



## Case Report

# Capitate fracture nonunion in association with triquetrum avulsion fracture: Rare injury with massive effect on hand function, a case report

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## ABSTRACT

**Introduction and importance:** Capitate fractures are rare and usually occur due to high-energy trauma. They are often associated with other wrist injuries or dislocations. An isolated occurrence of capitate and triquetral fractures due to high-energy trauma is rarely reported in the literature. This rare injury pattern has a significant effect on wrist function, as presented in this case.

**Case presentation:** A 19-year-old male manual worker, presented with persistent right wrist pain and progressive loss of function after sustaining motor vehicle collision 5 months prior. The patient had major concerns regarding the return of wrist function.

**Clinical discussion:** A diagnosis of collapsed capitate fracture nonunion associated with a triquetral avulsion fracture was made based on radiography, computed tomography (CT) scan, and magnetic resonance imaging (MRI). Treatment with internal fixation and strut corticocancellous autograft to restore capitate height resulted in substantial improvement in wrist function and alleviation of pain. The Mayo wrist score increased from 15/100 to 90/100 at the 6-year follow-up visit.

**Conclusion:** Capitate fractures can occur in association with triquetral fractures in the absence of dislocation or greater arch injuries. Nonunion is a common complication, and internal fixation with bone graft is the gold standard for the treatment of capitate fracture nonunion, resulting in excellent outcomes and return of function.

## 1. Introduction

The capitate bone is the largest carpal bone. It is located in the center of the wrist and connects both the proximal and distal rows of carpal bones. Capitate fractures are rare, accounting for only 1–2% of carpal bone fractures. They are more prevalent in young male and older female individuals [1]. Although it can present as an isolated injury, most cases are associated with more complex injuries, such as greater arc injuries.

Greater arc injuries typically involve capitate fractures centrally extending radially to the scaphoid or distal radius and ulnarly to the hamate, triquetrum, and distal ulna. These injuries are usually caused by high-energy trauma [1].

The most commonly reported complications of capitate fractures are nonunion, avascular necrosis, and posttraumatic arthritis. This may be

attributed to retrograde blood flow similar to that of the scaphoid bone [2].

Capitate fractures associated with triquetrum avulsion, that are not part of the greater arch injury pattern, are scarcely reported in the literature. To the best of our knowledge, only two articles reported a total of eight cases of capitate fractures associated with triquetrum fractures that were not part of greater arch injuries [1,3].

Here, we report a rare case of an adult patient with capitate fracture nonunion associated with triquetrum avulsion that was not part of a greater arch injury, which occurred due to high-energy trauma. The injury resulted in severe deterioration of hand and wrist function. We describe the surgical management of this injury and the outcomes after 6 years of follow-up. This case report is in line with the SCARE 2020 criteria [4].

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## 2. Case presentation

A nineteen-year old, right-handed, male construction worker presented to our clinic with a complaint of significant right wrist pain for 5 months. The pain started after he was involved in motor vehicle collision that resulted in right wrist injury and posterolateral left knee injury. He was diagnosed with non-displaced capitates fracture and treated with splinting for 3 weeks. His surgical history included ligament reconstruction for knee instability. The patient had no chronic medical illnesses and was a non-smoker, with no history of drug allergy or abuse, and no family history of congenital disorders.

On examination, he had tenderness on the dorsal right wrist with significant limitation in range of motion; he had only 10° of wrist flexion and extension. His grip strength was less than 5 pounds. The mean Mayo wrist score was 15/100. He scored 8/10 on the pain visual analogue score (VAS).

Radiographs of the wrist showed a displaced transverse capitate fracture with signs of nonunion and a decrease in capitate height, in addition to a partially healed small avulsion fracture of the triquetrum

(Fig. 1). Computed tomography (CT) confirmed a capitate non-union and healed triquetrum fracture with no other associated carpal bone fractures (Fig. 2). Magnetic resonance imaging (MRI) showed changes in the bone marrow signal of the proximal fragment of the capitate, suggesting early changes in avascular necrosis (Fig. 3).

The patient was consulted and consented to undergo surgery. The surgical procedure was performed by an experienced fellowship-trained hand surgeon at a private hospital, which is a referral center for trauma cases. The procedure was performed under general anesthesia while the patient was supine, and a tourniquet was applied above the elbow. We used the dorsal wrist approach through the fourth dorsal compartment. We identified the fracture site and excised the fibrous nonunion. A 3–4-mm thick tricortical iliac crest autograft was harvested from the right iliac crest, adjusted, and inserted into the fracture site to restore the capitate height. We then fixed the graft with one (3.0 mm) cannulated headless compression screw under fluoroscopic guidance.

