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Review Article

Surgical Outcomes of Perilunate Dislocations and Perilunate Fracture-dislocations: A Review of 20 Cases

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Abstract

Background: Perilunate dislocations and perilunate fracture-dislocations (PLD/PLFD) are the second most common wrist injuries.
Objectives: Given the limited available case series due to the rarity of these injuries, in this study, we report the functional outcomes of 20 patients who received surgical treatment with a mean follow-up of 28 months (range 24-36).
Methods: We retrospectively reviewed the admissions to *Imam Khomeini* Hospital Sari, Iran, and included patients with (PLD/PLFD) who underwent surgical treatment between January 2014 to December 2019. We included 20 patients (16 males, mean age±SD=33.6±12.4) who had received urgent surgical treatment following the initial closed reduction in the emergency department. All of the patients received surgical treatment from the same surgical team using the dorsal approach.
Results: We observed the average Mayo Wrist Score (MWS) of 73.8±8.4 (range 65-100) with excellent or good outcomes in 40% of patients. The MWS was slightly higher in patients with the non-dominant injured side, yet it did not significantly differ with those with dominant hand injury (75.4±9.6 vs. 71.2±5.8, P=0.29). Furthermore, we did not find a significant difference in MWS between the lesser and greater arc injuries (76.5±10.1 vs. 71.1±5.7, P=0.15). The observed flexion and extension ROM were significantly lower than the contralateral side (P<0.001). Similar patterns of lower grip and pinch strength were observed on the injured side, which were significantly lower than the contralateral hand; 38.4±8.6 (74±14% of the contralateral) and 9.9±2.4 (81±15% of the contralateral), respectively (P<0.001).
Conclusion: In line with other cohorts, the present case series demonstrates relatively good functional postoperative outcomes in PLD/PLFD. Our findings are comparable with prior reports concerning reasonably satisfactory MWS, ROM relative to the contralateral side and reported occasional mild pain with activity. Future studies should be directed to investigate long-term complications associated with these injuries, particularly the development of wrist osteoarthritis.

Keywords: Wrist injuries, Perilunate Dislocations, Perilunate Fracture-dislocations, Open reduction, Dorsal approach.

Introduction

Carpal bones are connected through several strong ligaments both on the volar and dorsal portion, on which carpal stability depends. Dislocations or fracture-dislocations of the carpal bones are uncommon injuries associated with high energy trauma and present a clinical challenge with multiple variations.[1,2] After the scaphoid fracture, perilunate dislocations (PLD) and perilunate fracture-dislocations (PLFD) are the second most common traumatic carpal injuries that comprise 7-10% of injuries to the wrist and involve progressive ligamentous injury and detachment of the bones in proximal and distal rows.[3] Some cases of PLD/PLFD are only limited to the acute ligamentous injury, but about 65% of these injuries are associated with transscaphoid perilunate dislocations, referred to as the "lesser and greater arc" injuries, respectively.[4] Alterations to the carpal joint could be difficult to notice due to the intense swelling of the wrist associated with a carpal dislocation. As observed in case series with medium to long-term follow-up, these injuries frequently occur in young adults and could be initially missed, leading to debilitating poor functional outcomes including posttraumatic arthritis and chronic carpal instability due to delayed intervention.[5-8]

The current treatment guidelines recommend early open reduction, internal fixation, and ligament repair in PLD/PLFD, and therapeutic trends have shifted from earlier approaches that advocated the closed reduction of these injuries.[1,9] Initial closed reduction and immobilization would rarely lead to definitive treatment but could relieve the pressure on the median nerve and prevent further damage to the cartilage. To ensure better anatomic alignment and clinical outcomes, open reduction using dorsal, volar, or a

