Perilunate Injuries: In Brief

Perilunate injuries result from high-energy trauma to the carpus. Early diagnosis and treatment is essential to optimizing outcome. Initial management should consist of closed reduction of any carpal malalignment. Subsequent open reduction with percutaneous pinning or internal screw fixation and soft tissue repair is required to maintain carpal congruency. Despite early recognition and appropriate treatment, outcomes after perilunate injuries are often poor. Loss of grip strength and range of motion as well as post-traumatic arthritis are common sequelae.

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Expert Commentary
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Perilunate injuries are uncommon. They are often missed acutely in the emergency room setting and may not present to the hand specialist until several days later[1]. Early anatomic reduction of any carpal malalignment is of the utmost importance. Unfortunately, even with optimal treatment, outcomes after perilunate injuries are frequently poor. Generalized wrist stiffness, diminished grip strength, and post-traumatic arthritis commonly develop[2]. In the following article, the basic anatomy, history and physical exam findings as well as diagnostic work up for perilunate injuries will be discussed. Treatment options and outcomes will also be reviewed.

Anatomy and Carpal Kinematics

The carpus consists of eight bones arranged in two rows of four. These bones are stabilized by numerous ligaments, which can be divided into intrinsic and extrinsic ligaments[3]. Intrinsic ligaments run between two carpal bones within the same row. Extrinsic ligaments run between carpal bones of different rows and anchor the carpus to the distal radius, ulna, and metacarpals. In the proximal carpal row, the two most important intrinsic ligaments are the scapholunate and lunotriquetral. While these ligaments stabilize their respective bony structures, they also allow slight rotational motion between them.

The most important extrinsic ligaments of the proximal row are located volarly and include the radio-scaphoid-capitate, long radiolunate, and short radiolunate (Figure 1). While these ligaments stabilize the radiocarpal joint radially, the ulnocarpal ligaments (including the ulnolunate, ulnotriquetral, and ulnocapitate) provide support ulnarly. Of note, a weak spot or anatomic defect in the volar ligamentous structures known as the Space of Poirier lies at the volar aspect of the proximal capitate and can be torn in perilunate dislocations.

The most important dorsal ligaments are the dorsal transverse intercarpal, which runs from the scaphoid to the triquetrum, and the dorsal radiocarpal ligament, which connects the radius to the triquetrum. These two ligaments form a "V" with the apex of the "V" directed ulnarly (Figure 2).

History and Physical Examination

Perilunate injuries typically occur secondary to a high-energy trauma to the carpus, such as that seen during a motor vehicle collision or fall from a significant height onto an outstretched hand. Patients often present to the emergency room with a chief complaint of vague wrist pain and loss of motion. Snuffbox tenderness may be present if there is an associated scaphoid fracture. They may also complain of paresthesias, typically in the median nerve distribution.

In perilunate dislocations, the carpus is usually dorsally displaced while the lunate remains in its normal position. Careful examination may reveal a prominent capitate behind the lunate. The patient may also be holding his or her fingers in slight flexion. In a pure lunate dislocation, which most commonly occurs volarly, the patient may present with signs of an acute carpal tunnel syndrome. Recall from anatomy that the lunate forms the floor of the carpal tunnel. In addition to gradually worsening median nerve paresthesias, they may also develop progressive weakness in the intrinsic thenar muscles. Acute carpal tunnel syndrome requires prompt surgical decompression.

Radiographic Evaluation

Standard radiographic evaluation includes a PA (or AP), lateral, and oblique view of the wrist (Figure 3). A scaphoid view (i.e. PA view with the wrist in ulnar deviation) may also be helpful

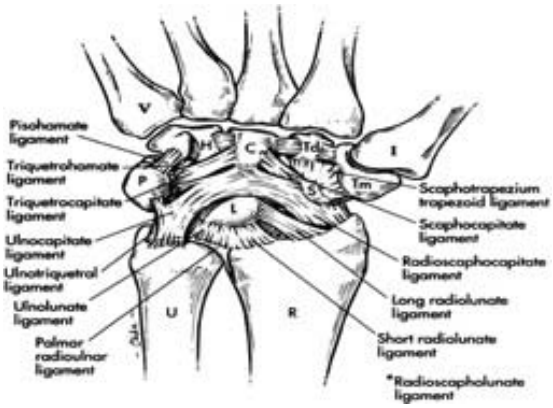

Figure 1. Volar extrinsic ligaments of the wrist. C, capitate; H, hamate; L, lunate; P, pisiform; R, radius; S, distal pole scaphoid; Td, trapezoid; Tm, trapezium; U, ulna; I, first metacarpal; V, fifth metacarpal. (From Berger[3] with permission from Elsevier.)