A below-elbow volar splint was applied for 4 weeks, after which we started the rehabilitation program. The patient adhered to the surgeon and therapist instructions. Follow-up showed clinical and radiological



**Fig. 1.** An AP view radiograph of the right wrist showing collapsed capitate fracture and triquetral chip avulsion fracture.

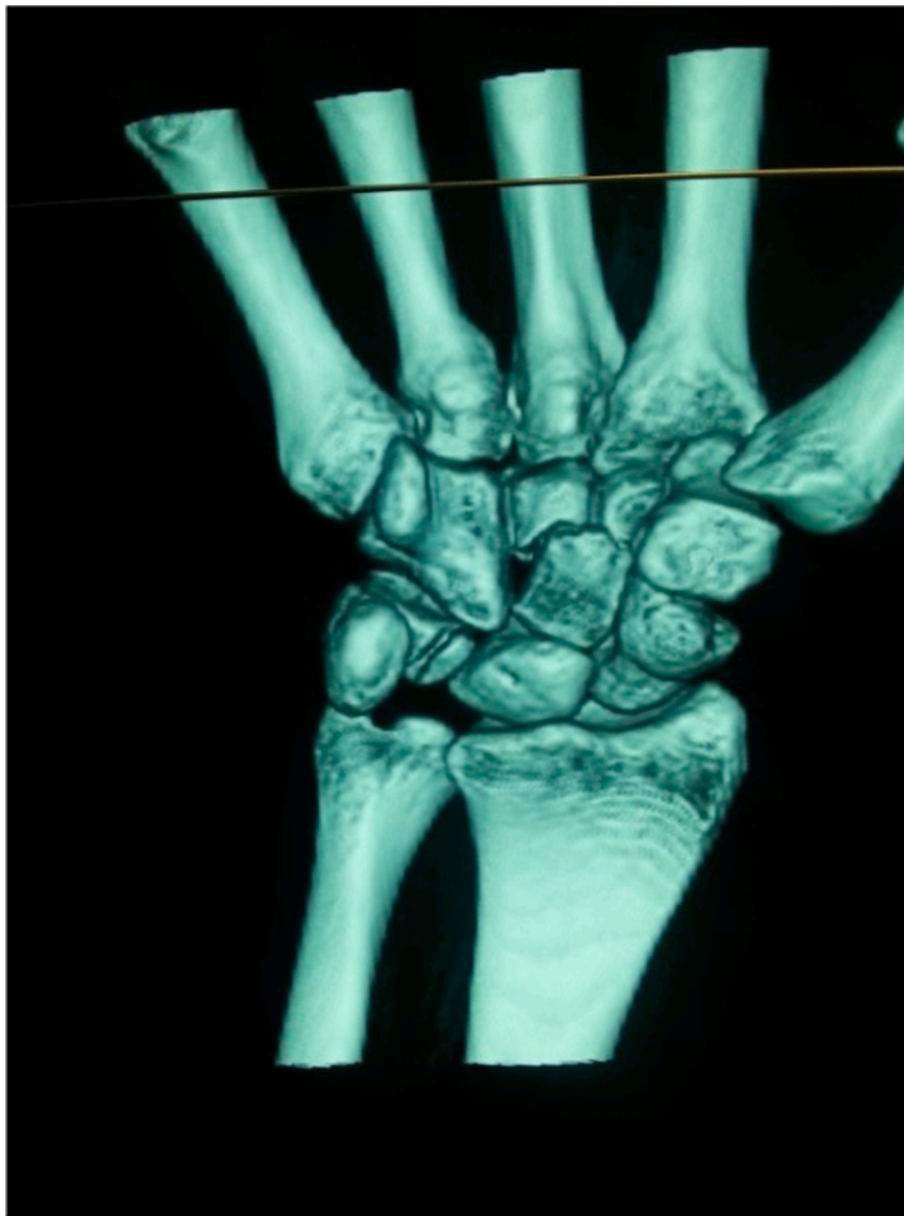


Fig. 2. CT scan 3D reconstruction showing nonunion of capitate fracture

signs of union 3 months after surgery (Fig. 4). At the 6-month follow-up visit, the patient scored 2/10 on the VAS pain score. He showed substantial improvement in the range of motion with wrist flexion/extension of up to 60°. His right grip strength was 60 pounds, compared to 70 pounds on the left hand. The Mayo wrist score improved from 15/100 to 70/100. His last follow-up was performed 6 years postoperatively, and his range of motion was 80° of extension and 70° of flexion. Grip strength was 92 pounds, which is 10% higher than that of his normal left hand. The final Mayo score was 90/100. Radiographs obtained at the final follow-up showed completely healed capitate fracture with no significant signs of arthritic changes in the mid-carpal joint (Fig. 5). No complications or adverse events were reported, which correlates with the outcomes of capitate nonunion managed by fixation with bone graft reported in the literature [1]. The patient reported great satisfaction with the outcomes as he was able to return to demanding labor in the construction field, free of limitation.

### 3. Discussion

This report describes a rare wrist injury pattern in which an adult patient has a capitate fracture associated with avulsion of the triquetrum but without scaphoid or distal radius fractures, despite the high-energy mechanism of the trauma. The presence of knee instability due to disruption of the posterolateral complex may indicate the severity of the trauma event in our patient. High-energy trauma typically results in greater arch wrist injuries, including radial side fractures (scaphoid/radial styloid) and ulnar-sided fractures (hamate/triquetrum), in addition to capitate fractures [1].

We reviewed the literature on similar cases and found only two articles on capitate fractures associated with only triquetrum fracture/avulsion. Kadar et al. [1] reviewed 53 cases of capitate fractures and found only seven cases of capitate fractures associated with triquetrum injuries that were not part of greater arch injuries. Unfortunately, they did not mention the treatment received by the seven patients. Rommeet et al. [3] reported a similar case, but in a 6-year-old child who was treated conservatively.