combined dorsal and volar approach have been used in PLD/PLFD based on the preference and experience of the surgical team.[10] Controversy still exists over these approaches, and the optimal surgical approach remains a matter of debate. Many clinical reports recommend using the dorsal incision because it offers a more convenient view of the proximal carpal row, joints, and ligaments, particularly the scapholunate interosseous ligament (SLIL), which is a key factor determining the long-term clinical outcomes.[11,12] Moreover, using the dorsal approach would enable the surgeon to treat scaphoid and other carpal bone fractures as well. However, easier decompression of the carpal tunnel and a direct repair of the capsule and the volar lunotriquetral ligament could be achieved with the volar approach.[13] Notably, some groups have highlighted the importance of releasing the carpal tunnel, emphasizing prevention of potential postoperative swelling and median nerve injury following a high-energy trauma.[14] Nonetheless, some experts are in favour of the combined dorsal-volar approach for access to all of the injured structures and offer the advantages of both approaches mentioned earlier.[15]

Objectives

Given the limited available case series due to the rarity of these injuries, we retrospectively reviewed all patients with PLD/PLFD admitted to our centre between January 2014 to December 2019, and the current case series seeks to evaluate the postoperative outcomes of these complex carpal injuries.

Materials and Methods

We obtained the institutional review board (IRB) approval to review the medical records retrospectively, and this study was conducted in accordance with the Declaration of Helsinki. In this descriptive study utilizing the existing data, we retrospectively reviewed the entire admissions to Imam Khomeini Hospital Sari, Iran, and included all patients who underwent surgery for PLD/PLFD between January 2014 to December 2019. Incomplete medical records, past medical history of musculoskeletal diseases, structural disorder, inaccessibility due to change of address and contact number, lack of follow-up data, and patient's death were considered as exclusion criteria. Since the postoperative assessment required comparison with an uninvolved contralateral upper limb, patients with bilateral upper limbs injury were also excluded from this study, resulting in a final sample of 20 patients.

Closed reduction manoeuvres were attempted for all of the patients in the emergency department to restore carpal stability and prevent median nerve injury and cartilage damage. Except for two patients, everyone underwent emergency surgery in the first 6 hours, and the average delay to surgery for the mentioned exceptional cases was 18 hours. All of the patients received surgical treatment by the same surgical team, and for all, the dorsal approach was used. Surgical treatment involved using Kirschner wire fixation for perilunate dislocations, scapholunate and lunotriquetral fixation (2 K-wire for each) and other carpal bone fractures, and Herbert screw or kirschner wire for scaphoid fracture, as well as dorsal scapholunate ligament repair, followed by a 6-week Sugar-tong splint immobilization in all patients. The intraoperative image of the two patients is presented in Figure-1 and Figure-2. Post-operation protocol was the same for all patients consisting of 6-week sugar-tong splint immobilization and removal of k-wires after eight weeks.

Functional outcomes after treatment with a mean follow-up of 28 months (range 24-36) were assessed using the Mayo Wrist Scoring (MWS),[16] and pinch and grip strength were measured using Saehan hydraulic hand dynamometer, and a single reading was considered the maximum grip/pinch strength. Wrist range of motion, grip/pinch strength, and subjective pain intensity were compared with the unaffected contralateral side.

For the continuous variables, we used paired sample t-test to compare the injured wrist with the contralateral side and an independent sample t-test to compare functional outcomes of the dominant vs. non-dominant, greater arc vs. lesser arc injuries between individuals. For the categorical variables, Chi-square test was employed. A p-value of < 0.05 was considered statistically significant. All statistical analyses were performed using IBM SPSS Statistics (version 18.0).

Results

A total of 20 patients (16 males, mean age±SD = 33.6±12.4 years) with perilunate fracture (PLD) or perilunate fracture-dislocation (PLFD) were investigated. The dominant hand was involved in 12 patients, and the remaining eight had injury of the non-dominant hand. Table-1 presents general characteristics of the sample and postoperative outcomes. Figure-2 presents some samples of the pre and postoperative radiographs.

In the clinical examination, we observed the average Mayo Wrist Score (MWS) of 73.8±8.4 (range 65-100) with excellent or good outcomes in 40% of patients. The MWS was slightly higher in patients with the non-dominant injured hand, yet it did not significantly differ with cases who had the dominant hand injury (75.4±9.6 vs. 71.2±5.8 P-value=0.29). Furthermore, we did not find a significant difference in MWS between the lesser and greater arc injuries (76.5±10.1 vs. 71.1±5.7 P-value=0.15).