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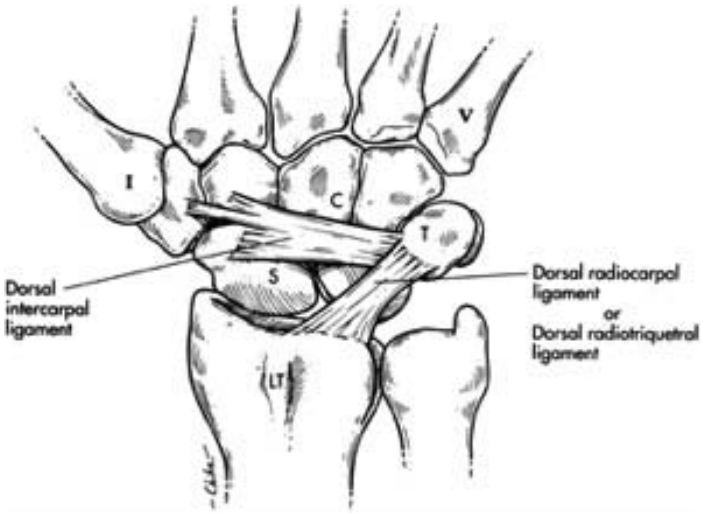

Figure 2. Dorsal extrinsic ligaments of the wrist. LT, Lister's Tubercle; C, capitate; S, scaphoid; I, first metacarpal; V, fifth metacarpal. (From Berger[3] with permission from Elsevier.).

for detecting a scaphoid fracture. The PA view is particularly helpful in that it enables one to assess Gilula's lines, which are imaginary lines drawn across the proximal and distal aspects of the proximal carpal row and the proximal aspect of the distal carpal row. These lines should appear as three smooth arcs running nearly parallel to each other[4]. Any disruption in these lines suggests carpal malalignent. One might also note a triangular-shaped lunate on the PA view, which is a sign of lunate dislocation[5]. Lastly, the PA view may help differentiate between a greater arc injury, in which fracture of the carpus occurs, and a lesser arc injury, which is purely ligamentous.

While the PA view is certainly useful, the lateral view is the most important in diagnosing a perilunate injury. The lateral allows one to assess the colinearity of radius, lunate, and capitate, which is a key relationship to appreciate. Any disruption in this colinearity is strongly suggestive of perilunate dislocation. Lastly, a CT scan after closed reduction of a lunate or perilunate dislocation may be helpful in diagnosing associated bony injury to the carpus such as scaphoid or triquetral fracture. Knowledge of these associated fractures is particularly helpful in terms of pre-operative planning.

Classification

Mayfield described four stages of perilunate instability proceeding from a radial to ulnar direction around the lunate[6,7]. Of note, there is also a very rare injury pattern known as a reverse perilunate in which instability proceeds from ulnar to radial. Mayfield based his four stages on 32 cadaveric wrists that he loaded to failure via a hyperextension and ulnar deviation mechanism. Stage I involves disruption of the scapholunate joint, while Stage II involves both the scapholunate and capitolunate. In Stage III, the scapholunate, capitolunate, and lunotriquetral ligaments are disrupted and the result is a perilunate dislocation, usually dorsal. Finally in Stage IV, all the ligaments surrounding the lunate are disrupted and the lunate dislocates volarly.

Treatment

Closed Reduction

Initial management of perilunate injuries consists of immediate closed reduction of any carpal malaligment[8]. Conscious sedation may be required, as these reductions can be particularly difficult depending on how long ago the injury occurred. For a dorsal perilunate dislocation, gentle traction followed by volar flexion of the wrist with volar pressure on the lunate and dorsal pressure on the capitates is required. Closed reduction should be confirmed with PA and lateral views of the wrist. If closed reduction is unsuccessful, open reduction is advised. Restoration of anatomic carpal alignment is necessary to optimize outcome.

A B

Figure 3. PA (A) and lateral (B) radiograph of the wrist demonstrating a dorsal transcaphoid perilunate dislocation.

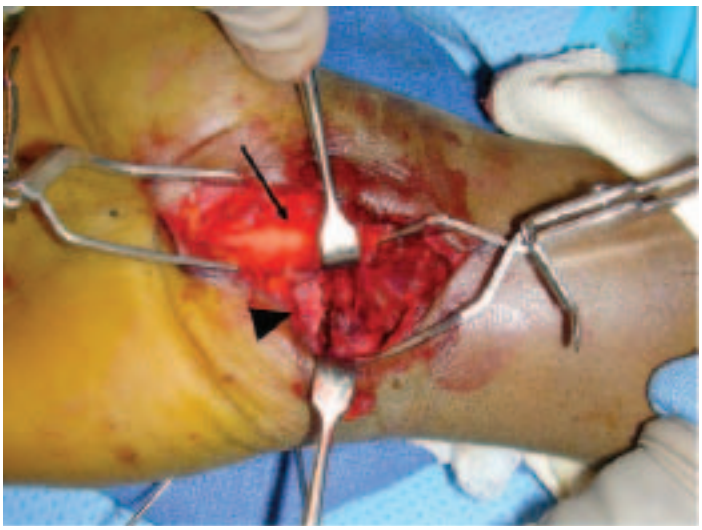

Figure 4. Volar approach to a perilunate dislocation using an extended carpal tunnel incision. Arrow is pointing to the flexor tendons and median nerve being retracted radially. Arrowhead demonstrates a rent in the volar capsule.

