Isolated complete dislocation of hamate bone with an ulnar nerve injury: a case report and literature review

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Background: Isolated complete dislocation of the hamate bone is a rare wrist injury. Only 22 cases have been reported in the literature. Four of them were associated with nerve injury, but it is a pity that the causes of ulnar nerve injury had never been deeply analyzed. In the case report, it was stated that the ulnar nerve injury was caused by both displacement of uncinate bone and change of position of transverse carpal ligament. The complete dislocation of the hamate bone is mostly caused by direct force, often accompanied by tears of the surrounding ligaments.

Case Description: A 30-year-old woman was treated because her left hand was crushed by a machine roller. Plain film X-ray showed isolated dislocation of the volar hamate and rotation of the hamate bone to the volar side. Clinical manifestations and computed tomography (CT) signs suggest ulnar nerve injury. The patient was quickly transported to the operating room for open reduction and internal fixation of the hamate bone and repair of the dorsal carpal ligament. The patient fully recovered after 12 months.

Conclusions: Isolated complete dislocation of the hamate bone is a rare injury. The most common cause is direct compression force to the wrist. Diagnosis can be made through review of the patient's medical history, physical examination and X-ray, however, CT can accurately evaluate the displacement and rotation of the hamate bone, hamate bone fracture and other concomitant wrist fractures, suggesting compression changes of the median nerve and ulnar nerve to provide a reliable basis for the formulation of a clinical care plan. The case report added the evidence-based practice, and discussed the anatomical mechanism and imaging manifestation of ulnar nerve injury associated with complete dislocation of hamate bone.

Keywords: Hamate bone; dislocation; computed tomography (CT); ulnar nerve; case report

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Introduction

Carpal dislocation is a serious injury that may affect the stability of the wrist joint and lead to functional disability of the wrist. Complete dislocation of the hamate bone is very rare (1,2). In our routine work, we encountered a case of isolated complete dislocation of the hamate bone with an ulnar nerve injury. The clinical manifestations and computed tomography (CT) signs suggested ulnar nerve injury. We also reviewed the current literature. We presented the following case in accordance with the CARE reporting checklist (available at https://atm.amegroups.com/article/view/10.21037/atm-22-1031/rc).

Case presentation

The patient is a 30-year-old female and her left wrist was crushed by the machine roller 1 hour before. A 5 cm wound was visible on the back of the hand. The ulnar soft tissue

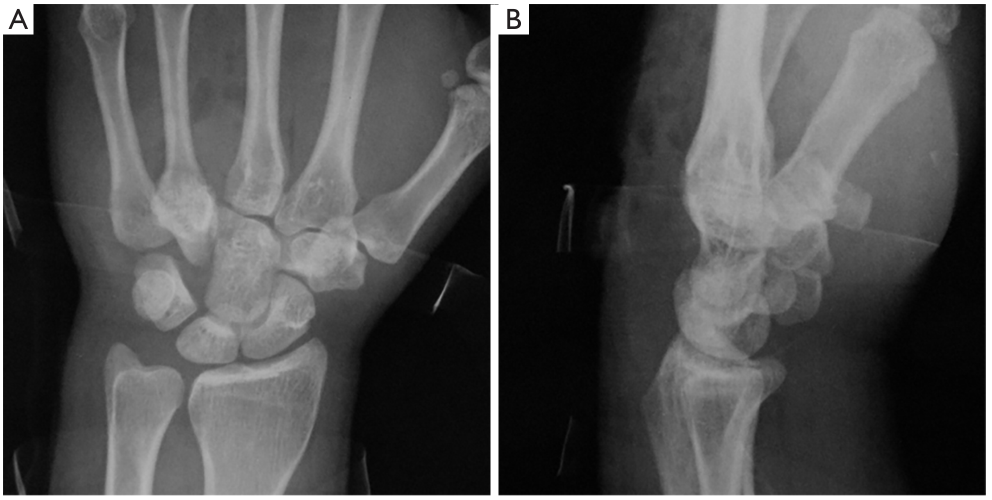

Figure 1 Plain film X-ray shows that the hamate bone shifts to the volar side and overlaps with the base of the fourth metacarpal bone, the gap between the capitate bone and the triangular bone is empty, the base of the fourth and fifth metacarpal bones shifts to the proximal side, and the soft tissue is obviously swollen.