The mean wrist flexion and extension ROM of the injured wrist were 61.5±11.8 (81.4±14% of the contralateral hand) and 50.8±8.9 (79±13% of the contralateral hand), respectively. As shown in Table-2, the observed flexion and extension ROM were significantly lower compared with the contralateral unaffected side (P-value<0.001). We observed similar patterns of lower grip and pinch strength on the injured side that were significantly lower compared with the contralateral side; 38.4±8.6 (73.9±14% of the contralateral hand) and 9.9±2.4 (81.1±15% of the contralateral hand), respectively (P-value<0.001).

Regarding the reported pain with activity, we had a significantly greater proportion of patients with occasional mild pain. The pain was moderate in 2 patients, 14 cases had mild pain and four patients reported no pain in everyday activities and manual work (P-value<0.05). Overall, 16 patients returned to work at their pre-injury level of activity with no issues.

Regarding complications, we had one case of scaphoid non-union without AVN that required a second round of surgery using iliac bone grafting and Herbert screw to achieve complete union. No sign of osteoarthritis was observed in our cases that could be due to lack of a long-term follow-up. In addition, we did not have any cases of postoperative infections, carpal tunnel syndrome, and median nerve neuropathy. No patient developed complex regional pain syndrome in our series, and the radiographs were not suggestive of avascular necrosis of the scaphoid or lunate. In the radiologic assessment, we did not find evidence of dorsal intercalated segmental instability (DISI), and the scapholunate angle was in the range 30- 60 degrees in our cases.

Table-1. General characteristics of patients in this series

Variable	
Age (years)	33.6 (12.4)
Sex:	
Male	16 (80%)
Female	4 (20%)
Side of injury:	
Dominant hand	12 (60%)
Non-dominant hand	8 (40%)
Right hand	11 (45%)
Left hand	9 (55%)
Type of injury:	
Greater arc	10 (50%)
Lesser arc	10 (50%)
Mayo wrist score	73.8 (8.4)
Pain:	
No pain	4 (20%)
Mild and occasional pain	14 (70%)
Moderate to severe pain	2 (10%)
Function:	
Return to normal activity	16 (80%)
Limited activity	4 (20%)

Continuous data presented in mean (SD) and categorical data as N(%)

Table-2. Functional postoperative outcomes grip strength, pinch strength, and extension/flexion range of motion of the injured compared with the contralateral hand

	Wrist (n=20)		
	Injured	**Contralateral**	**P-value**
Grip strength (kg)	38.4 (8.6)	51.9 (9.3)	<0.001[a]
Pinch strength (kg)	9.9 (2.4)	12.2 (2.1)	<0.001[a]
ROM Extension (°)	50.8 (8.9)	64.3 (7.3)	<0.001[a]
ROM Flexion (°)	61.5 (11.8)	75.5 (5.6)	<0.001[a]

a paired t-test

Continuous data presented in mean (SD)

