Unusual Case of Isolated Lunate Fracture Without Ligamentous Injury

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abstract

Fractures of the lunate are rare injuries that usually result from high-energy trauma and are typically associated with other carpal and ligamentous injuries. The incidence of lunate fractures has been cited as 0.5% to 6.5% of all carpal fractures. These fractures are not frequently reported in the literature, and no consensus exists on the treatment of these injuries in the acute and chronic setting. The mechanism typically producing this fracture is a loading force applied to a dorsiflexed, ulnarly deviated wrist such that the capitate is driven downward into the lunate.

No prior reports exist in the literature of an isolated fracture of the lunate without perilunate dislocation or ligament disruption. This article reports a case of an isolated displaced transverse shear fracture of the lunate seen 3 months after initial injury, which was successfully treated using a volar and dorsal combined approach and open reduction and internal fixation using microscrews. Bony union across the fracture site was obtained by 7-week follow-up and continued to show improved consolidation through 10-month follow-up. The patient had decreased pain, normal range of motion, and no radiographic evidence of lunate osteonecrosis on most recent follow-up despite the delayed presentation and degree of fracture displacement. This case demonstrates a previously unreported type of wrist injury.

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Figure 1: Preoperative lateral radiograph demonstrating a nonhealed transverse shear fracture of the lunate with the dorsal fragment impinging against the dorsal distal radius and an increased scapholunate distance. Figure 2: Postoperative lateral radiograph at 10-month follow-up showing continued lunate reduction, normal distance between the scaphoid and lunate bone, and good bony fusion across the fracture site.
Lunate fractures are rare injuries that usually result from high-energy trauma in younger patients and are typically seen in association with other carpal injuries. The incidence of lunate fractures has been cited as 0.5% to 6.5% of all carpal fractures. The mechanism typically producing this injury is a loading force applied to a dorsiflexed, ulnarily deviated wrist such that the capitate is driven downward into the lunate.

No prior reports exist in the literature of an isolated transverse fracture of the lunate without perilunate dislocation or ligament disruption, in either the acute or chronic setting. This article reports a case of an isolated displaced transverse shear fracture of the lunate seen 3 months after initial injury, which was successfully treated using a volar and dorsal combined approach and open reduction and internal fixation using microscrews. Informed written consent was obtained from the patient for publication of this case report.

CASE REPORT
A 20-year-old Caucasian right-hand-dominant male laborer presented to an outside emergency department after falling onto his right wrist. The patient stated that he forcefully hyperflexed his wrist and landed on the dorsal aspect of his hand at the time of impact. The patient had moderate pain and swelling on initial examination, and initial radiographs showed no evidence of fracture or dislocation. He was diagnosed as having a wrist sprain and placed in a cock-up splint for immobilization.

No further medical evaluation was sought for 3 months until the patient presented to our clinic with symptoms of difficulty with passive wrist extension and mild pain at extremes of flexion and extension. The patient’s medical history was positive for osteogenesis imperfecta diagnosed at birth, with 6 related incidences of a fractured femur requiring multiple surgeries and no other fractures reported.

On examination, he had no swelling and no pain with range of motion (ROM) of bilateral shoulder or elbows. Contralateral left wrist flexion was 85° and extension 80°, while right wrist flexion was 70° and extension 35° with associated discomfort over the dorsal aspect of the wrist. The patient could make a full fist with a tip-to-palm distance of 0 cm. There was no point tenderness throughout the wrist and no pain to palpation over the anatomic snuffbox, capitate, or lunate.

Three-view plain radiographs of the right wrist and bilateral grip views showed equal scapholunate intervals bilaterally along with a nonhealed transverse shear fracture of the lunate on the lateral and oblique views (Figure 1). The dorsal lunate fragment was noted to be completely displaced and dorsally rotated, impinging against the dorsal distal radius. The patient was made nonweight bearing to the right wrist and was immobilized in a wrist brace. Computed tomography (CT) of the wrist showed a transverse, comminuted fracture of the lunate with patchy osteopenia and no significant sclerosis or traversing trabeculae (Figure 2). Magnetic resonance imaging (MRI) confirmed the CT findings of a transverse lunate fracture with extensive associated bone marrow edema and edema in the scaphoid, capitate, hamate, and triquetrum (Figure 3). Magnetic resonance imaging also showed mild volar scapholunate diastasis and subtle evidence of a possible partial scapholunate ligament tear. The patient was diagnosed with a right lunate fracture.

