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Case Report

Uncommon Dorsal Radiocarpal Fracture Dislocation Complicated With Median Nerve Palsy: Case Report, Review of the Literature, and a New Classification System Guiding the Management

罕見的手腕橈骨骨折及背側橈腕關節脫位伴有正中神經併發症之病例報告、文獻回顧及新的分類系統導引其治療方法

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ABSTRACT

We report the case of a 36-year-old lorry driver who sustained left dorsal radiocarpal fracture dislocation and left median nerve injury in a traffic accident in 2010. Emergency operation of closed reduction, cross-wrist-bridging external fixation, percutaneous transradial styloid Kirschner wire fixation, decompression of left median nerve, and repair of the partially torn palmar radiocarpal ligament were performed under general anaesthesia. Because of the persistent depressed dorsal articular rim fracture of left distal radius, another operation of open reduction, corticocancellous bone grafting, and dorsal buttress plating was performed 5 days after the initial operation. Six months after the operation, the patient enjoyed good range of wrist motion but weak twisting power, especially in supination. There was no radiological feature of radiocarpal subluxation.

中 文 摘 要

本文報告一名三十六歲貨車司機在二零一零年一宗交通意外中遭受左手手腕橈骨及尺骨莖突骨折與橈腕關節背側脫位和正中神經受傷。他接受緊急正中神經減壓手術，橈骨莖突骨折復位及以鋼針內固定，橈腕關節背側脫位復位後並且以外固定支架固定，我們並將部份撕脫了的橈腕掌側韌帶修補。因橈骨背關節面邊緣仍然下陷，五天之後，他接受了第二次手術，我們以開放式復位方法、植骨、及以支持鋼板作內固定。手術後六個月他的左手手腕活動能力恢復良好，但是手腕的旋後力量較弱。X光顯示沒有橈腕關節半脫位的情況。

Introduction

Radiocarpal fracture dislocation is a rare complex injury that usually follows a high-velocity trauma. It is associated with various ligamentous injuries and fracture patterns. There is no consensus concerning the treatment protocol.

Case Report

A 36-year-old male lorry driver sustained a catapult injury of his left wrist as his lorry turned over in a traffic accident in 2010. He landed on pronated outstretched left wrist. He complained of left wrist pain and left hand numbness immediately after the injury. On examination, there were swollen left wrist, a palmar radial abrasion wound, and paraesthesia in the distribution of median nerve, but a good distal circulation. Radiographs revealed dorsal radiocarpal dislocation with displaced fractures of both radial and ulnar styloid processes as well as a depressed dorsal articular rim of the left distal radius (Figure 1A).

Closed reduction under sedation failed, and an emergency operation was performed under general anaesthesia. The radiocarpal dislocation was reduced with traction and pronation of left wrist under radiological control. The radial styloid fracture was reduced by palmar flexion and ulnar deviation (Figure 1B). Cross-wrist-bridging external fixator was applied, and percutaneous transradial styloid fixation with two 1.4-mm Kirschner wires (K-wires) was performed (Figure 1C). Then, the median nerve was explored and adequately decompressed (Figure 2A). The deep radioscapholunate ligament was avulsed from the distal radius at

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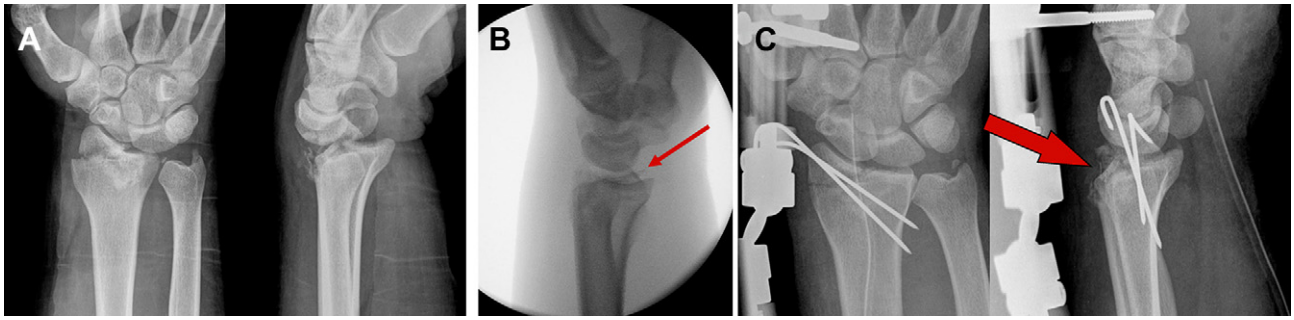

