Delayed Avascular Necrosis and Fragmentation of the Lunate Following Perilunate Dislocation

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abstract

Perilunate and perilunate fracture dislocations are high-energy injuries with the wrist loaded in extension, ulnar deviation, and intercarpal supination. The force vector travels from a radial to a ulnar direction and can result in complex carpal instability. The diagnosis is often delayed, which can result in suboptimal outcomes. Nonoperative management can produce inferior results, with patients experiencing pain and weakness. Therefore, early treatment with open reduction and internal fixation is recommended to assess the osteochondral and ligamentous disruption and to achieve anatomic reduction of the carpus. Despite this, these patients can develop radiographic degenerative joint disease, which can be seen in up to 90% of cases. This can be due to difficulty in holding and maintaining carpal reduction. Increased radiodensity of the lunate following these injuries has been observed but is believed to be a transient phenomenon without risk of progression to avascular necrosis. This may be due to the blood supply of the lunate, which has varied patterns of intraosseous and extraosseous vascularity. The authors report a patient who developed avascular necrosis and delayed lunate fragmentation following a Mayfield Type IV perilunate dislocation. This finding highlights the importance of long-term follow-up with these patients. [Orthopedics. 2015; 38(6):e539-e542.]
Perilunate dislocations are the result of high-energy injuries secondary to forceful wrist extension, ulnar deviation, and intercarpal supination. The injury pattern has previously been well-described and is categorized into 4 stages, with increasing disruption with each successive stage, beginning in a radial to ulnar direction. In stage I, the scapholunate ligament becomes disrupted, leading to scaphoid flexion. In stage II, the capitoluminate joint is disrupted. Stage III is defined by lunotriquetral ligament disruption. Stage IV is defined by dislocation of the lunate, typically in a palmar direction. For this to occur, Mayfield et al proposed that the dorsal radiocarpal ligament, which stabilizes the lunate to the radial fossa, becomes disrupted and allows the lunate to rotate volarly. During this process, it has been noted that a transient increase in radiodensity of the lunate may occur.

White and Omer reported a 12.5% incidence of increased lunate radiodensity following a perilunate dislocation and theorized that this was due to transient avascularity. As the lunate was rotated palmarly, the dorsal blood supply was disrupted, along with the dorsal capsular structures. With further displacement, the volar vessels were impinged upon, temporarily causing the lunate to become avascular. Gellman et al noted that anatomic reduction of the lunate restored the volar vascularity, relieving the ischemic event. Despite the risk for damage to the vascular supply of the lunate during a perilunate dislocation, these injuries are not believed to be risk factors for avascular necrosis (AVN) or delayed fragmentation of the lunate. The authors report a patient who developed AVN and a delayed lunate fragmentation 14 months after open reduction and repair of a Mayfield Type IV perilunate dislocation.

**Case Report**

A 30-year-old, right-hand–dominant man sustained a left Mayfield Type IV perilunate dislocation during a motor-cycle accident. Following closed reduction, radiographs and computed tomography demonstrated satisfactory reduction of the perilunate dislocation without evidence of lunate AVN, collapse, or fracture (Figures 1-3).

The patient underwent a combined dorsal and volar approach to anatomically repair the dorsal scapholunate and volar lunotriquetral ligaments. Care was taken to ensure the blood supply to the carpus was not injured during the surgical approach. The carpus was stabilized by scapholunate, scaphocapitate, and lunotriquetral Kirschner wires for 8 weeks.

The patient had an uneventful postoperative recovery, with removal of the buried Kirschner wires at 8 weeks postoperatively. Following a course of structured hand therapy, he returned to his previous occupation as a mechanic, without pain, 2 months after wire removal.

The patient returned to the clinic 14 months postoperatively for a routine follow-up appointment. He was asymptomatic and functioning without complications. Radiographic evaluation of the wrist demonstrated evidence of AVN and coronal fragmentation through the lunate, which was confirmed with computed tomography (Figure 4). Measurement of the modified carpal height ratio demonstrated no evi-
dence of carpal collapse. After discussion with the patient, given that he was currently asymptomatic, he elected continued observation of the lunate fragmentation. He was last seen 23 months after his injury and was progressing well without any pain. His radiographs demonstrated lunocapitate arthritis but because he was asymptomatic, the patient elected continued observation (Figure 5).

**DISCUSSION**

There are several described complications following a perilunate injury, including posttraumatic arthrosis, complex regional pain syndrome, decreased grip strength, median neuropathy, and wrist stiffness. Transient radiodensity of the lunate has also been observed but is described as a benign and self-limited process. This increased radiodensity is thought to occur from transient ischemia and is not thought to be a risk factor for the development of AVN. This conclusion is supported by a study by Gellman et al in which they noted AVN-type changes of the lunate intraoperatively during a delayed open reduction 3 months following a perilunate injury. These changes appeared to be resolving radiographically by 9 months postoperatively and were resolved at the last follow-up examination 4 years later.

Lunate vascularity was well-described by Gelberman et al in a cadaveric series. In this series, the authors described consistent dual dorsal and volar extraosseous vascularity. Intraosseous vascularity was more variable, with 60% of specimens demonstrating a “Y” pattern, with the stem of the “Y” entering either dorsally or volarly. In 30% of specimens, the intraosseous vascularity consisted of an “X” pattern, and in 10% a single intraosseous vessel, or “I” pattern, was described. This single vessel may be an additional risk.
factor for the development of AVN and lunate fragmentation following a perilunate injury.

To the current authors’ knowledge, this case report of AVN of the lunate with an associated delayed fragmentation following a Mayfield Type IV perilunate dislocation is the first case published in the English literature. A potential cause for this devastating complication may be the disruption of the blood supply at the time of injury or during the surgical repair. It is the authors’ standard practice to address perilunate instability with a dorsal and volar approach to repair the dorsal scapholunate and volar lunotriquetral ligaments, respectively.

The authors postulate that the vascular insufficiency seen in this case is from the injury pattern rather than occurring during the surgical approach because the disruption to the space of Poirier and access to the lunotriquetral is readily apparent after these injuries and minimal dissection is needed for repair. The authors believe this finding is an important potential complication following a perilunate dislocation and highlights the importance of long-term follow-up of these patients.

References