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Traumatic Volar Dislocation of a Hemi-Scaphoid-Lunate Complex across the Carpal Ligament: A Case Report

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Learning Point of the Article:

Extreme proximal volar migration of a hemi-scaphoid-lunate complex across the carpal ligament is a rare variant of trans-scaphoid perilunate dislocation; despite radiographic signs suggestive of osteonecrosis, a combined volar-dorsal reduction and fixation approach can restore carpal anatomy and yield a satisfactory functional outcome without radiocarpal arthritis at 3-year follow-up.

Abstract

Introduction: Palmar trans-scaphoid-lunate dislocation with proximal migration of the fragment complex is an exceedingly rare carpal injury whose management is not standardized. We report a case of extreme proximal volar dislocation of a hemi-scaphoid and lunate complex displaced approximately 5 cm from its anatomical location.

Case Report: A 16-year-old right-handed male sustained a closed injury to his left wrist after falling from a one-story building. He underwent surgical fixation 2 weeks after injury, once soft-tissue swelling had settled sufficiently for open reduction. Neurovascular examination was normal, but wrist mobility was limited and a 3 × 3 × 2 cm mass was palpable in the volar forearm. Radiographs and computed tomography revealed a volar trans-scaphoid perilunate fracture-dislocation with the lunate and proximal scaphoid migrated into the forearm. The fragments were mobilized through a volar approach and reduced anatomically through a dorsal 3–4 carpal approach. The scaphoid was stabilized with a Herbert screw and the lunate with three Kirschner wires. At 12 months, imaging raised concern for osteonecrosis of the scaphoid and lunate without arthritic change. At 3-year follow-up, the patient was pain-free with improved wrist motion, a disabilities of the arm, shoulder, and hand score of 7.5, and mild degenerative radiocarpal change but no loss of carpal height.

Conclusion: Combined volar and dorsal reduction and fixation of a severely displaced hemi-scaphoid-lunate complex can achieve good mid-term functional results despite early radiographic features suggestive of osteonecrosis, though long-term surveillance remains necessary.

Keywords: Lunate, dislocation, proximal migration, perilunate, carpal injury.

Introduction

A variety of intricate injuries are represented by carpus fracture-dislocations. There are not many documented instances of a displaced lunate and a scaphoid fragment being moved close to the radiocarpal joint [1,2,3,4]. The viability of the proximal pole of the scaphoid and lunate is at high risk due to the rupture of vascular systems and the extension of soft-tissue lesions in these types of injuries [5]. If the blood supply is not restored, scaphoid non-union, lunate avascular necrosis, scaphoid proximal pole avascular necrosis, and future carpal instability are unavoidable [6]. We describe a young patient who experienced severe proximal volar dislocation of a complete lunate complex and hemi-scaphoid, around 5 cm from its anatomical placement.

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Author's Photo Gallery

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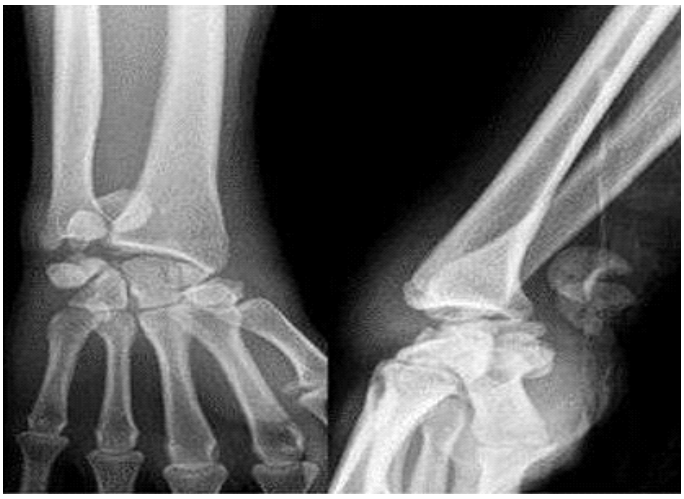

Figure 1: Posteroanterior and lateral X-ray of the left wrist showing volar trans-scaphoid perilunate fracture-dislocation migrated into the forearm.