Open Reduction

If successful closed reduction is achieved, the patient can be immobilized temporarily in a plaster splint. However, open reduction and either pinning or internal fixation will ultimately be required to maintain this alignment. The exact timing of open reduction and fixation is controversial, but most authors would argue that earlier is better[9]. Dorsal, volar, and combined approaches have been described with many surgeons favoring the latter[2,9].

In most cases the dorsal approach is selected first. A longitudinal incision is made over the dorsum of the wrist. Dissection occurs between the third and fourth dorsal compartments. After the capsule is exposed, reduction of the lunate to the capitate is confirmed. If any fractures are present in the carpus (e.g. scaphoid), they are internally fixed at this time. The scapholunate articulation is then addressed. If the scapholunate ligament is disrupted, the joint should be reduced and pinned. Repair or reconstruction of the scapholunate ligament is then performed. Finally, the lunotriquetral articulation is reduced and stabilized with pins. As an alternate to percutaneous pinning, intercarpal screw fixation can be used. A recent study by Souer et al showed no substantial difference in outcome between the two methods of fixation[10].

The volar approach, if selected, is typically done second. It is performed via an extended carpal tunnel incision (Figure 4). It allows decompression of the carpal tunnel, and enables one to repair volar capsular ligaments, which increases overall carpal stability. Currently, many surgeons favor a combined dorsal-volar approach, as several recent studies support its efficacy[2,9]. Post operatively, patients are placed in a long arm thumb-spica cast for 4 weeks, followed by a short arm cast for 4 to 8 weeks (Figure 5). If present, pins are removed at 10 to 12 weeks.

Outcomes

In general, outcomes after either perilunate or lunate dislocation are fair to good at best but can be optimized with prompt, appropriate treatment. Closed reduction and casting as definitive treatment has been abandoned due to frequent loss of reduction and poor outcomes overall[11]. Early open reduction (i.e. less than 3 days) has been shown to be especially beneficial[1,2]. However, even those treated early and with a

A B

Figure 5. PA (A) and lateral (B) radiograph status post open reduction internal fixation of a transcaphoid perilunate dislocation.

combined approach can expect a loss of grip strength and range of motion of approximately 70% compared to the contralateral side[2, 9]. Over half of these patients will develop radiographic signs of osteoarthritis and some will require additional salvage procedures[9].

Summary

Perilunate injuries are devastating injuries to the carpus. They should be treated early with closed reduction followed by open reduction and percutaneous pinning and/or internal fixation. Either a dorsal or combined dorsal-volar approach is acceptable. A carpal tunnel release may be necessary at the time of open reduction if the patient complains of persistent or progressive median nerve symptoms. It is important to discuss the severity of a perilunate injury with patients at the onset of their treatment. They should be aware of the likelihood of loss of wrist motion, grip strength, and development of post-traumatic arthritis despite receiving the best possible care for their injury.

Ask the Expert

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How do I manage perilunate dislocations acutely?

If a patient with an acute perilunate dislocation has successful closed reduction in the emergency department, has no signs of an acute carpal tunnel or forearm compartment syndrome, and can be relied upon to contact us if his or her fingers become increasingly numb, then the patient can be splinted and sent home. The patient is instructed to return to clinic in 2-3 days and surgery is scheduled shortly thereafter.

How do I approach them surgically?

If the patient has no signs of an acute carpal tunnel syndrome, a dorsal approach alone is sufficient. I reattach the dorsal parts of the scapholunate and lunotriquetral ligaments to the lunate using suture anchors. I fix the scaphoid and the triquetrum to the lunate using 3.0-millimeters cannulated screws that I plan to remove 3 months later. If an acute carpal tunnel syndrome is suspected, an extended carpal tunnel release is performed after the dorsal approach is complete. Any rents in the volar capsule, including the space of Poirier, can be repaired at this time.

Lastly, the carpus is inspected for ulnar translocation, which indicates injury to the radiocarpal ligaments. If there is indeed an injury, the ligaments are repaired via the extended carpal tunnel incision and the radiocarpal joint temporarily cross pinned with Kirschner wires.

What is puzzling about these injuries is why we need to open them at all. If the carpal bones are properly aligned, the ligaments should heal without us needing to suture them. However, in practice it can be difficult to get the carpus aligned with closed means. Therefore, I consider percutaneous and arthroscopic-assisted techniques to be experimental. Many surgeons I have met around the world do not routinely stabilize the lunotriquetral interval, another idea which may have some merit, but remains experimental.

What is my post-operative management for a perilunate dislocation?

Post-operatively, patients are placed in a thumb spica splint for 2 weeks. The intercarpal screws are removed after 3 months. Active and passive wrist range of motion begins once the sutures are removed, which typically occurs at 2 weeks. Patients are informed from the beginning that their injury is a wrist changing event with the potential for considerable loss of function; however, they are also encouraged that commitment to post-operative therapy will help them achieve the best possible result.

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