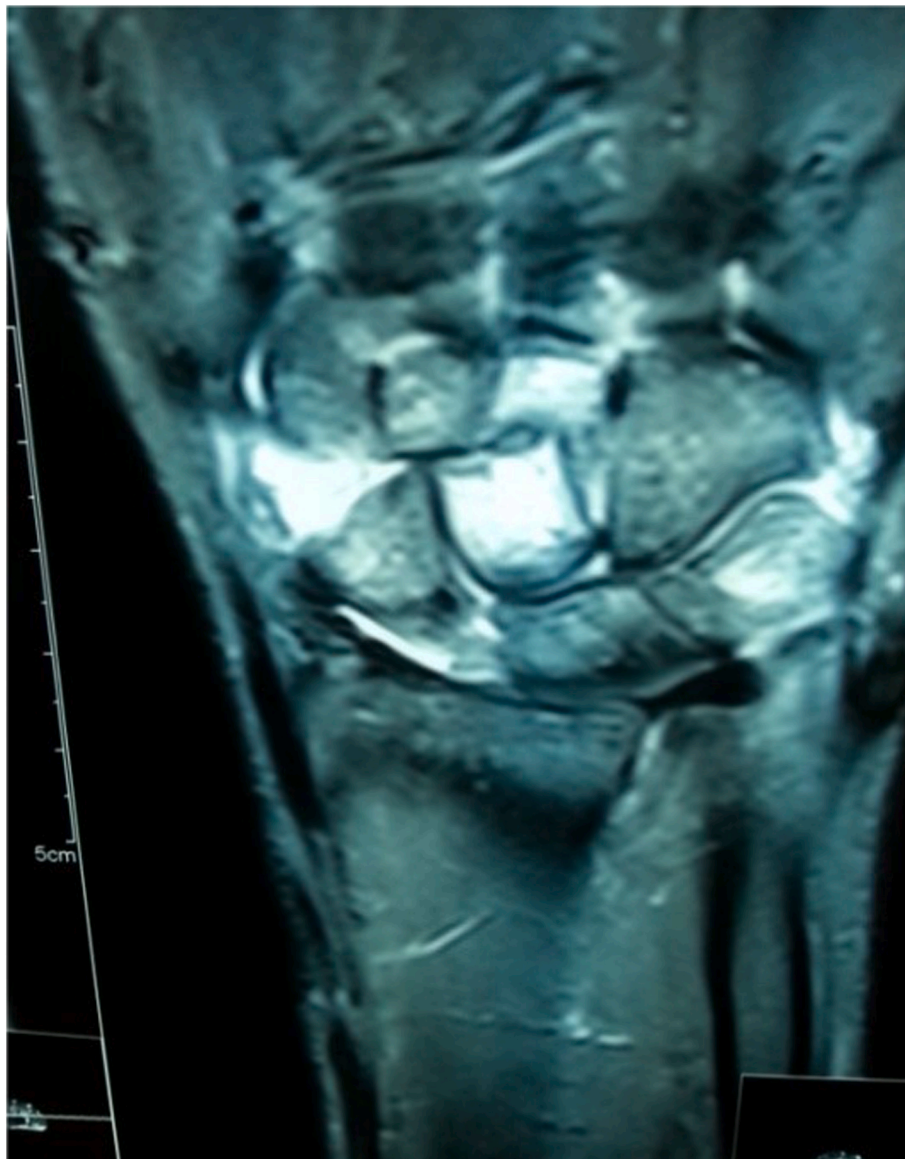


Fig. 3. MRI T2 fat sat sequence showing bone marrow edema of proximal fragment of capitate.

The diagnosis of capitate fractures is usually delayed, especially if there is no dislocation or disruption of the carpal rows. Additional CT or MRI should be considered if the initial radiographs are negative for fractures [4]. Our patient was diagnosed on the initial radiograph, and he was told he had a non-displaced capitate fracture for which a splint was applied for 3 weeks. Despite this treatment, the patient had persistent wrist pain with progressive loss of function; therefore, he was referred for hand surgery. We suggest that the persistent pain and progressive loss of wrist function in our patient were due to nonunion and loss of capitate height, as observed on radiography (Fig. 1). This was also confirmed by CT (Fig. 2) and MRI (Fig. 3).

Nonunion is one of the most common complications of capitate fractures and may occur in more than half of the such cases [5,6]. Other complications include avascular necrosis and posttraumatic arthrosis. The theories behind the higher risk of nonunion in capitate fractures are due to delayed diagnosis and treatment, in addition to the retrograde blood flow pattern [6].

Treatment of capitate fracture nonunion includes prolonged immobilization or surgical fixation. There is no consensus in the literature regarding the optimal protocol. Some authors prefer non-surgical management [7], while others have reported excellent long-term

outcomes with internal fixation [2,5,6,8]. The most commonly reported method of internal fixation is headless compression screws supported by cancellous bone autograft (either from the proximal tibia, iliac crest, or distal radius) [2,5,6,8]. In our case, we used a tricortical iliac crest autograft to restore the capitate height and fixed the capitate using one headless compression screw. We did not fix the triquetral fracture as it was a small chip fracture with no tenderness over it, which showed partial healing on CT scan.

The results of internal fixation supported by bone autografts are rewarding. Our patient achieved a Mayo wrist score of 70/100 at 1 year postoperatively compared to 15/100 preoperatively, and a score of 90/100 on his final 6-year follow-up visit.

