lateral, and ulnar deviation views. Clinical evaluation was assessed with PRWE (Patient rated wrist evaluation) and QuickDASH score. The joint range of motion (ROM) was measured in degrees using a goniometer in both wrists in flexion and extension (10).

**Surgical technique**

The surgical approach was chosen according to the scaphoid fracture site. A dorsal approach was used to facilitate fixation of distal pole scaphoid fractures. The entry point was at the proximal pole, directly adjacent to the scapholunate ligament insertion. The scaphoid was fixed first using a cannulated drill, and a 3.0-mm Herbert screw (DePuy Synthes) was inserted; screw length was 2 mm shorter than the

**Table 1.** Patient cohort.

Study Population	Gender	Dominant Wrist Involved	Age	Type of Injury	Comorbidities
n 12	12 males	11 patients	Mean age 28.3 years	Motorcycle accident: 9	Diabetes Type 1: 1 patient
				Falling from height during work activity: 3	Rheumatoid arthritis: 1

axial length of the scaphoid. Extrinsic ligaments were reconstructed using transosseous sutures (Table 2) (Figure 2). A volar approach was used in PLFDs with proximal pole scaphoid fractures. Lunate dislocation was reduced with dorsal percutaneous pinning. None of the cases required a combined approach. None of our patients developed severe swelling, allowing primary wound closure in all cases. The pattern of K-wire stabilization was adapted to the dislocation pattern. Osteochondral lesions of the capitate head and ligamentous disruptions were assessed intraoperatively (Figure 3). Osteochondral lesions result from impaction against the anterior or posterior horn of the lunate, while ligamentous injuries—especially of the scapholunate ligaments—are frequent and may lead to long-term post-traumatic arthritis if untreated. Surgical treatment must address both ligamentous instability and bony reduction/fixation. Options include

closed or arthroscopically assisted reduction with percutaneous fixation, or open reduction and fixation. Closed or arthroscopic techniques are less invasive, preserve the joint capsule, reduce the risk of carpal bone devascularization, and minimize post-operative articular fibrosis and stiffness (11). In most PLDs, adequate reduction can be achieved using two K-wires as joysticks to restore the physiological scapholunate angle; the lunate can be temporarily stabilized with a radiolunate wire inserted dorsally from the radius (12). The lunotriquetral joint is then stabilized with two K-wires inserted from the ulnar side, followed by stabilization of the scapholunate joint with two K-wires from the radial side. If the capitate head is unstable, an additional scaphocapitate K-wire may be inserted. In bony-ligamentous lesions such as trans-scaphoid or trans-styloid PLFDs, fractures are fixed first after relocating the capitate, followed by ligamentous

**Table 2.** Surgical approaches, scaphoid fracture patterns, associated chondral lesions, and ligamentous injuries observed intraoperatively in the study cohort.

Approach	Pattern of Scaphoid Fracture	Condral Associated Lesions	Ligament Injuries
Volar: 1	Distal pole: 11	Capitate Head: 2	Scapholunate: 2
Dorsal: 11	Proximal pole: 1	Posterior horn of the lunate: 1	
Combined: 0			



**Figure 2.** Transosseous repair of the scapho-lunate dorsal ligament.



**Figure 3.** Marginal impaction of the capitate head with cartilage damage.

stabilization (13,14). Postoperatively, the wrist was immobilized for four weeks in a short-arm plaster cast, allowing gentle movement of the metacarpophalangeal joints in all digits except the thumb. After four weeks, the cast was removed, and gentle wrist and finger mobilization was initiated as part of physical therapy. K-wires were removed six weeks after surgery. All the patients underwent biophysic stimulation with low dose local magnetic field; clodronic acid was prescribed to all patient for 4 months.