Figure 1. (A) Radiocarpal joint was dorsally dislocated with fractures of radial, ulnar styloid processes and depressed dorsal articular rim fracture of left distal radius. (B) A tiny radio-opaque shadow (red arrow) was seen inside the palmar radiocarpal joint in lateral view. An osteochondral fragment was suspected. (C) Radiocarpal joint was reduced and radial styloid fracture was fixed with Kirschner wires. Dorsal articular fragment (red arrow) was unreduced.

the rim of the lunate fossa and folded into the radiocarpal joint together with two tiny pieces of osteochondral fragments that were avulsed from palmar rim of distal radius at the lunate fossa (Figure 2B). These two tiny (about 2 mm thick) osteochondral fragments were excised. The ligament was then retrieved and repaired with suture by drilling holes in the distal radius.

A computed tomography scan of left wrist performed 1 day after the initial operation revealed unreduced depressed dorsal articular rim fracture of left distal radius. There was also a palmar die-punch fracture of distal radius at the lunate fossa (Figure 3A). The second operation was performed 5 days after the first operation. It included open reduction, internal fixation with Arbeitsgemeinschaft für Osteosynthesefragen (AO) 2.4-mm L-shaped titanium locking plate, and corticocancellous bone grafting harvested from the iliac crest for the depressed dorsal articular rim fracture of left distal radius through dorsal approach and exchange of transradial styloid K-wires with 3.5-mm cannulated screws (Figure 3B).

He was given a protective short arm slab for 3 weeks post-operatively. Gentle active mobilisation exercise of left wrist was started at 3 weeks. However, he defaulted the rehabilitation programme at 7 weeks. Finally, objective assessment could be accomplished at 6 months.

Result

The median nerve recovered completely 4 weeks after the operation. At the 6th month, there was no left wrist pain. He enjoyed 55° flexion, 50° extension, and full radial and ulnar deviation of left wrist motion. The power grip and the pinch grip were 30.0 kgf and 8.0 kgf, respectively, for left hand, and 58.0 kgf and 11.5 kgf, respectively, for right hand. The rotation strength was much weaker on left wrist, especially in supination. The power of supination was 39 lbs for left hand and 76.3 lbs for right hand. The power of pronation was 50.3 lbs for left hand and 77.7 lbs for right hand. It was limited by pain. He had resumed his duty as a lorry driver 8 weeks after the operation.

Subsequent radiographs showed that the radial styloid fracture had healed and there was no scapholunate dissociation even on fisting view. The lateral scapholunate angle was 50° (for right wrist, it was 47°) (Figure 4). There was no radiocarpal subluxation shown on flexion/extension views. By the method of Chamay, "the carpal translation index" was used to see whether there was any ulnocarpal displacement.[1] The index (0.28 ± 0.03) was 0.31 for left wrist and 0.29 for right wrist. There was no significant ulnar carpal translation.