Case Report

A 16-year-old right-handed male experienced an isolated closed injury to his left wrist following a fall from the rooftop of a one-story building. On examination, the left wrist exhibited swelling and tenderness on palpation. Neurovascular assessment of the hand revealed no abnormalities, and there were no sensory deficits in the distribution of the median nerve. Range of motion in the wrist was limited, and a palpable mass measuring 3 × 3 × 2 cm was noted in the mid-portion of the volar forearm. Imaging studies, including X-ray and computed tomography (CT), indicated a volar trans-scaphoid perilunate fracture-dislocation that had migrated into the forearm (Figs. 1 and 2). The patient underwent surgical fixation 2 weeks after injury, once the soft-tissue envelope was assessed as suitable for open reduction. Under general anesthesia, a volar approach was utilized to release the lunate and the proximal pole of the scaphoid, which were connected by the scapho-lunate ligament.

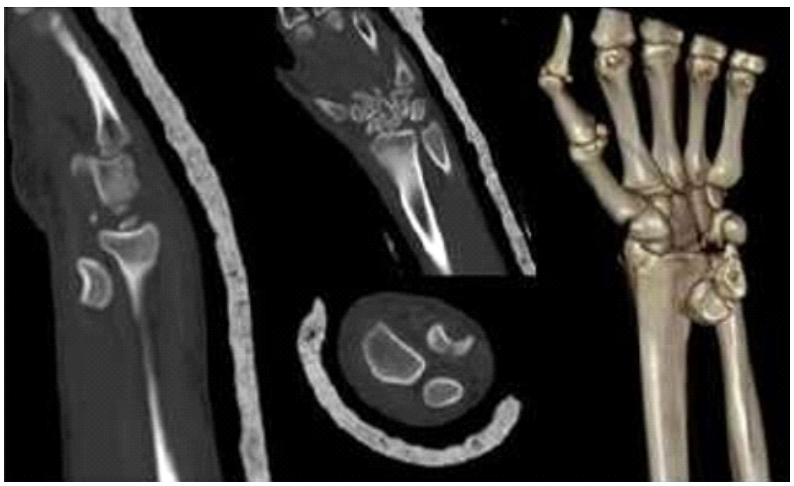

Figure 2: Computed tomography (CT) scan and CT reconstruction of the left wrist showing volar trans-scaphoid perilunate fracture-dislocation migrated into the forearm.

Figure 3: Intraoperative photograph showing the surgical approach used to access and mobilize the displaced lunate and proximal scaphoid.

Intraoperatively, this scapholunate ligament was found intact and was, therefore, preserved rather than repaired; the torn volar (palmar) radiocarpal capsule and palmar radiocarpal ligaments were identified, tagged, and protected for later repair, and the median nerve and flexor tendons were retracted and decompressed during this exposure. Following this release, reduction to their anatomical positions was achieved through a dorsal 3–4 carpal approach (Fig. 3). Reduction was performed sequentially: the lunate was first reduced into the lunate fossa under fluoroscopic guidance to restore the radiolunate relationship, after which the hemi-scaphoid fragment, still tethered to the lunate by the intact scapholunate ligament, was reduced and provisionally pinned to re-establish the scapholunate and midcarpal relationships. The torn dorsal radiocarpal, capitolunate, and triquetrolunate ligaments identified through the dorsal approach were repaired primarily using non-absorbable sutures passed through drill holes in the lunate and triquetrum, and the previously tagged volar capsule and palmar radiocarpal ligaments were then repaired through the volar window to reconstitute the palmar carpal stabilizers. The scaphoid fracture was stabilized using a 2.4 mm Herbert screw, while the lunate was secured with three 1.0 mm Kirschner wires (Fig. 4). Three Kirschner wires, rather than a single wire, were chosen for the lunate because its small size and largely cartilage-

