A Unique Presentation of Scaphocapitate Syndrome With Extrusion Into the Carpal Tunnel: A Case Report

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Sheriff D. Akinleye¹ and Eitan Melamed²

Abstract

Background: Scaphocapitate syndrome is a rare variety of perilunate instability, described as a trans-scaphoid, trans-capitate fracture, with rotation of the capitate head either 90° or 180°. **Methods:** We present a unique case of scaphocapitate syndrome in which the rotated proximal capitate fragment expelled into the carpal canal. **Results:** The capitate head was extricated from the carpal tunnel via the volar approach, and was anatomically aligned and fixed through the dorsal approach using two 2.0 mm headless compression screws. The scaphoid fracture was then also reduced through the dorsal approach and stabilized with a 2.5 mm headless compression screw. All intercarpal ligaments appeared intact. **Conclusions:** Volar dislocation of the proximal capitate into the carpal tunnel in scaphocapitate syndrome presents a unique challenge that can be addressed with a combined volar and dorsal approach.

Keywords: scaphocapitate syndrome, Fenton syndrome, perilunate fracture dislocation, carpal tunnel, proximal capitate, capitate head, carpal instability

Introduction

Due to both the infrequency and complexity of perilunate fracture dislocations, injuries of this entity are often missed, further complicating management of these conditions. Scaphocapitate syndrome, an exceedingly rare variety of carpal instability, is no exception as a delay in diagnosis has been reported in up to 25% of cases.^{1,2} This carpal injury is characterized by transverse fractures of both the scaphoid and capitate with subsequent rotation of the proximal capitate to either 90° or 180°. ^{3,4} Few cases of this unusual fracture pattern have been reported since 1956,^{2,3,5-7} when Fenton first defined this phenomenon.⁸

Scaphocapitate syndrome is considered a unique subset of perilunate instability. The trans-scaphoid and trans-capitate disruptions represent the greater arc pattern found in the classic radial-to-ulnar propagation of carpal injury described by Mayfield et al,⁹ with the most severe stage defined by volar dislocation of the lunate into the carpal tunnel. We report a case of scaphocapitate syndrome in which it is the capitate head that dislocates into the carpal tunnel. This specific presentation of scaphocapitate syndrome, in which the proximal fragment of the capitate is propelled through the volar capsule to enter the carpal canal, has not previously been described.

Case Report

A 31-year-old right-hand dominant male presented to the emergency department with severe left wrist swelling and

pain following a fall onto his hand while in handcuffs. Initial radiographs (Figure 1) demonstrated a displaced fracture of the waist of the scaphoid, a comminuted fracture of the triquetrum, and a fracture through the neck of the capitate that was not diagnosed. A volar splint was applied, and the patient was referred to the senior author (EM) 12 days later, at which point the true scope of his injury was discovered. Physical examination revealed marked swelling and tenderness isolated to the left wrist and no signs of neurovascular deficit. A computed tomography (CT) scan of the left wrist was performed to better delineate the extent of injury (Figures 2 and 3), demonstrating the volarly displaced proximal capitate fragment flipped 90° with the articular surface now facing palmar (Figure 3b and 3c). Although the CT scan delineated the volar displacement of the proximal fragment, it was still unclear whether the capitate head remained in the joint or extruded through the palmar ligaments. Therefore, a two-incision volar and dorsal approach was planned in case the fragment could not be extracted through the dorsal approach.

¹Maimonides Medical Center, Brooklyn, NY, USA

²NYU Langone Orthopedic Hospital, NYU Langone Health, New York City, USA

Corresponding Author:

Sheriff D. Akinleye, Maimonides Medical Center, Orthopaedic Surgery, 927 49th Street, Brooklyn, NY 11219, USA.

Email: akin923@gmail.com

Figure 1. Initial injury films demonstrating posteroanterior, oblique, and lateral radiographs of left wrist.

Figure 2. Progressive coronal cuts of the computed tomography scan of the left wrist from palmar to dorsal: (a) proximal pole fractures of scaphoid and capitate, with comminution of triquetrum, (b, c) displaced scaphoid and capitate head fractures.

Surgery was prolonged to 48 days following the date of injury, as the patient initially sought nonoperative management against medical advice; however, the persistence and progression of wrist discomfort influenced his decision to

comply with the plan for open reduction internal fixation of the carpus. The patient was taken to the operating room under regional anesthesia, with the use of a tourniquet and fluoroscopic guidance.