of the wrist is obviously swollen and numb, and the active and passive activities of the wrist joint are limited. Surgical examination: the ulnar soft tissue of the left wrist was obviously swollen, the 4th and 5th carpometacarpal joints were locally elevated to the palmar side, the 4th and 5th phalanges were flexed, and the sensation of the ulnar nerve innervation area decreased. The X-ray film (*Figure 1*) shows that the hamate bone shifts and rotates to the volar and distal sides; meanwhile, there is a void between the capitate and triangular bones, the basal space of the third and fourth metacarpal bones is slightly wide, the surrounding soft tissue is obviously swollen, and the gas density is scattered in the soft tissue. CT cross section (*Figure 2A*) shows that the hamate bone is displaced to the volar side, and the walking area of the ulnar nerve is compressed and swollen; the sagittal plane (*Figure 2B*) shows that the distal end of the hamate bone is displaced to the volar and distal sides, the distal end of the hamate bone rotates to the volar and radial sides, and the soft tissue swelling on the ulnar side of the hamate bone is obvious, suggesting that the ulnar nerve is compressed; the coronal plane (*Figure 2C*) shows the emptiness between the skull and the triangular bone, suggesting a sign of hamate bone loss, and three-dimensional reconstruction of CT scan image intuitively (*Figure 2D*) shows the displacement and rotation; the basal space of the 3rd and 4th metacarpal bones was slightly wider, the basal space of the 4th and 5th metacarpal bones was slightly displaced proximal, and the surrounding soft tissue was diffusely swollen. The clinical diagnosis was isolated complete dislocation of the hamate bone.

Operation

The extensor tendon of the dorsal carpal was stretched, the dorsal carpal ligament was exposed, the ligament tear of the dorsal carpal interosseous was exposed, and the hamate bone was dislocated. Then, the hamate bone was reset, and fixed with an absorbable cartilage nail and two Kirschner wires, rivets were implanted in the dorsal carpal bone, and the dorsal carpal ligament was sutured with silk thread. The patient was followed up for 12 months until there were no symptoms of limited joint movement or pain in the wrist. The X-ray film (*Figure 3*) showed reduction of the hamate bone, suggesting the dorsal rivet of the hamate bone. Two Kirschner wires are also shown.

The entire treatment timeline reported by the patient during the course of the treatment are summarized in *Figure 4*. And no adverse and unanticipated events occurred during the course of the treatment.

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). 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 editorial office of this journal.