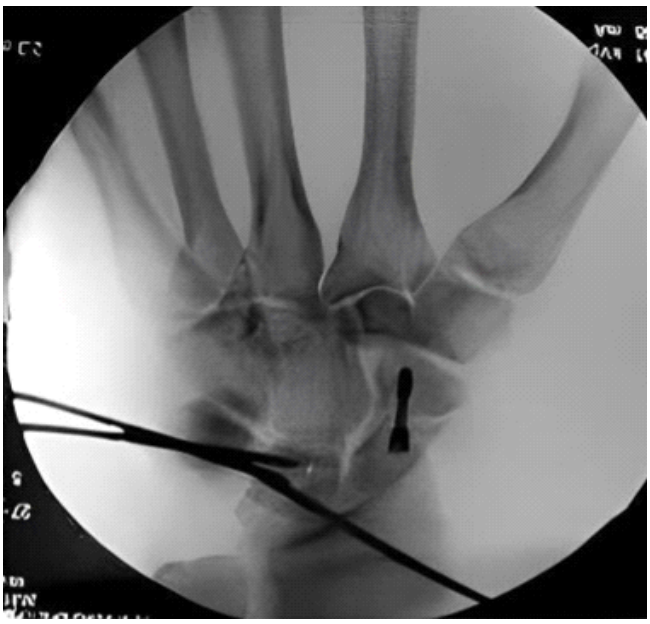

Figure 4: Intraoperative posteroanterior fluoroscopic image of the left wrist after reduction and fixation of the scaphoid with a Herbert screw and the lunate with Kirschner wires.

covered surface precluded screw fixation; a triangulated, multiplanar wire configuration engaging the lunate, capitate, and triquetrum was used to neutralize rotational and shear forces on the reduced lunate and protect the ligament repairs during healing. The procedure lasted approximately 1 h 50 min, with negligible (nil) blood loss under pneumatic tourniquet control maintained for almost 2 h. A dorsal forearm splint was applied, allowing for free movement of the elbow and fingers. The Kirschner wires were removed 8 weeks post-surgery, and the splint was subsequently replaced with an orthosis for wrist immobilization. A structured hand-therapy program, focusing on edema control and active range-of-motion exercises for the fingers and elbow, was initiated at 3 weeks post-surgery while the wrist remained protected in the splint; protected active and active-assisted wrist range-of-motion exercises were then introduced following Kirschner-wire removal and transition to an orthosis at 8 weeks, with progressive strengthening exercises added once radiographic union and adequate soft-tissue healing were confirmed.

At the 12-month follow-up, the patient reported experiencing pain in the left wrist, quantified as 5 on the visual analog scale (VAS). The range of motion in the wrist was restricted, with flexion at 60°, extension at 80° (Fig. 5), ulnar deviation at 15°, and radial deviation at 15°. Imaging studies, including X-ray, CT, and magnetic resonance imaging (MRI) conducted 12 months post-operation, indicated an altered signal in both the scaphoid and lunate bones, which raised concerns for osteonecrosis; however, there was no definitive evidence of radiocarpal or midcarpal arthritis (Fig. 6). MRI was obtained at this stage specifically to evaluate osteonecrosis, and the concern for avascular change in the scaphoid and lunate at 12 months was based on this MRI finding of altered marrow signal rather than on radiographs or CT alone, since MRI remains the most sensitive modality for assessing carpal vascularity. The patient did not attend subsequent appointments and returned for evaluation 2 years later. Three years following the fracture, the patient indicated a complete absence of wrist pain (VAS: 0) and demonstrated improved wrist motion: Flexion at 70°, extension at 90°, ulnar deviation at 30°, and radial deviation at 15° (Fig. 7). The disabilities of the arm, shoulder, and hand score recorded at 3 years were 7.5. Assessments of tip pinch and grip strength yielded results of 2.75 kg (contralateral 4 kg) and 27 kg (contralateral 30 kg), respectively. X-ray findings showed mild degenerative changes in the radiocarpal joint; while the possibility of lunate necrosis could not be entirely ruled out, there was no observable loss of height when compared to the contralateral wrist (Fig. 8). The patient expressed satisfaction with the outcome and declined any surgical intervention at that time.