### Results

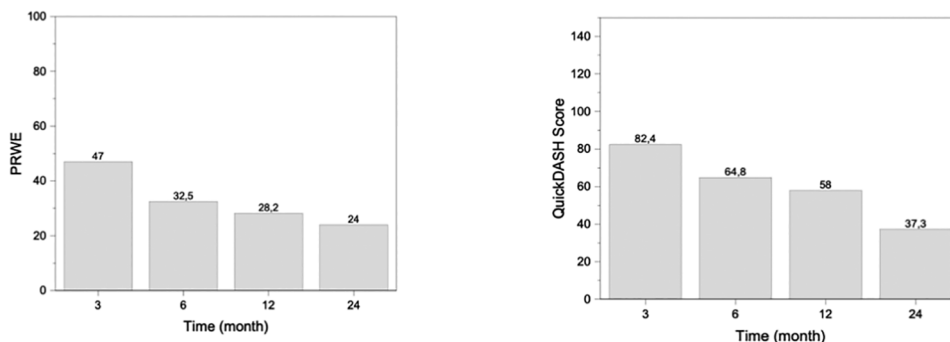
Eleven patients achieved satisfactory reduction of the scaphoid fracture and intercarpal alignment

through closed reduction. In one patient, this procedure was not feasible due to a delayed diagnosis and treatment performed 13 days after the trauma. Radiographic comparison of the surgically treated wrists with the contralateral healthy wrists, performed immediately postoperatively and at 2-year follow-up, showed no significant differences in the scapholunate, radiolunate, or capitulate angles, nor in the scapholunate gap. None of the patients developed scaphoid nonunion or subsequent DISI or VISI instability. Clinical outcomes were assessed using PRWE and QuickDASH scores at 1, 3, 6, 12, and 24 months (Table 3, Figure 4). All patients reported high satisfaction and returned to their previous work activities (Figure 5,6). The mean time to return to contact sports was 12 months (Table 4).

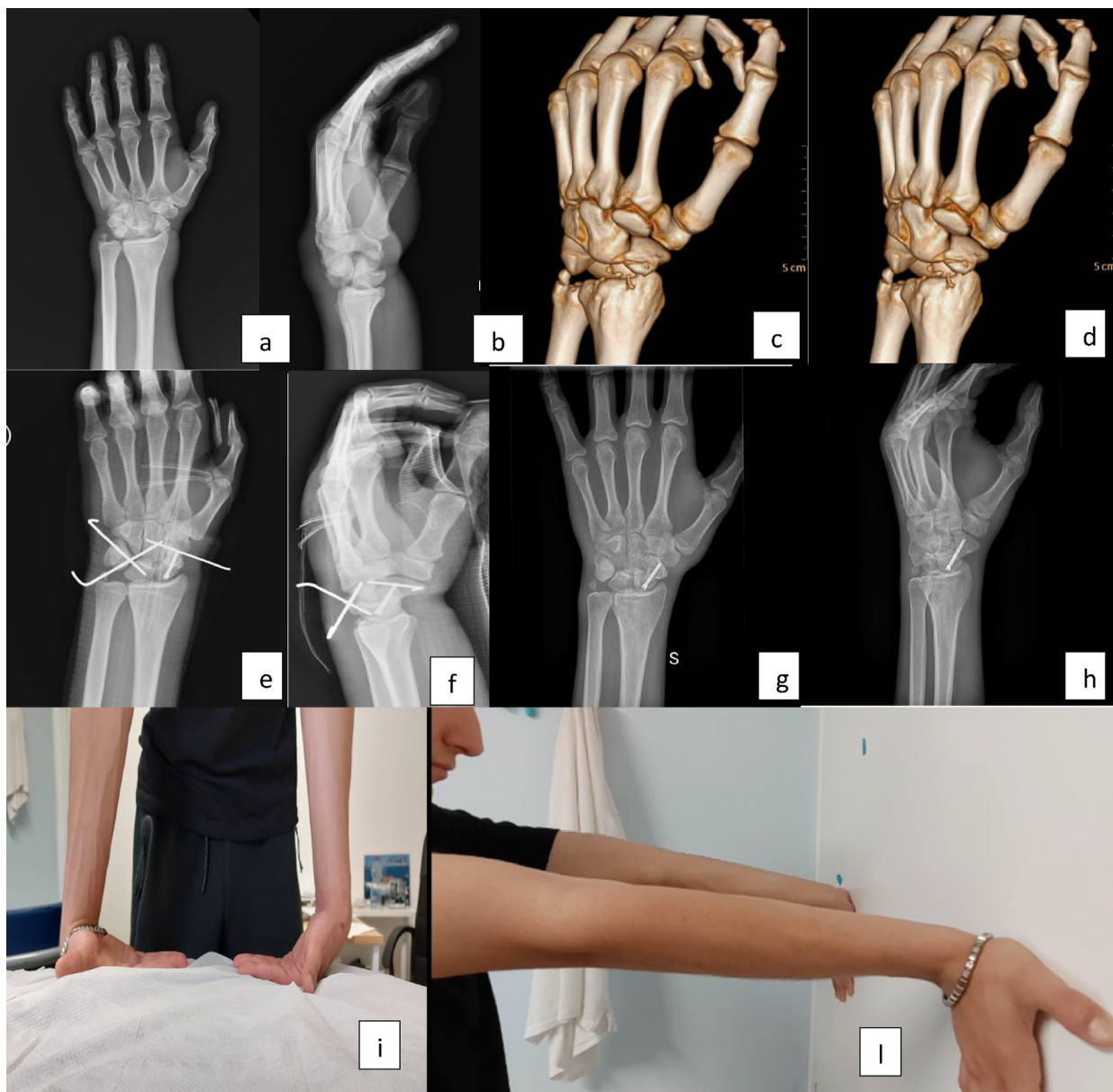
**Table 3.** Clinical outcome scores assessed during follow-up using the Patient-Rated Wrist Evaluation (PRWE) and QuickDASH questionnaires at 3, 6, 12, and 24 months postoperatively.

