

Perilunate Dislocations

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THE PATIENT

A 37-year-old man injured his right wrist in a motor vehicle collision. In the emergency department he had severe wrist pain and median nerve paresthesia. Wrist radiographs identified a dorsal perilunate dislocation (PLD) with the carpus dislocated dorsally and the lunate tilted volar but still located in the lunate fossa. Post-reduction computed tomography scan confirmed no fractures.

THE QUESTIONS

What is the optimal surgical approach for this patient with a purely ligamentous (i.e., “lesser arc”¹) dorsal PLD? What bones should be immobilized and what is the best method of internal fixation?

CURRENT OPINION

PLDs are high-energy carpal injuries that result in wrist stiffness and arthrosis even if good carpal alignment is restored.^{2–7} PLD merits urgent reduction when there is associated median nerve dysfunction, but otherwise treatment can be planned.^{8,9} Some surgeons believe that PLDs and perilunate fracture-dislocations (PLFDs) presenting in a delayed fashion have substantial risk of arthrosis and poorer clinical outcome.³ Manipulative reduction and fabricating an orthosis doesn’t always restore carpal alignment^{2,3,10–15} and operative treatment is usually recommended. Areas of uncertainty and debate include the timing of open reduction in the absence of median nerve dysfunction, which surgical approach to utilize (i.e. dorsal, volar, combined, or arthroscopic), which carpal intervals to stabilize, when and

how to repair ligaments, and the optimal method of internal fixation.

THE EVIDENCE

Surgical approach

In 1964, Campbell et al described 50 PLDs and PLFDs treated with closed or open reduction (29 wrists), a salvage procedure such as lunate excision or proximal row carpectomy (19 wrists), or no treatment (2 wrists).¹⁶ Of 31 attempted closed reductions only 12 could be reduced with manipulation alone under general anesthesia. Information regarding outcome was limited.

Adkison and Chapman described 55 patients with dorsal PLDs (9 wrists), volar lunate dislocations (13 wrists), and trans-scaphoid PLFDs (33 wrists) treated with a variety of methods.¹⁰ Among the purely ligamentous injuries, closed reduction and immobilization achieved and maintained reduction in only 4 of 13 attempted closed reductions (2 of 5 dorsal PLDs and 2 of 8 volar lunate dislocations). Early in the series the authors abandoned use of an isolated extended carpal tunnel approach because of suboptimal correction of carpal alignment and the observation that preoperative median nerve paresthesia resolved in 8 of 9 patients treated without carpal tunnel release. Using an isolated dorsal approach and K-wire fixation of the scapholunate (SL) interval alone without ligament repair, the authors reported maintenance of carpal alignment in 75% of cases.

Inoue and Kuwahata retrospectively reviewed 14 wrists with PLD treated with closed reduction and cast immobilization (1 wrist); open reduction and casting (1 wrist); closed reduction and percutaneous K-wire stabilization (4 wrists); or open reduction via a dorsal approach, repair of the dorsal SL ligament, and K-wire stabilization (8 wrists).¹⁴ The 2 patients treated with reduction and cast immobilization were rated as unsatisfactory. The 8 patients treated with an open reduction via a dorsal approach and repair of the SL ligament had slightly, but not significantly higher Cooney wrist scores (mean score of 84) compared with those treated percutaneously (mean score of 78). The 4 patients treated percutaneously had greater SL diastasis (mean, 3.0 mm) than patients treated with open reduction and ligament repair (mean, 1.8 mm).

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Sotereanos et al used a combined dorsal and volar approach to treat 11 patients with PLD or PLFD.⁷ An average of 30 months after surgery, 7 of 11 had satisfactory pain relief, flexion-extension arc averaged 71% of the opposite wrist, grip strength averaged 77% of the opposite wrist, and one patient developed scapholunate advanced collapse arthritis.

Melone et al followed 28 of 42 PLD/PLFDs treated with a combined dorsal and volar approach for a mean of 56 months.¹⁷ Twenty-four of 28 wrists were rated good-to-excellent on the modified Green-O'Brien system, 11% developed midcarpal arthritis, and 95% returned to preinjury activities.

Hildebrand et al described 23 PLDs and PLFDs treated through combined open dorsal and volar-ulnar (extended carpal tunnel) approaches including carpal tunnel release, proximal row fixation, and ligament repairs.⁴ At 3-year follow-up, the arc of wrist flexion and extension motion averaged 57% of the uninjured wrist and grip strength averaged 73% of the uninjured wrist. Average Mayo wrist scores were 66 (categorically rated as satisfactory function in this system). Over time, the SL angle increased and the revised carpal height ratio decreased significantly. Four patients had salvage procedures, and half the remaining patients had carpal collapse and degenerative radiographic changes.