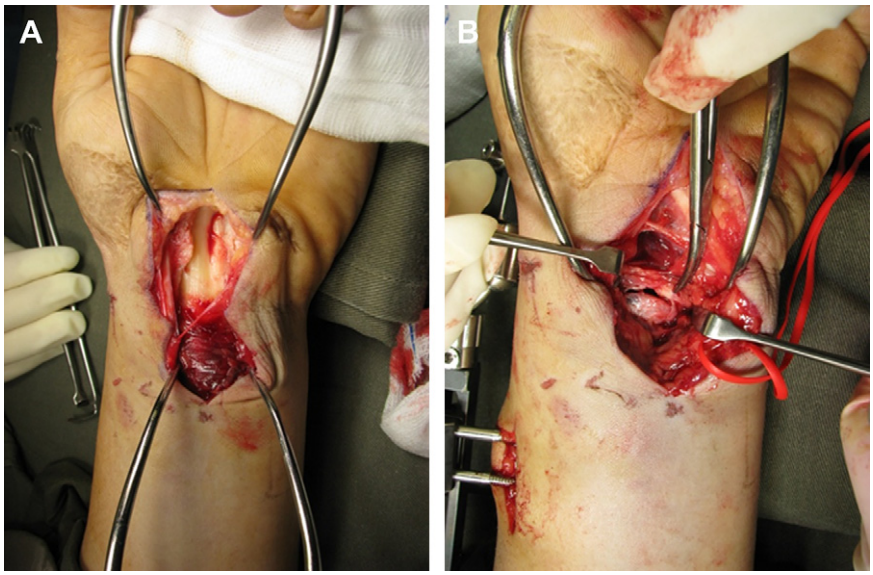

Figure 2. (A) Diffuse bruising around the median nerve was noted. (B) Palmar radiocarpal ligament that adhered with two tiny osteochondral fragments were avulsed from palmar rim of distal radius at lunate fossa.

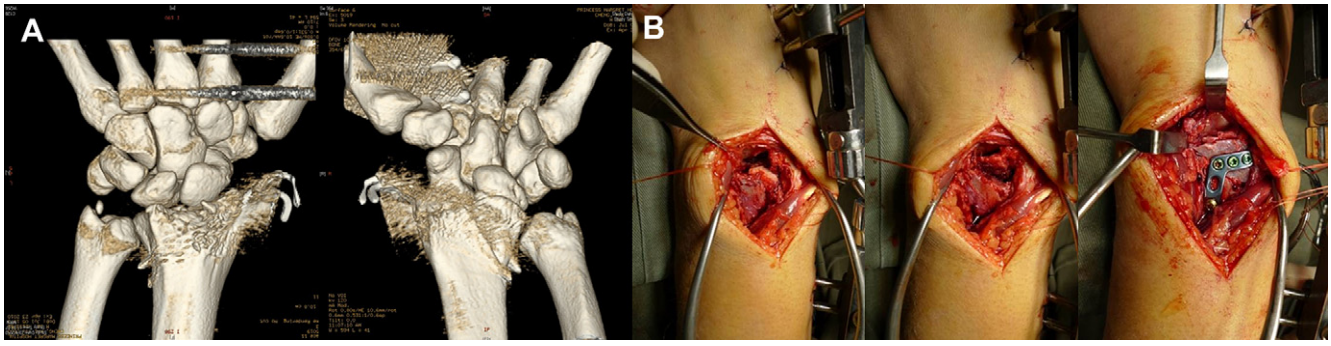

Figure 3. (A) Computed tomography scan showed an unreduced depressed dorsal articular rim fracture of left distal radius and a palmar die-punch fracture of distal radius at lunate fossa. (B) The depressed dorsal articular rim fracture of left distal radius was elevated and reduced. The corticocancellous graft was applied and fixed with buttress plate.

Discussion

In the literature review, dorsal radiocarpal fracture dislocation is slightly more common than palmar counterpart. Open injuries were more frequently seen in dorsal radiocarpal fracture dislocation. Traction neuropraxia is common, especially in dorsal radiocarpal fracture dislocation.[2–6] Median nerve appears to be involved more frequently than the ulnar nerve. Circulatory embarrassment is sometimes present.[2]

Weiss et al[3] were able to produce dorsal radiocarpal dissociation with disruption of the distal radioulnar joint by applying compressive and torsional force to a hyperextended and pronated wrist. A torsional element was essential to produce a radiocarpal dislocation with fractures of the radial and ulnar styloid processes. Freeland et al[7] concluded that shearing forces at the palmar or dorsal edges of the radiocarpal joint, often accompanied by excessive reciprocal rotation force, have been implicated as the principal mechanism causing radiocarpal dislocation and instability. In our case, hyperextension and torsion at the level of radiocarpal joint apparently caused partial tear of the palmar radiocarpal ligament. The torsion and compression force from the impact resulted in fractures of both radial and ulnar styloid processes, dorsal articular rim of distal radius, and die-punch fragment of distal radius at the lunate fossa.