Follow Up	Prwe Patient Related Wrist Evaluation	QuickDASH Score
3 Month	47/100	82.4/150
6 Months	32.5/100	64.8/150
12 Months	28.2/100	58/150
24 Months	24/100	37.3/150

FOLLOW UP	PRWE PATIENT RELATED WRIST EVALUATION	QuickDASH Score
3 Month	47/100	82.4/150
6 Months	32.5/100	64.8/150
12 Months	28.2/100	58/150
24 Months	24/100	37.3/150



**Figure 4.** Trend of PRWE and QuickDASH scores during follow-up at 3, 6, 12 and 24 months.



**Figure 5.** Case 1, 18 years old, male, dominant wrist. a-b) preoperative x-rays, c-d) preoperative CT scan, e-f) postoperative x-rays, g-h) 3-months follow-up, i-l) flexion-extension measurement.

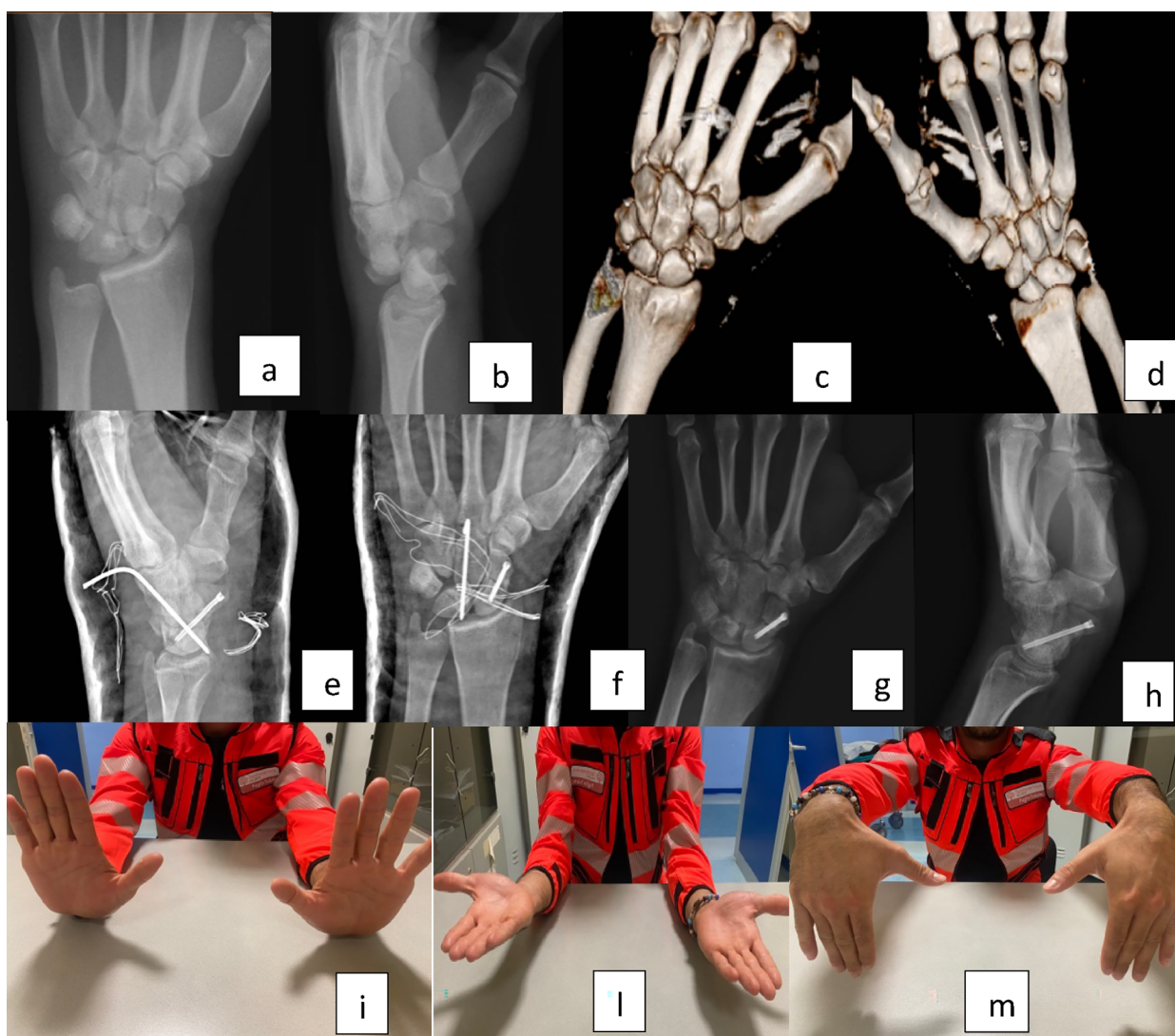
### Statistical analysis

This is a prospective observational study. We collected clinical data and conducted follow-up to report the incidence of complications and functional recovery. Due to the limited number of patients enrolled, statistical analysis may not reach significance. Clinical results demonstrated marked symptomatic improvement, with moderate recovery of function, range of

motion, and strength in the affected wrist compared with the contralateral side.

### Discussion

A diagnostic delay occurs in approximately 25% of cases, which may be attributed to several factors. First, despite improvements in initial emergency care, the