Figure 1: Preoperative anteroposterior (A), oblique (B), and lateral (C) radiographs demonstrating a nonhealed transverse shear fracture of the lunate with the dorsal fragment impinging against the dorsal distal radius and an increased scapholunate distance.

Figure 2: Preoperative coronal (A) and sagittal (B) CT scans of the wrist showing a transverse, comminuted fracture of the lunate with no significant sclerosis or traversing trabeculae. Figure 3: Preoperative coronal (A) and sagittal (B) fat-suppressed T2-weighted MRIs showing a transverse lunate fracture with extensive associated bone marrow edema and edema in the scaphoid, capitate, hamate, and triquetrum.
nonunion with possible scapholunate ligament injury and was scheduled for open reduction and internal fixation of the lunate with possible distal radius bone graft and scapholunate ligament repair.

In the operating room, the wrist was placed into traction and flexion, and it was not possible to reduce the fracture fragments using these measures. A longitudinal incision was made dorsally in line with the middle ray, and the extensor retinaculum was exposed and opened in a diagonal fashion to allow for repair. The extensors were retracted and the capsule was incised in an inverted-T fashion exposing the lunate. The dorsal and volar halves of the lunate were directly visualized and the transverse fracture pattern confirmed. In addition, the scapholunate and lunotriquetral ligaments were directly visualized and found to be intact with no evidence of tears. After mobilizing the fracture fragments with a freer, the fracture site was debrided and noted to have healthy cancellous bone with no sclerosis. The dorsal fragment could not be manually reduced with appropriate alignment, and therefore a volar extended carpal tunnel approach was used.

The transverse carpal ligament was incised longitudinally and completely released to the level of the lunate. A large pointed reduction forceps was used to reduce and compress the 2 lunate fragments. With the clamp in place, a 0.035 guide wire was placed dorsal to volar across the lunate and then overdrilled with an Acutrak microdrill (Acumed, Hillsboro, Oregon). A 16-mm Acutrak microscrew was placed until the head of the screw was beneath the cartilage, and this process was repeated once more using a 14-mm screw. The lunate moved as a unit with postflexion and extension with continued reduction of the lunate and a concentric joint line between the lunate and radius. The patient was continued nonweight bearing in a short-arm cast and was instructed to use a bone stimulator over the lunate for 20 minutes per day.

At 7-week follow-up, the cast was removed and the patient had 30° of flexion and extension with well-healed incisions and no point tenderness over the lunate. Radiographs showed good lunate reduction with evidence of new bone formation across the fracture site. The patient was switched to a removable splint with active, active-assisted, and passive ROM along with continued use of a bone stimulator. At 3-month follow-up, the patient had continued improvement in ROM to 70° of flexion and 65° extension with no pain and 80° of pronation and supination. Radiographs showed continued consolidation across the fracture site with the proximal fracture site no longer visible. The patient was cleared for return to work as a forklift driver with no lifting >5 pounds, continued active and passive ROM, and bone stimulator use.

At most recent 10-month follow-up, the patient was without pain and had ROM to 80° flexion and 70° extension with 80° of pronation and supination. Radiographs showed normal distance between the scaphoid and lunate bone and good bony fusion across the fracture site (Figure 4).
in 27 cases, a fracture line was present that divided the lunate into volar and dorsal fragments. Only 2 fresh lunate fractures were noted, and both were treated with cast immobilization as they were undisplaced.