Discussion

Seldom has palmar trans-scaphoid-lunate dislocation been documented in the literature [2,3,4]. The lunate and scaphoid complexes were badly proximally dislocated in our case. The mechanism of damage is poorly understood. According to Mayfield et al. [7], it appears to be a variation of the lunate and perilunate dislocations. A scaphoid fracture results when the scaphoid impinges on the dorsal lip of the radius when a pronated forearm is subjected to a force of hyperextension and

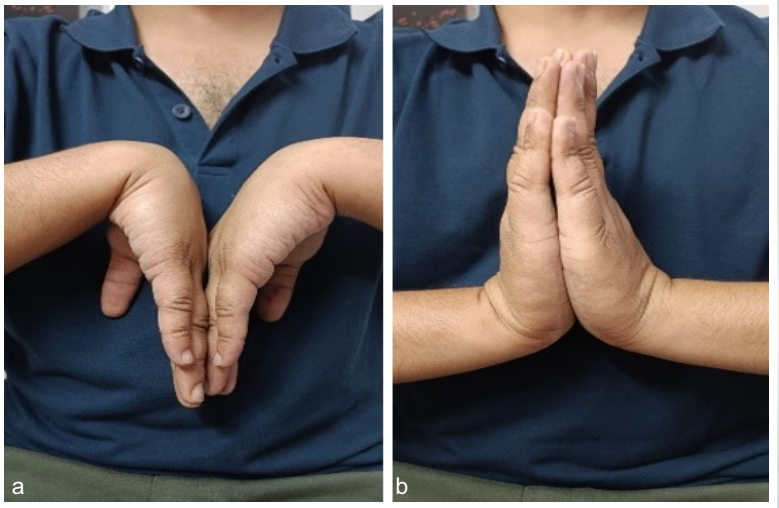

Figure 5: Clinical photographs showing wrist flexion (a) and extension (b) 12 months after injury.