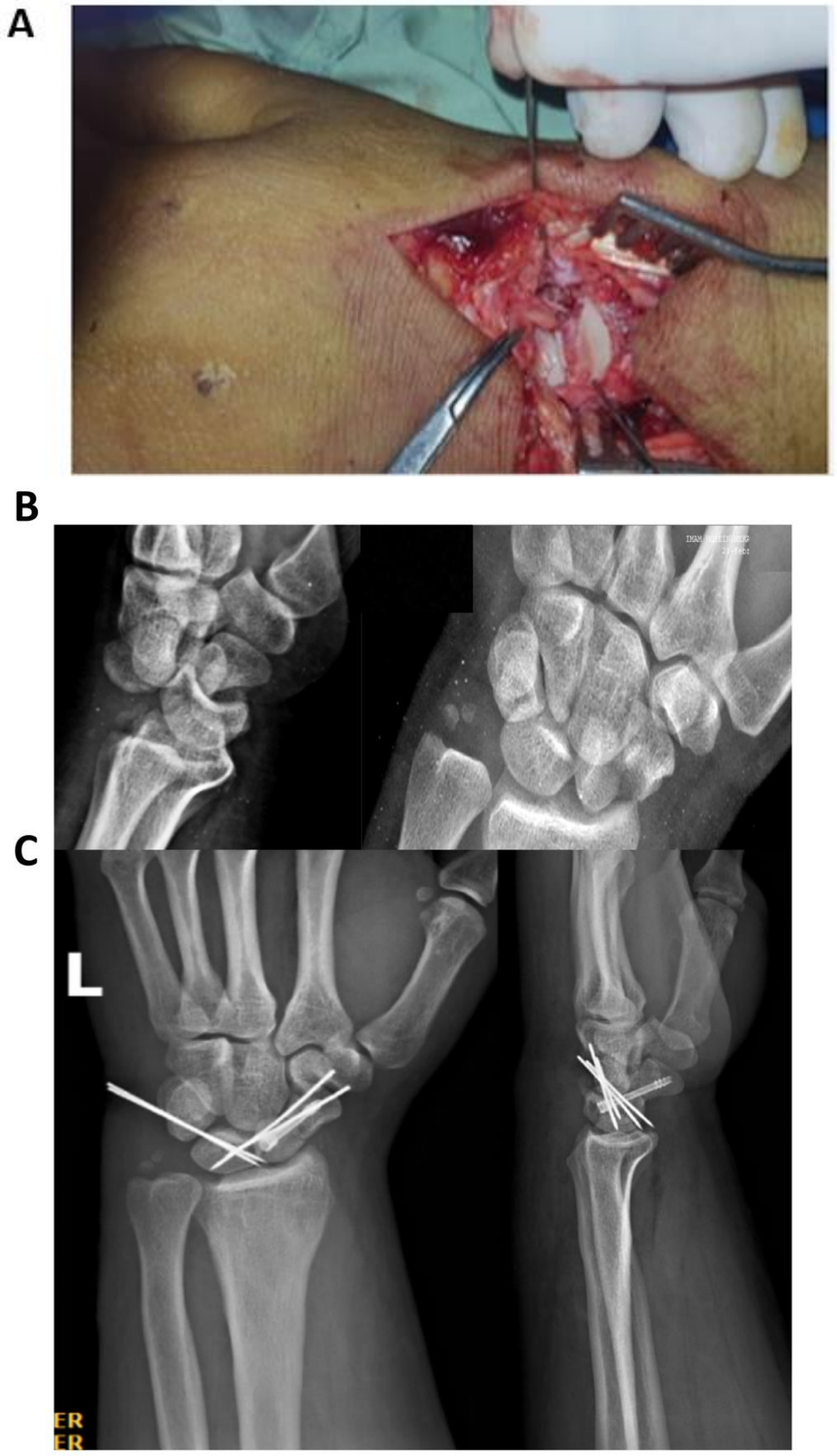

Figure-1. (A) Dorsal approach in a 31 male with transscaphoid perilunate fracture dislocations (PLFD)
(B) Preop and (C) postop radiograph of the patient treated with open reduction, scaphoidosteosynthesis with Herbert screw and k-wire fixation.