Perilunate fracture-dislocations are commonly reported in the literature and combine ligament ruptures, bone avulsions, and fractures in a variety of clinical types. The most commonly reported perilunate-lunate injury is the trans-scaphoid perilunate dislocation. Variants of this pattern include those associated with fractures of the capitate, triquetrum, lunate, distal radius, radial styloid, and ulnar styloid. However, acute fractures of the lunate are rare among carpal fractures and are often overlooked, misdiagnosed, or confused with fragmentation due to Kienböck’s disease.1,6 Lunate fractures, especially those not recognized early and appropriately treated, may lead to osteonecrosis, chronic wrist pain, and disability.5 Diagnosis is difficult, as clinical symptoms are nonspecific since the lunate has the largest cartilage-covered area of all the carpal bones, thus making it relatively insensitive as nerve supply leading to clinical pain is essentially in the periostea.1,6 A multicenter review showed that 25% of all perilunate fracture-dislocation diagnoses were initially missed, with an even higher likelihood of missed lunate fracture diagnoses.7 The mechanism of injury is usually high-energy, 3-dimensional loading of the wrist in which axial or torsional forces are applied in any combination of hyperextension, hyperflexion, and radial or ulnar deviation.7

Toft et al14 first reported a case of perilunate dislocation with an associated lunate fracture. The translunate, trans-scaphoid perilunate fracture-dislocation was accompanied by a fractured palmar styloid, ulnar styloid, and fifth metacarpal. Ruijters and Kortmann9 reported a translunate fracture dislocation of the capitate in which axial loading with slight dorsiflexion produced a compression fracture of the lunate. Conway et al10 reported 3 cases of translunate palmer perilunate fracture subluxation of the capitate with a mechanism of injury similar to trans-scaphoid perilunate dislocation injuries. The hypothesized mechanism of injury was an additional longitudinal loading force through the capitate leading to lunate fracture. Freeland and Ahmad11 reported 2 cases with displaced oblique shear fractures of the lunate associated with distal radius fractures, with 1 patient having transient vascular necrosis after open reduction and mini-screw fixation. Hofmeister and Faruqui7 reported 2 cases of coronal lunate fractures not in association with a perilunate dislocation.

Noble and Lamb13 reported a rare transverse fracture of the lunate associated with a fracture of the proximal pole of the scaphoid and radial styloid. Similar to this case, we believe that in our case the mechanism of the isolated comminuted fracture was due to the fact that under high-impact stress, the bone was more likely to break first before the surrounding ligaments tore.13 Mason et al14 reported a case of translunate dorsal perilunate fracture-dislocation associated with a comminuted radial styloid and avulsed lunate styloid fracture. The proposed mechanism of injury was that a direct volar blow to the lunate caused a transverse lunate fracture, and as the lunate was driven dorsally against the dorsal lip of the radius, a shear fracture of the lunate resulted. Vasireddy and Lowdon15 also reported a case of central transverse fracture of the lunate with a depressed central fragment and minimal anteroposterior displacement that presented 9 weeks after initial injury, which was treated with casting and physical therapy.

Fractures of the lunate are not frequently reported in the literature, and no consensus exists on the treatment of these fractures in the acute and chronic setting. Traditionally, authors have supported closed treatment with prolonged cast immobilization for a minimum of 6 weeks for undisplaced and small avulsion fractures of the lunate.1,2,6 Definitive management of displaced lunate fractures focuses on immediate anatomic reduction using open reduction and internal fixation with Kirschner wires and microscrews to improve anatomic alignment and functional status and to decrease the risk of future osteonecrosis.13 Dana et al16 recently reported a case of a dorsal pole avulsion fracture of the lunate with a bony fragment detaching the posterior part of the scapholunate ligament, which was treated successfully with arthroscopic percutaneous screw repair. In cases of delayed presentation with chronic carpal instability and arthrosis, salvage operations such as proximal row carpectomy and wrist arthrodesis are often performed.7

CONCLUSION

In our case, we were able to achieve anatomic reduction and fixation of the lunate with no development of radiographic or clinical evidence of lunate osteonecrosis despite the delayed presentation and degree of fracture displacement. This case demonstrates a previously unreported type of wrist injury and contributes to the expanding knowledge available regarding carpal injuries.

REFERENCES