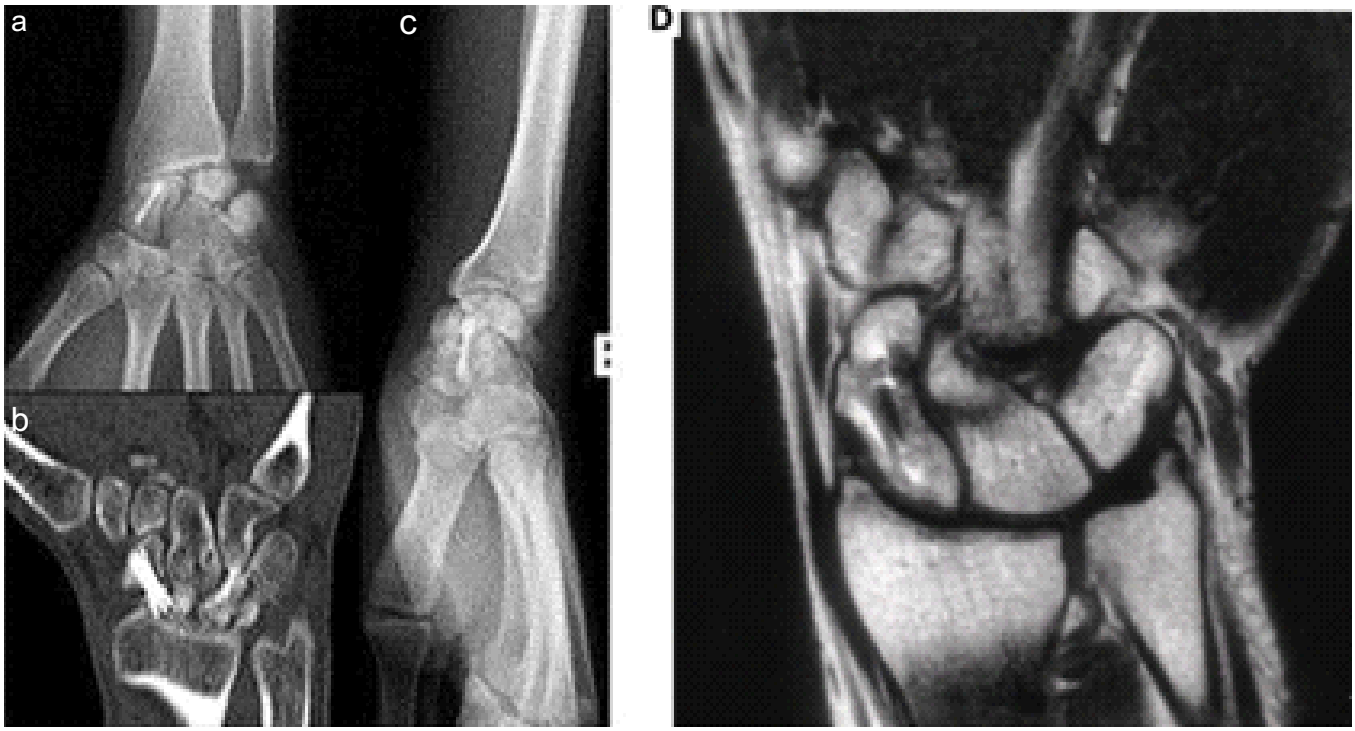

Figure 6: (a) Posteroanterior and (b) lateral X-ray, (c) computed tomography scan, and (d) coronal T2-weighted magnetic resonance imaging of the left wrist 12 months after injury, the latter showing altered marrow signal in the scaphoid and lunate that raised concern for osteonecrosis, without evidence of radiocarpal or midcarpal arthritis.

ulnar deviation of the wrist. The lunate and proximal pole complex of the scaphoid are vulnerable to dislocation if this forced movement continues, as it tears the dorsal and palmar radiocarpal ligaments and ruptures the capitolunate and triquetrolunate ligaments. To improve the likelihood of functional recovery and lower the high risk of osteonecrosis linked to this kind of damage, the normal intercarpal morphology must be restored as soon as possible [3]. Due to the intricacy of this lesion, the greatest outcome is typically obtained by combining a volar and dorsal technique. The volar technique permits direct palmar capsule repair, ligament tear repair, and carpal tunnel decompression, whereas the dorsal route provides improved exposure for anatomical alignment and interosseous ligament reconstruction or repair [8]. The authors of a case that was remarkably similar to ours, Lee et al. [4], decided to reduce the danger of osteonecrosis using a single volar approach. However, the X-rays revealed dorsal-ulnar subluxation of lunate and ulnar subluxation of scaphoid at the 12-month follow-up, even though there was no sign of osteonecrosis.

The authors suggested the combined technique as a superior option in a case with this degree of intercarpal ligament injury, citing the inability to execute a correct ligament restoration using the volar approach as the primary cause of this event. With a dislocation comparable to ours, Koh et al. [2] reported another instance, in which the two-fold approach produced good radiographic and functional results.

To place the present case in context, Table 1 summarizes the salient clinical, radiographic, and treatment features of the current case alongside those of the four previously reported

Figure 7: Clinical photographs showing wrist flexion (a) and extension (b) 3 years after injury.