Figure 3. Progressive sagittal cuts of the computed tomography scan of the left wrist from ulnar to radial: (a) comminuted minimally displaced triquetral fracture, (b, c) volarly displaced proximal capitate rotated 90°, (d) displaced scaphoid fracture with proximal pole involvement.

The dorsal approach was utilized, upon which the extensor retinaculum was sharply incised to identify and retract the extensor pollicis longus (EPL) tendon radially for exposure of the dorsal wrist capsule. Given the chronicity of the injury, 3 mL of cancellous autograft was harvested from Lister tubercle to assist in fixation of the malunited capitate and scaphoid. The wrist capsule was opened with a radially based flap using the ligament sparing capsulotomy as described by Berger.¹⁰ The scapholunate and lunotriquetral ligaments were inspected and found to be intact; however, there was a visible defect at the radial aspect of the proximal capitate head, involving the entire scaphocapitate and 60% of the capitolunate articulation. Despite a thorough assessment, the proximal fragment of the capitate was not visible through the dorsal approach.

At this point, the decision was made to proceed with a standard volar approach to the carpal tunnel, in search of the proximal capitate fragment. Upon release of the transverse carpal ligament, the capitate head was found to be lying inside the carpal tunnel (Figure 4) within a rent between the radioscaphocapitate and long radiolunate ligaments (space of Poirier). The capitate head was retrieved, with a healthy appearing articular surface, and attention was then returned to the dorsum of the carpus. The salvaged capitate fragment was anatomically reduced into the proximal defect of the capitate, and fixed with two 2.0 mm headless compression screws (Stryker, Kalamazoo, Michigan).

Figure 4. Articular surface of capitate within the carpal canal, protruding through volar extrinsic ligaments.

Figure 5. Intraoperative fluoroscopy demonstrating fixation of the capitate with two 2.0 mm headless compression screws and fixation of the scaphoid with one 2.5 mm headless compression screw.

Attention was then turned to the scaphoid fracture, which was provisionally reduced with 0.9 mm Kirschner wires. The fracture site was then debrided to healthy bone, packed with cancellous autograft, and fixed with a 2.5 mm headless compression screw (Stryker). All screw heads were buried beneath articular cartilage, and final fluoroscopic images are shown in Figure 5. The triquetrum was comminuted and minimally displaced; therefore, the decision was made to forgo fixation. The capsular flap and the extensor retinaculum were repaired with non-absorbable sutures, and the left wrist was immobilized in a fiberglass volar splint. Two weeks following surgery, sutures were removed, and the splint was replaced with a thumb spica cast. Figure 6 shows images taken at 1-month follow-up.

The postoperative therapy regimen consisted of active and passive motion of adjacent joints, edema reduction, and progressive wrist range of motion of wrist after 2 months of immobilization. At 7-month follow-up, Figure 7 shows imaging consistent with a healed capitate and a scaphoid nonunion. The scaphoid likely healed as a fibrous union, as the patient was asymptomatic to palpation along the anatomic snuffbox. He reported no pain with active wrist range of motion, and the grip strength of his operative hand was 25 lbs, in comparison with 65 lbs in his contralateral hand. Given the patient's relocation to another state, he was given the contact information of a local hand surgeon for follow-up of the scaphoid nonunion.

Discussion

Scaphocapitate syndrome usually presents in young men, secondary to high-energy falls or vehicle accidents.¹¹ Diagnosis of this rare perilunar fracture is often initially missed, as was the instance in this case presentation, highlighting the need for CT imaging in the setting of carpal injury.^{2,6,7} Delays in diagnosis further complicate management, leading to an increased risk of posttraumatic carpal arthritis, avascular necrosis, and/or carpal collapse.^{2,12} There is a general consensus among authors that injuries of this variety require open anatomic reduction of both the capitate and scaphoid, followed by internal fixation.^{2,5,7,11-13} Although the proximal portions of both the capitate and scaphoid are vulnerable to posttraumatic avascular necrosis due to the retrograde blood supply of these fragments, the capitate head is nourished by synovial fluid and has demonstrated the ability to revascularize when anatomically reduced.¹⁴ Excision of the proximal capitate fragment will lead to a predictable progression of degenerative arthritis⁶; thus, regardless of the injury pattern, salvage of this fragment should always be attempted. As was employed in this case, previous presentations of volar dislocation of the proximal capitate beyond the capsule utilized a combined dorsal and volar approach; the volar approach is employed to extract the capitate head, and the dorsal approach is used to reduce and stabilize this fragment to its distal segment.^{13,15,16} The displaced scaphoid fracture should be addressed after fixation of the

Figure 6. Posteroanterior (PA) and lateral radiographs taken at 1-month follow-up demonstrating proper alignment of hardware and evidence of successful healing. Well-circumscribed lucency at distal radius (seen on PA) represents sequelae of donor site from autograft taken from Lister tubercle.