This case report highlights a rare pattern of injury comprising a capitate fracture and triquetral avulsion injury. It also indicates the importance of proper initial management of capitate fractures to prevent further complications and loss of hand and wrist function. When nonunion is suspected, proper evaluation of capitate height and fracture displacement using CT scan can help in determining the best way to manage this complication. Open reduction and internal fixation with bone grafts have excellent outcomes as the patient in this report was satisfied with as he return to his daily activities free of pain.



Fig. 4. An AP and lateral views radiograph of right wrist at 3 months postoperatively showing union of capitate fracture and restoration of its height.



Fig. 5. An AP and lateral views radiograph of right wrist at 6-year postoperatively showing union of capitate fracture with no evidence of arthritic changes.

#### 4. Conclusion

Capitate fractures can occur in association with triquetral fractures in the absence of dislocation or greater arch injuries. Nonunion is a common complication. We recommend internal fixation and grafting for the treatment of capitate fracture nonunion.

#### Ethics approval and consent to participate

Not applicable.

#### Consent for publication

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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#### Authors' contributions

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Not applicable.

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#### Ethical approval

N/A.

#### Author contribution

Anas AR Altamimi: study concept, writing paper. Mohammed Alisi: study design, writing paper. Osama Mahmoud Al-Odat: literature review, data collection. Imad Abushahin: literature review, data

collection. Asaad Ahmad: study concept and design.

#### Registration of research studies

1. Name of the registry: N/A
2. Unique Identifying number or registration ID: N/A
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): N/A

#### Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

#### Guarantor

Anas AR Altamimi.

#### Declaration of competing interest

None For All Authors.

#### Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2021.103169>.

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