Figure 8: Posteroanterior and lateral X-rays of both wrists 3 years after injury.

cases of this injury pattern, by Stevanovic et al. [1], Koh et al. [2], Ekerot [3], and Lee et al. [4]. Several features distinguish our case from this small existing series. First, at 16 years of age, our patient is, to our knowledge, the youngest reported with this injury pattern; the four comparator cases all involved skeletally mature adults, and the balance of remodeling potential against decades of expected joint use may differ substantially in an adolescent. Second, the approximately 5 cm proximal migration of the fragment complex in our patient is among the most extreme displacements reported, comparable to the 6 cm migration described by Lee et al. [4] and exceeding the migration distances in the Koh et al. [2] and Ekerot [3] cases. Third, unlike Lee et al. [4], who used an isolated volar approach and observed residual dorsal-ulnar subluxation of the lunate and ulnar subluxation of the scaphoid at 12 months, we combined volar and dorsal exposures – as did Koh et al. [2] – and achieved a stable, anatomically reduced carpus without recurrent subluxation. Fourth, our case is one of the few with imaging evidence of altered scaphoid and lunate signal on serial follow-up and uniquely documents its radiographic evolution from 12 months to 3 years, showing apparent improvement without loss of carpal height or progression of arthritis, information not available from the shorter or less granular follow-up reported in the other cases.

Despite initial considerable displacement and soft-tissue disturbance, some investigations have revealed the possibility of revascularization of the proximal poles of the lunate and scaphoid [3,9]. Twelve out of 27 patients with trans-scaphoid lunate or perilunate dislocation had osteonecrosis of one of these bones, and nine of them had revascularization, according to Panting et al. [9]. According to the theory put forth by Ekerot et al. [3], lunate revascularization occurs as a result of the intact scapholunate interosseous ligament and the united scaphoid fracture. Some speculate that the avascular alterations that occur after wrist dislocation may be temporary [6]. Magnetic resonance imaging remains the most sensitive modality for evaluating carpal vascularity and is recommended whenever

Table 1: Comparison of the present case with previously reported cases of trans-scaphoid-lunate/perilunate dislocation with proximal migration of the fragment complex

Study (year)	Age/sex	Injury pattern and migration	Approach and fixation	Osteonecrosis/imaging	Follow-up and outcome
Stevanovic *et al* . [1] (1996)	Adult, F	Trans-scaphoid, transtriquetral, volar lunate fracture-dislocation	Not reported in available abstract	Not reported in available abstract	Not reported in available abstract
Ekerot [3] (1995)	Adult, F	Total palmar trans-scaphoid-lunate dislocation	Open reduction, bone grafting, internal fixation (approach not further specified)	No osteonecrosis	70 months; wrist function almost normal
Koh *et al* . [2] (2012)	24 year, M	Total volar extrusion of lunate and scaphoid proximal pole with scapholunate dissociation	Combined dorsal + volar; open reduction and internal fixation	No avascular necrosis on MRI	12 years; ROM 75% and grip 76% of contralateral side; pain-free, satisfied
Lee *et al* . [4] (2017)	Adult, M	Volar dislocation of lunate and scaphoid proximal pole, migrated ~6 cm proximal to the radiocarpal joint through the transcarpal ligament	Isolated volar approach	No osteonecrosis; dorsal-ulnar subluxation of lunate and scaphoid	12 months; persistent subluxation without osteonecrosis
Present case (2026)	16 year, M	Hemi-scaphoid and lunate complex, migrated ~5 cm	Combined volar + dorsal; Herbert screw (scaphoid) + 3 Kirschner wires (lunate)	Altered scaphoid/lunate signal, concern for osteonecrosis at 12 months; apparent improvement by 3 years	3 years; pain-free, DASH 7.5, improved motion, mild degenerative radiocarpal change, no loss of carpal height, satisfied