Figure 7. Posteroanterior, lateral, and scaphoid view at 7-month follow-up demonstrating healed capitate and fibrous union of scaphoid.

capitate; previous studies have demonstrated that the anatomic reduction of the capitate guides proper alignment and fixation of the scaphoid.¹⁷

Scaphocapitate syndrome represents a rare subtype of perilunate instability for which there are several proposed mechanisms of injury. Fenton⁸ argued that combined

hyperextension and radial deviation of the wrist caused the radial styloid to fracture both the scaphoid and the capitate. Stein and Siegel¹⁷ suggested that it was solely extreme wrist dorsiflexion that resulted in direct compression and fracture at the neck of the capitate as it abuts against the dorsal margin of the distal radius; the continuation of this motion leads to the 2-step rotation of the proximal capitate.¹⁷ Vance et al suggested that either extreme of dorsiflexion or palmarflexion of the wrist could lead to impaction of the distal radius into the capitate, leading to the characteristic fracture pattern and subsequent rotation.⁴ Most authors, however, do agree that scaphocapitate syndrome represents the later stage of a greater arc perilunate fracture dislocation that has spontaneously reduced.^{6,11,18} Accompanying the rotated proximal capitate fragment are often both radial (scaphoid or scapholunate ligament disruption) and ulnar-sided (hamate, triquetrum, or lunotriquetral ligament compromise) injuries, with a volar lunate dislocation representing the final stage.¹⁹

This case of scaphocapitate syndrome is unique in that the proximal capitate fragment dislocated volarly into the space of Poirier without concomitant dislocation of the lunate. Given the central location of the capitate, articulating with the base of the third and fourth metacarpals, the scaphoid, the hamate, the trapezoid, and the lunate, isolated dislocation of this bone or its fragments are exceptionally rare.^{19,16} Richards reported of a case of scaphocapitate syndrome with a volar dislocation isolated to the proximal capitate; however, the capitate head was accessed via the dorsal approach, demonstrating that it did not extrude through the volar extrinsic ligaments.¹⁶ Pandit previously reported a case of scaphocapitate syndrome with volar dislocation of the lunate and proximal pole of scaphoid into the volar aspect of the forearm. Interestingly, the rotated proximal fragment of the capitate head was found in the rent of the volar extrinsic ligaments left by the gap of the lunate.¹⁸ Kim et al later reported a similar injury pattern, positing that the lunate and attached proximal scaphoid first dislocate as one unit, with the proximal capitate and distal scaphoid subsequently following as another unit.⁶ One reported case of scaphocapitate syndrome did actually present as an isolated volar dislocation of the capitate head through the volar extrinsic ligaments, however, the capitate head was located in the forearm proximal to the transverse carpal ligament; thus, it technically was not within the carpal canal.¹⁵

There have been reported cases of isolated proximal capitate dislocation into the carpal tunnel; however, the injury profiles in those cases do not fit the true definition of scaphocapitate syndrome. Guiral et al²⁰ presented a case of volar dislocation of the capitate head in the carpal canal in a isolated capitate fracture, whereas Nagai et al¹³ reported a case of median nerve palsy in a trans-scaphoid, trans-capitate volar fracture dislocation without rotation of the proximal capitate. Thus, this is the first reported case of scaphocapitate

syndrome in which there was an isolated dislocation of the proximal capitate fragment into the carpal tunnel.

The low frequency of median nerve involvement in scaphocapitate syndrome is thought to be due to the premise that the energy that would be utilized to expel the proximal capitate appreciably volar, is otherwise expended to rotate the fragment.¹³ However, the location of the space of Poirier at the capitollunate articulation, an area of which expands upon wrist dorsiflexion, renders it plausible that the proximal aspect of the capitate can also propel through this interval without requiring a preceding lunate dislocation. Despite compromise of the carpal tunnel, the patient in this case presentation did not present with median nerve palsy. Nonetheless, a thorough neurovascular examination is especially critical in any case of scaphocapitate syndrome associated with a volar dislocation of the proximal capitate. Early recognition of this unique presentation of scaphocapitate syndrome will help optimize prompt diagnosis, surgical planning, and successful long-term functional outcomes.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

No identifiable information of the patient was included in this case report; therefore, informed consent was not required.

Declaration of Conflicting Interests

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