Intercarpal fixation and ligament repair

Kremer et al described 16 PLD and 23 PLFD injuries.⁶ They started with a dorsal exposure alone (13 wrists), adding a volar approach when anatomic reduction was not possible or when median nerve symptoms were present (23 wrists). Three patients were treated with an isolated volar exposure—a strategy that was abandoned early in the study period. Patients treated with a combined approach had significantly lower Mayo wrist scores (mean, 64 vs 79) and Krimmer scores (mean, 61 vs 83; a German wrist score similar to the Mayo score), as well as greater upper-extremity specific disability as assessed by Disabilities of the Arm, Shoulder, and Hand (DASH) scores (mean, 33 vs 11) compared with those treated with an isolated dorsal or volar approach.

Palmer et al described 10 patients with PLD undergoing open reduction, comparing those treated with open reduction via combined volar and dorsal approaches and K-wire fixation of the SL interval without ligament repair or reconstruction (6 wrists) with those with acute SL ligament reconstruction (4 wrists) via a technique modified from Taleisnik using flexor carpi radialis tendon graft passed through bone tunnels in the scaphoid and lunate.¹⁸ They found no

difference in range of motion, grip strength, or patient satisfaction between groups, but those undergoing ligament reconstruction had more consistent maintenance of SL angle and SL diastasis (although statistical comparison was not performed).

Minami and Kaneda reported a series of 32 patients with PLDs and lunate dislocations that were treated with or without SL repair/reconstruction.¹⁹ Repair of the SL complex was performed when possible with nonabsorbable sutures through 3 drill holes in the scaphoid and reconstruction was performed with extensor carpi radialis longus tendon graft passed through drill holes in the scaphoid and lunate, in both cases stabilized with 3 K-wires. The 12 patients undergoing SL ligament repair/reconstruction had higher average modified Green-O'Brien scores (82 vs 59) compared with the 20 cases treated without repair/reconstruction. Furthermore, the authors reported no increased SL diastasis and an average SL angle of 50° in patients undergoing repair/reconstruction versus 4 of 20 patients with an increased SL diastasis and an average SL angle of 71° in patients without repair/reconstruction (no statistical analysis was performed on radiographic results).

Among 13 PLDs/PLFDs treated with closed or open reduction, Minami et al did not stabilize or repair the disrupted LT interval in any wrist and they stabilized the SL interval but did not repair the SL ligament in 4 of 7 open reductions.²⁰ Two years after surgery those with residual LT incongruity (N = 2) did as well as patients with anatomic carpal relationships, and patients with an SL gap greater than 3 mm (N = 3) had significantly greater pain, worse range of motion, and weaker grip.

Forli et al reported the results of 18 PLD/PLFDs in which the LT interval was stabilized with temporary K-wires in 7 of the 11 PLDs without repair of the LT ligament and found no cases of LT dissociation or gap, nor any cases of volar intercalated segment instability (VISI).¹² Thirteen years after surgery, 12 of 18 wrists had arthrosis and 10 of 18 were graded as fair or poor on the Mayo wrist score.

Knoll et al described 25 patients with transscaphoid PLFDs treated with screw fixation of the scaphoid, repair of the LT ligament with a small bone anchor, and temporary K-wire stabilization of the LT interval.²¹ At more than 3-year follow-up (average, 44 months; range, 25–79 months) there was no LT diastasis and no VISI deformity, with 92% of patients returning to their pre-injury occupation.

Trumble and Verheyden²² described cerclage wire fixation of the SL interval in 22 dorsal perilunate and lunate dislocations utilizing a combined dorsal/volar

approach, stabilization of the LT interval with 2 K-wires, and suture anchor repair of SL and LT ligaments with selective volar capsular ligament repair. An average of 4 years after surgery in 15 of the 22 patients, the flexion-extension arc averaged 80% and grip strength 77% of the contralateral extremity. SL angles and gaps were maintained. The cerclage wire was removed in 73% of patients for pain or after breaking.

Arthroscopic treatment

Souer et al described retrospective cohorts of 18 patients with PLDs/PLFDs treated with a dorsal approach, SL and LT ligament repair, and temporary stabilization of the SL and LT intervals with either a 3.0-mm cannulated screw (9 wrists; no midcarpal immobilization) or 0.062-inch K-wires (9 wrists; all with midcarpal immobilization as well).²³ K-wires and screws were removed an average of 3 months and 5 months after surgery, respectively. An average of 44 months postoperatively the mean final flexion-extension arc was 71% of the contralateral wrist in those with screw fixation compared with 55% in those with K-wire fixation, grip strength was 76% versus 67%, Mayo score 71 versus 66, and DASH score 31 versus 11, but none of these differences were statistically significant with the numbers available. One of patient in the K-wire group presented a septic wrist. Three of 8 patients in the screw cohort and 6 of 8 patients in the K-wire cohort developed advanced midcarpal arthritis within 4 years of follow-up. Two patients (1 in each cohort) were treated with wrist arthrodesis.