M: Male, F: Female. ROM: Range of motion, MRI: Magnetic resonance imaging, DASH: Disabilities of the arm, shoulder, and hand. For the comparator cases by Stevanovic *et al* . [1] and Ekerot [3], full-text articles were not accessible to us; the corresponding table entries were therefore compiled from the published abstract alone, and fields not addressed in the abstract are marked "Not reported in available abstract" rather than inferred

osteonecrosis is suspected on plain radiographs or CT, as illustrated by Koh et al. [2], who used MRI to confirm the absence of avascular necrosis 12 years after combined reduction and fixation. Three years after the fracture, we saw a good evolution in the X-ray with no loss of lunate height in proportion to the contralateral wrist and no discernible evolution in radiocarpal arthritis, despite the altered sign of the lunate and scaphoid after the 1st year. Some publications recommend a primary proximal row carpectomy (PRC) when injuries of this grade of severity are present [10]. Given the patient's age, we believe that there is potential for an open reduction and osteosynthesis attempt, which would allow for a PRC in the event that the standard anatomy preservation approach is unsuccessful.

Beyond primary reconstruction, PRC is the salvage procedure most widely used for irreparable perilunate injuries or established avascular necrosis with carpal collapse; it converts the wrist into a capitate-radius articulation and can preserve a useful arc of motion and grip strength, as reported after early PRC for severe carpal trauma [10]. However, PRC depends on an intact, congruent articulation between the capitate head and the lunate fossa of the radius, and outcomes deteriorate with pre-existing capitate or radial-fossa cartilage damage; because it also predisposes to accelerated radiocapitate degeneration over time, most authors reserve primary PRC for older, lower-demand patients or as a secondary salvage after failed anatomical reconstruction, rather than as first-line treatment in adolescents and young adults, in whom preservation of carpal height and native articular cartilage is prioritized. Consistent with this reasoning, Trumble and Verheyden [11] showed that combined dorsal-volar reduction, ligament repair, and intraosseous cerclage fixation of perilunate and lunate dislocations – a strategy similar to that used in our patient – restored a wrist flexion-extension arc and grip strength averaging 80% and 77% of the contralateral side, respectively, with high patient satisfaction, supporting an initial attempt at anatomical reconstruction even in complex, severely displaced injuries. Other salvage options, such as four-corner fusion or total wrist arthrodesis, sacrifice further motion and are generally reserved for failure of both primary reconstruction and PRC. Given our patient's youth and the potential, demonstrated in this case, for radiographic and functional recovery despite early signs suggestive of osteonecrosis, we favored an initial attempt at anatomical open reduction and internal fixation, reserving PRC or further salvage procedures for failure of this approach – a strategy also adopted by Koh et al. [2] in a similarly young patient.

Despite this intricate injury, our patient expressed great satisfaction with the outcome, demonstrating strong muscles and improved mobility as compared to the contralateral side. Although the absence of limitations in a young, active patient is extremely encouraging, the follow-up period is still too brief to make firm judgments regarding the injury's long-term sequelae.

Conclusion

When a hemi-scaphoid and lunate dislocate volarly proximal to the carpal ligament, there is no consensus on the optimum course of action. Combined dorsal and volar approaches may provide satisfactory reduction and fixation in selected cases of this rare injury pattern. In the case reported here, this approach achieved good functional results at 3-year follow-up, with mild degenerative radiocarpal change but no loss of carpal height and no definitive evidence of osteonecrosis; however, a single case cannot establish the superiority of one surgical strategy over another, and comparative studies with larger cohorts are needed. Because there are few published studies on these injuries, reporting both short- and long-term outcomes remains important to help guide this challenging treatment decision.

Clinical Message

In extreme proximal volar dislocations of the hemi-scaphoid-lunate complex, a combined volar-dorsal approach with rigid internal fixation allows anatomical restoration of carpal alignment. Early radiographic signs suggestive of osteonecrosis should not be taken as a poor prognostic indicator in isolation, as clinical and radiographic recovery may continue over several years; close, prolonged follow-up is essential to guide further management.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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