**Figure 6.** II case. 25 years old, male, non-dominant wrist. a-b) preoperative x-rays, c-d) preoperative CT scan, e-f) postoperative x-rays, g-h) 3-months follow-up, i-l-m) flexion-extension measurement.

clinical presentation of perilunate fracture-dislocations is often subtle or misleading. Swelling, pain, and limited motion may be overshadowed by other, more apparent injuries in polytrauma patients. Second, obtaining strict lateral X-ray views in the emergency setting can be challenging due to patient discomfort, positioning difficulties, or the presence of other injuries. Even when such images are obtained, interpretation can be difficult for non-specialized practitioners who may not be familiar with subtle carpal misalignments. These factors collectively contribute to delayed or missed diagnoses, which can in turn complicate

subsequent treatment. This study can be considered a pilot project, aimed at refining the diagnostic algorithm to enable faster and more reliable detection of perilunate fracture-dislocations, ultimately allowing earlier and safer definitive surgical intervention. Early diagnosis is crucial because delayed treatment may lead to more complex procedures, increased risk of complications, and poorer functional outcomes. In our experience, open surgery remains the gold standard for treating PLFDs, whether using a dorsal, volar, or combined approach. Recent studies have reported arthroscopic-assisted techniques in combination with

**Table 4.** Comparison of flexion–extension arc between the surgically treated wrist and the contralateral healthy wrist at final follow-up for each patient.