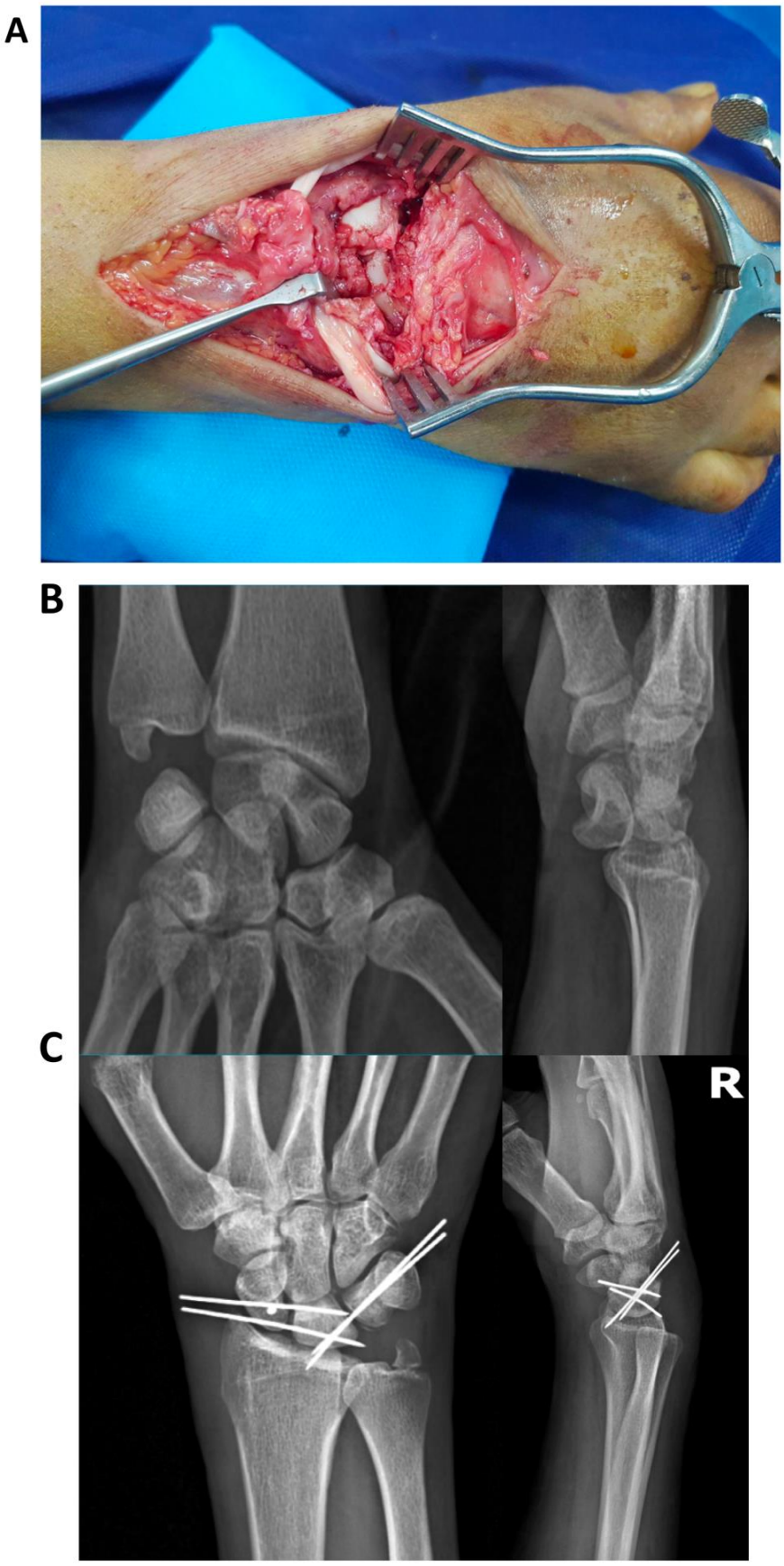

Figure-2. (A) Dorsal approach (B) preop and (C) postop radiograph in a 38 male with Perilunate dislocation (PLD)

Discussion

The current case series evaluated clinical outcomes of 20 patients with PLD/PLFD (16 males, mean age±SD=33.6±12.4 years) who underwent surgical treatment using a dorsal approach in Imam Khomeini Hospital. Consistent with prior studies, our findings on the post-operative range of motion, Mayo wrist score, grip and pinch strength relative to the contralateral side, and pain suggest relatively desirable outcomes. Nevertheless, grip/pinch strength and extension/flexion range of motion in the injured hand were significantly lower compared with the contralateral side.