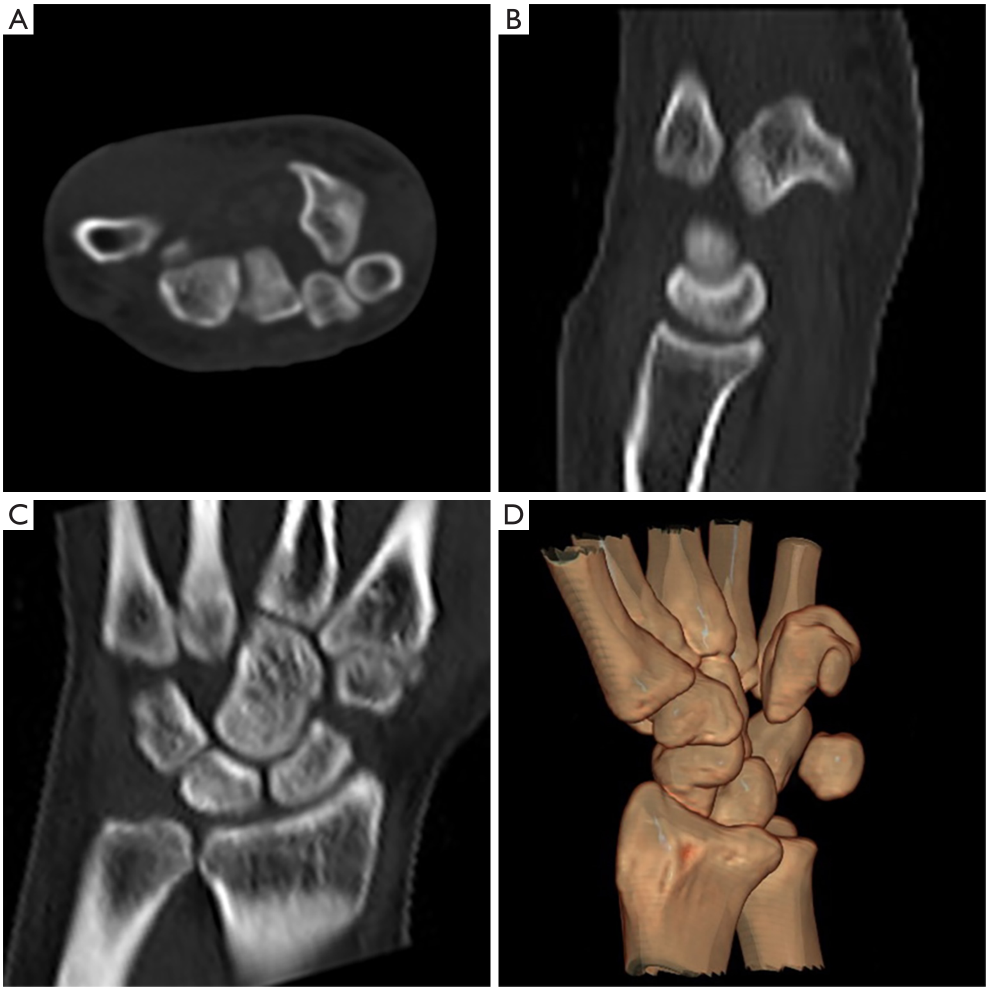

Figure 2 CT cross sections (A) showed forward rotation and displacement of the distal end of the hamate bone and compression of the walking area of the ulnar nerve. CT sagittal plane (B) showed the rotation and displacement of the distal end of the hamate bone to the volar side and the base of the 4th and 5th metacarpal bones to the proximal and dorsal sides; CT coronal plane (C) showed a void between the capitate bone and the triangular bone, suggesting the sign of loss of hamate bone, and the base of the 4th and 5th metacarpal bones had proximal displacement; CT three-dimensional reconstruction (D) showed that the hamate bone moved forward on the volar side of the wrist bone, the distal end of the hamate bone rotated to the volar side, and the base of the 4th and 5th metacarpal bones moved proximally.

Literature review

The 22 relevant papers (1-17) at home and abroad are all individual cases, of which 6 articles [Kumar *et al.* (1) in 2014, Saiz *et al.* (2) in 2020, Johansson (3) in 1926, Geist (4) in 1939, Arnaud *et al.* (5) in 1987, Zieren *et al.* (6) in 2000] were reviewed. Combined with this specific case, there were 23 additional cases: the male to female ratio of 19 patients (missing sex data for 4 patients) was 16:3. The age range of 19 patients (missing age data for 4 patients) was 18–55 years old, with an average age of 29.7±10.0 years.

Injury mechanism

There were 13 cases of direct violent crush injuries such as injuries that involved gears and heavy objects, 5 cases of traffic accidents and 5 cases of fall injuries. Seventeen patients were diagnosed after trauma, and the time to diagnosis in 6 patients ranged from 2 days to 6 months. The left-handed to right-handed ratio of 17 cases (lack of data for approximately 6 cases) was 7:10; there were 13 cases of simple complete dislocation of hamate bone and 10 cases of wrist and/or other partial fractures. This case was simple complete dislocation of the hamate bone; there

Figure 3 Postoperative plain film X-ray showed reduction of the hamate bone, suggesting the dorsal rivet of the hamate bone. Two Kirschner wires are also shown.

were 14 cases of anterior dislocation and 9 cases of posterior dislocation of the hamate bone. Among the 22 cases (1 case was not reported), 13 cases were open reduction and nail fixation (including 3 cases of operation after closed reduction failure), 7 cases of closed reduction (including 3 cases of operation after closed reduction failure), 4 cases of surgical resection and 1 case of conservative nonreduction. After follow-up from 3 months to 36 months, 7 of the 20 cases (3 cases were not mentioned) resolved well without limited joint movement and clinical symptoms, and the other 13 cases had varying degrees of wrist pain or limited joint function.

Discussion

The hamate bone is the distal carpal bone located on the ulnar side of the wrist joint, which is joined with the capitate bone, triangular bone and the fourth and fifth metacarpal bones. The proximal end of the hamate bone is conical, and the volar side of the hamate bone is the forward projection of the hamate bone, forming the radial edge of the Guyon tube through which the ulnar nerve and artery pass. A hamate bone fracture is not common, accounting for approximately 5% of wrist injuries. Dislocation is very rare, and little is known about the best treatment method (1). The first case of isolated complete dislocation of hamate bone was reported by Buchanan *et al.* (7). The dorsal side of the hamate bone and the hook of the hamate bone are covered by ligaments. These surrounding ligaments limit the displacement of the hamate bone fracture and limit the complete dislocation of the hamate bone (18).

The injury mechanism is usually a direct impact on the carpal bone, which requires a high dynamic impact to cause the dislocated hook to leave its position (1), followed by volar (8-10) or dorsal (5,6,11) dislocation. The position of dislocations depend on the magnitude and direction of the force. The direct impact on the hamate bone may tear the surrounding ligament. Combined with the integrity of the transverse carpal ligament (TCL), if the TCL is torn, the hamate bone may be dislocated to the dorsal side. If the TCL remains intact, the hamate bone may be pulled to the volar side (12). Using direct compression force that is sufficient enough to cause complete dislocation of the hamate bone, we should be vigilant about the possibility of hand tendon compartment syndrome (2,13). Comprehensive analysis of the literature shows that wrist injuries in patients with complete dislocation of the hamate bone are mostly caused by direct violent crushing injuries such as injuries that involve gears and heavy objects, accounting for 56.5% of all cases.