Patient	Flexion-Extension Arc Wrist Affected	Flexion -Extension Arc Controlateral Wrist
1.	125°	135°
2.	115°	120°
3.	115°	125°
4.	130°	143°
5.	130°	140°
6.	110°	125°
7.	120°	125°
8.	135°	140°
9.	125°	130°
10.	120°	130°
11.	130°	140°
12.	135°	140°

fluoroscopy, which can allow less invasive treatment. However, the sample sizes in these studies have been limited, and the techniques require significant arthroscopic skill and experience. Minimally invasive approaches may be used solely for scaphoid fixation or, in some cases, to assess and address lunate dislocation as well. The choice of technique is therefore highly dependent on the surgeon's experience and skill set. Preservation of vascularity, especially of the distal scaphoid pole, is critical for anatomical healing, proper carpal biomechanics, and long-term wrist function (15,16). Among the most commonly reported early complications is loss of reduction. Scapholunate diastasis may become apparent in mid-term postoperative radiographs (typically between the fourth and fifth month), and loss of carpal height can be detected as early as the second postoperative month (17). These findings highlight the importance of achieving precise anatomical reduction and rigid fixation of both bony and ligamentous structures during surgery. When scaphoid and triquetrum fractures are properly reduced and fixed, and midcarpal alignment is restored, proximal carpal instability may theoretically be avoided, preventing progressive deformity and post-traumatic arthritis. Pain, stiffness, and loss of strength are frequently reported after PLFDs, affecting approximately 20–30%

of patients in published series. Post-traumatic arthritis is a common long-term sequela, with reported incidence increasing over time; a mean rate of 60% has been observed at 10-year follow-up. Herzberg et al. specifically related the onset of midcarpal arthritis to primary cartilage damage sustained at the time of trauma. These findings underscore the importance of both timely intervention and meticulous surgical technique in minimizing long-term complications. Radiographic comparison with the contralateral wrist provides a standardized method for evaluating post-surgical alignment. This approach is particularly useful because it reduces the variability introduced by individual anatomical differences in the carpal bones and provides a reliable reference for assessing restoration of angles and joint congruity. Complications following PLFD surgery may necessitate revision procedures, with an overall reported rate of approximately 26%. Common complications include hardware loosening, scaphoid nonunion, and lunate osteonecrosis (18). In our series, scapholunate ligament reconstruction was not always performed, as intrinsic stability was often achieved through anatomical reduction and K-wire fixation, allowing satisfactory functional outcomes without additional ligament repair (19). Despite the encouraging outcomes observed in this study, there are several important limitations. The sample size is relatively small, reflecting the low incidence of these injuries. Additionally, the short follow-up period may not fully capture late complications, including progressive post-traumatic arthritis, ligamentous insufficiency, or subtle loss of carpal height. Future studies with larger cohorts and longer-term follow-up are needed to confirm our findings and refine both diagnostic and surgical strategies for PLFDs. Nevertheless, this study provides valuable insight into the management of a rare but clinically significant wrist injury, highlighting key considerations for early diagnosis, surgical planning, and postoperative care.

## Conclusion

Perilunate fracture-dislocations (PLFDs) represent the most significant high-energy injuries of the wrist in terms of both severity and frequency. The most

common pattern is a trans-scaphoid fracture associated with dorsal perilunate dislocation. Even in emergency settings, closed reduction of the lunate dislocation is mandatory and should be performed as soon as possible. Temporary immobilization can then be achieved using a cast or external fixation in cases of open injuries. The rationale for urgent reduction is twofold: to relieve pressure on the median nerve and to reduce tension on the articular capsule, thereby minimizing vascular compromise to the dislocated carpal bones. Early diagnosis and timely, appropriate treatment are essential to prevent debilitating instabilities, bone nonunion, malalignment, and post-traumatic arthritis.

**Conflict of interest:** Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

**Authors' contribution:** Conceptualization, PP, MF, AP, GR, LM, CC, and LV; methodology, PP, MF and GR; software, AP and GR; validation, PP, MF, AP, GR, LM, CC, and LV; formal analysis, GR, LM and LV; investigation, PP, MF, AP, GR, LM, and LV; data curation, PP, MF and AP; writing—original draft preparation, PP, MF, AP, GR, LM, CC, and LV; writing—review and editing, PP, MF, AP, GR, LM, CC, and LV; visualization, CC; supervision, PP and LV. All authors have read and agreed to the published version of the manuscript.

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