The observed functional outcomes in our patients are in agreement with prior case series on PLD/PLFD. In our patients, the average Mayo wrist score was 73.8±8.4, similar to several published cohorts. Our findings are in agreement with a series by Viegas et al., who reported MWS of 71, ROM of 67%, and grip strength of 68% relative to the contralateral side.[17] Moreover, the current observations are in line with previous cohorts reported by Hilderband,[18] Herzberg,[19] Dunn,[20] and Inoue,[21] who reported MWS of 73, 76, 72.9, and 76, respectively. Recent reports have observed functionally adequate outcomes in these complex injuries, including trans-scaphoid perilunate fracture-dislocations in case of early diagnosis and surgical intervention.[22] Consistent with the largest series on PLD/PLFD, we did not find significant differences in MWS between the greater and lesser arc injuries.[19] Another study has reported comparable functional outcomes in pure perilunate dislocations without associated fractures in 32 patients who received early closed reduction and percutaneous fixation without capsular ligament repair. In that study, 88% of cases maintained their routine manual activities and had excellent or good subjective functional outcomes.[23] Furthermore, in line with other cohorts, we observed frequent complaints of persistent mild pain with activity in our patients.[20]

Hand plays an important and sophisticated role in daily life, and given the more active involvement of younger individuals in routine physical activities, PLD/PLFD could be more devastating in these individuals. Notably, some studies suggest that functional outcomes of these injuries could be less satisfactory among the patients with higher physical demands. For example, a recent series published on the long-term outcomes of the PLD/PLFD injuries among the active military service members have highlighted that injury of the dominant extremity, greater arc injury, and transscaphoid PLFD could be associated with worse outcomes in patients with higher functional demands. It is concerning that nearly half of the PLD/PLFD patients in that report failed to return to active duty at their pre-injury level in the military;[20] compared with more than 82% of the less physically active cohorts who reported going back to their work following the wrist injury.[8] In line with this study, we found numerically worse outcomes for the dominant hand and the greater arc injuries; however, it did not reach statistical significance, which could be due to low sample size and statistical power in our analyses. In addition, in that study, they had 11 patients (27.5%) with a missed diagnosis on initial presentation, and the average time to surgery was 7.4 days with 5 cases having a delay of more than two weeks that could have remarkably contributed to the overall poorer outcomes.

Strengths and limitations

A major methodological strength of the current series is that one surgeon performed all of the surgeries using the same dorsal approach that resulted in a less heterogeneous sample compared with studies that included different treatment approaches, including an open and closed reduction.[24] Critically, all of the included patients in this series underwent an emergency closed reduction in the ED and received surgical treatment with less than 6 hours delay. However, similar to the prior published case series, this study has a handful of limitations that must be considered. Due to the rarity of PLD/PLFD, most published case series are limited with the retrospective design, lack of a control group, small sample size, and low statistical power. Moreover, the heterogeneity of the patients could lead to issues with satisfactory statistical analyses, limiting the presentation of data to descriptive statistics. Finally, we did not observe the development of osteoarthritis in this cohort due to short to medium-term follow-up of patients. One of the more recently published series, Krief et al. underscored the long-term follow-up of these injuries evaluating the functional and radiologic outcomes of PLFD in 30 cases with a mean follow-up of 18 years (range 15-24 years).They reported osteoarthritis occurring in 70% of the patients. Despite the observed low functional and clinical impact of osteoarthritis in this series, the lowest Mayo wrist scores were associated with most advanced arthritis.[24] It is important for future attempts to investigate the longer-term complications, including osteoarthritis, that are expected to be significantly associated with the length of follow-up.[14]

Conclusions

In line with prior studies, the present case series demonstrates relatively good functional postoperative outcomes in PLD/PLFD. Specifically, our results are comparable with prior reports with respect to reasonably satisfactory Mayo wrist score, ROM relative to the contralateral side and reported pain with activity. Future studies are required to investigate significant complications associated with these injuries, particularly the development of wrist osteoarthritis in long-term follow-up.

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None.

Authors' Contribution

All authors pass the four criteria for authorship contribution based on the International Committee of Medical Journal Editors (ICMJE) recommendations.

Conflict of Interests

The authors declared no potential conflict of interests with respect to the research, authorship, and/or publication of this article.

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