The male to female ratio of the complete dislocation of the hamate bone was 8.5:1. The age of onset was relatively young, with an average age of 29.3 years. There were more injuries to the right wrist than to the left wrist. In most cases, there is pain and swelling in the wrist, palm or back of the hand. Additionally, there was visible ulnar wrist bone protrusion or shortening. Attention should be given to the evaluation of nerves (2,13-15) or vascular injury. A few patients have acute osteofascial compartment syndrome (2,15).

The complex anatomical structure of the carpal bone and the insufficient mastery of the anatomical characteristics of the wrist joint are the main reasons for the misdiagnosis of the complete dislocation of the hamate bone by plain film X-rays. First, we should pay attention to the normal correspondence of the carpal bone, the three arcs corresponding to the normal carpal bone, the complete dislocation of the hamate bone usually disrupt the third carpal arcis, and the joint space between the carpal bones is basically equal to the head moon joint space. When the hamate bone is completely dislocated, the alignment of the hamate bone with the capitate bone and triangular bone is poor or even overlapped or widened. In addition, the M-shaped articular surface of the carpometacarpal joint disappears, and the hamate bone overlaps with the base of the 4th and 5th metacarpal bones. Multi-slice spiral CT

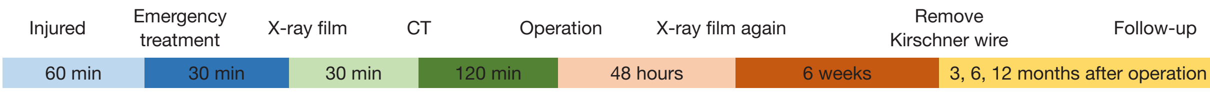

Figure 4 Timeline. Illustration of the examination and treatment received by the patient.

can more intuitively show the dislocation of the hamate bone and the associated adjacent injury. The distal end of the hamate bone rotates to the palmar side. The forward movement of the hamate bone often compresses the ulnar nerve, the transverse carpal ligament is relatively loose, and the median nerve will not be compressed. In contrast, when the distal end of the hamate bone rotates to the dorsal side, the hamate bone moves to the dorsal side, the transverse carpal ligament is in a high tension state, the carpal tunnel is compressed, and the median nerve is pinched at the same time. High-resolution CT can accurately diagnose hamate bone fracture (12,13,15,16).

What needs to be identified here is traumatic ulnar axial biased carpal dislocation, which is defined as the overall destruction of the transverse arch of the carpal bone and metacarpal bone and the loss of the normal convex relationship between the metacarpal bones (17). The hamate bone was completely dislocated, the metacarpal arch was normal, and the convex surface of the metacarpal head was complete. Ulnar axial partial carpal dislocation is mostly the dislocation of the base of the 4th and 5th metacarpal bone and the entire hamate bone, while the complete dislocation of the hamate bone is an isolated hamate bone dislocation, and the corresponding relationship of the remaining carpal bones remains intact.

The follow-up results of complete dislocation of the hamate bone were significantly different. The treatment methods are also different, including conservative observation, resection, splint fixation, closed reduction, closed reduction and percutaneous needle fixation, and open reduction with or without fixation (6,12,15). The outcomes ranged from significant loss of function to no residual symptoms or functional defects. A literature review shows that if reduction is possible, most complete dislocation of the hamate bone can be treated by closed reduction through percutaneous fixation, and open surgery is usually used in more complex or failed cases (6,12,15). Poor prognosis often results from delayed diagnosis (6).

Isolated complete dislocation of the uncinate bone is a rare wrist injury. So far, only 22 cases have been reported. Different from the previous case reports, we deeply analyzed the causes of ulnar nerve injury with the isolated complete dislocation of the uncinate bone. Also, The CT signs of nerve injury and its formation mechanism was explored. It is helpful to provide an intuitive and objective basis for the formulation of clinical treatment plan. Since this is a very rare wrist injury, only one case is the limitation of our study. The analysis and experience based on rare cases still need to be further verified. Therefore, we should further summarize and explore the biomechanical mechanism of this kind of injury to help to treatment decision-making.

Conclusions

We conclude that isolated complete dislocation of the hamate bone is a rare injury, and the most common cause is the compression of direct force to the wrist. Diagnosis can be performed through medical history, physical examination and X-ray, however, computed tomography (CT) can accurately evaluate the displacement and rotation of the hamate bone, hamate bone fracture and other wrist concomitant fractures. When the distal end of the hamate bone rotates and displaces to the palmar side, it often damages the ulnar nerve, and when the distal end of the hamate bone rotates and displaces to the dorsal side, it often damages the median nerve. Meanwhile, the three-dimensional reconstruction of CT scan images provides an intuitive and reliable basis for the formulation of surgical treatment plans.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at https://atm.amegroups.com/article/view/10.21037/atm-22-1031/rc

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://atm.

amegroups.com/article/view/10.21037/atm-22-1031/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). 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 editorial office of this journal.

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