Park and Ahn described 3 PLDs/PLFDs treated with arthroscopic-assisted reduction and K-wire fixation without direct ligament repair.²⁴ Patients were immobilized in a short-arm cast for 12 weeks, after which time K-wires were removed. Wrist motion averaged 85% of the contralateral wrist an average of 2 years after surgery. There was no radiographic evidence of carpal instability or arthritis at this relatively short-term follow-up.

Kim et al²⁵ treated 20 PLDs/PLFDs with arthroscopic reduction and percutaneous K-wire fixation. The wires were removed 10 weeks after surgery. An average of 2.5 years later, patients had an average 79% flexion-extension arc and 78% grip compared with the contralateral wrist. The mean DASH and Patient-Rated Wrist Evaluation scores were 18 and 30, respectively, and according to modified Mayo wrist scores (mean, 79) the overall functional outcomes were rated as excellent in 3 patients, good in 8, fair in 7, and poor in 2. Radiographic reduction was maintained in 75% of cases, although the mean SL

gap and SL angles both increased significantly on average from the initial postoperative radiograph to the final postoperative radiograph. At latest follow-up there were no instances of arthritis, although 1 patient with a transscaphoid perilunate fracture dislocation was treated with a 4-corner fusion and scaphoid excision for a scaphoid nonunion.

SHORTCOMINGS OF THE EVIDENCE

The data on PLD is limited to small retrospective case series with varying injury types and operative techniques. Very few series compare two techniques used in similar patients, and there are no prospective studies. There is likely selection bias, with patients treated with more surgery (eg, combined volar and dorsal exposure) having more severe or complex injuries. The radiographic, motion, and return to activity outcomes of various series are surprisingly different between studies and it's not clear why. Some studies seem to emphasize what went well, whereas others emphasize the shortcomings.

DIRECTIONS FOR FUTURE RESEARCH

A method to reliably and accurately diagnose chondral injury (reported in 29% to 35% of PLD^{4,26}) might help explain the variable outcomes observed.^{17,26,27} Large prospective randomized studies could help determine the advantages and disadvantages of specific techniques. Alternatively, large multicenter prospective cohorts or studies based on large retrospective databases might provide useful information. Specifically, we are interested in the influence of the following factors: (1) initial time to reduction; (2) use of capsulodesis techniques to supplement intercarpal ligament repair; (3) repair/stabilization of the lunotriquetral (LT) interval versus no treatment of that articulation; and (4) intercarpal fixation techniques. Studies of long-term motion, symptoms, disability, and radiographic findings would be useful for counseling patients regarding expected outcomes.

OUR CURRENT CONCEPTS FOR THIS PATIENT

For this patient, we prefer an extensile dorsal approach to allow visualization of the radiocarpal and midcarpal joints, precise anatomic reduction of the carpus, and direct repair of the dorsal part of the SL and LT interosseous ligaments.^{8,28} We prefer to perform a ligament sparing capsulotomy²⁹ as it can be readily converted to a dorsal intercarpal ligament capsulodesis to augment the SL repair, but we utilize pre-existing capsular flaps based on the traumatic dorsal capsulotomy⁶ in the acute setting when a ligament sparing capsulotomy is

not possible. When avulsion of the dorsal radiotriquetral complex is repairable, we repair it to the dorsal rim of the distal radius with suture anchors following intercarpal reduction and stabilization. We perform a dorsal capsulodesis when we think that the quality of the ruptured SL ligament is suboptimal for isolated primary repair. Although the effect of capsulodesis on outcome has not been discretely studied in the setting of PLD injuries, we assume it augments SL integrity based on the published experience in SL reconstructions for isolated SL instability.

We find it difficult to obtain anatomic intercarpal reduction without an open approach. We prefer open repair of the intercarpal ligaments, and we consider arthroscopic-assisted treatment experimental. In patients with median nerve dysfunction that persists after closed reduction, we perform a standard open (not extensile) carpal tunnel release. We use an extended volar exposure when the lunate is dislocated palmarward²⁹ and we repair the volar capsular rent. There is not good clinical evidence supporting an isolated volar approach to open reductions of PLDs, despite mention in many review articles.

We prefer buried K-wire fixation (removed at approximately 8 to 10 weeks) of the SL and LT intervals with direct dorsal ligament repairs using suture anchors as restoration of SL integrity has been shown to be a key determinant in outcome.^{4,6,18–20} We sometimes use supplemental scaphocapitate K-wire fixation based on the theory that it will neutralize the tendency of the scaphoid to volar flex following SL repair.

Although there is wide variation in reported outcomes for PLDs, in our experience long-term prognosis is guarded. Wrist motion is impaired and midcarpal arthrosis is commonplace.

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