Dorsal radiocarpal dislocation is frequently associated with fractures of the radial and the ulnar styloid processes[2–6]; adjacent injuries, such as distal radioulnar joint injuries; and dissociative wrist injuries, which are dictated by the direction of shearing force exiting through the proximal arc of the wrist. Combined radial and ulnar styloid fractures may hallmark “proximal arc” radiocarpal instabilities as, sometimes, spontaneous reduction of radiocarpal joint may mask radiocarpal dislocation. Therefore, combined styloid fractures should not be overlooked as they may be associated with significant soft tissue compromise.[7]

Two classifications have been proposed to guide the treatment decision by Dumontier et al[5] and Moneim et al.[8] However, they are not comprehensive enough to include all varieties of associated adjacent injuries, though they do point out the importance to restore bony and ligamentous structures so as to restore the stability of the radiocarpal joint and to prevent its chronic sequelae.

After reviewing all the literature, we classify this into three types that can guide our treatment.

Type 1: It includes pure radiocarpal dislocation or an additional tiny irreparable radial styloid tip avulsion. It is equivalent to Type 1 of Dumontier et al’s[5] classification. All palmar radiocarpal ligaments were torn or avulsion fractures were present at the insertion site.[5] They must be treated with reattachment of the ligaments through a palmar approach and temporary radiolunate fixation. Ulnar and volar carpal translocations are common and should always be ruled out because of late translational radiocarpal instability. Delayed reconstruction of this highly unstable condition often yields a disappointing result.[5] The attenuation of radiocarpal ligament may account for the delayed presentation of the radiocarpal instability and poor results. Our case also showed a small increase of the radioscaphoid gap, which may be an early sign of radiocarpal ligament attenuation. Longer follow-up of the patient is needed.

Type 2: It includes radiocarpal dislocation with a large radial styloid fracture through the scaphoid fossa with or without a basal fracture of the ulnar styloid process or dorsal/palmar articular rim fractures. These fractures contribute significantly to the instability of the radiocarpal joint. Anatomical reduction of these fractures is essential to restore the articular congruency so as to achieve bony and ligamentous stability, prevent subluxation, and minimise secondary osteoarthritis. Anatomical reduction of a large radial styloid fragment is warranted if the

Figure 4. The fractures healed and there was no radiological feature of radiocarpal subluxation on stress view.

radial styloid process fracture involves more than one-third of the width of the scaphoid fossa because the major palmar radiocarpal ligaments are probably intact and remain attached to it.[5] Casting with internal fixation for isolated radial styloid fracture after its reduction has generated good results.[5,8] Moneim et al[8] reserved open reduction for cases with failed closed reduction and those requiring anatomical reduction of radial styloid. Dumontier et al[5] recommended that exact articular reduction and K-wire fixation of radial styloid fragment should be performed through a dorsal approach. Our case belonged to Type 2, and we used screw fixation of the radial styloid fracture that was more stable than K-wires.

Reduction and fixation of any basal ulnar styloid process fracture are also crucial in restoring the triangular fibrocartilagenous complex integrity and contributing to the distal radioulnar joint stability. For any associated impacted dorsal articular rim depressed fractures, just as in our case, congruent reduction requiring elevation of the impacted depressed articular fragment, bone grafting, and buttress plating through dorsal approach were recommended. It can prevent dorsal carpal subluxation.[4] For any large palmar articular rim fractures, just like palmar Barton's fracture, the palmar articular fragment should be fixed with internal fixation through palmar approach. Bone stability restoration is the key in Type 2 injury.

Type 3: It includes more complex injury patterns, such as associated injury of distal radioulnar joint, dissociated wrist, or carpal bone injuries. In general, the outcome of the patients with associated carpal injuries is relatively poor.[4,8] A high rate of open reduction and internal fixation for these injuries was reported by Bilos et al.[2] Open reduction and ligament repair for carpal injuries through dorsal approach were recommended.[8,9] Concomitant irreducible distal radioulnar dislocation associated with soft tissue interposition rendered closed reduction difficult.[3,6,10] Open reduction and surgical treatment are usually warranted. Some of them even required later reconstruction.[2,3,5,10] The distal radioulnar joint should be immobilised or pinned in full supination.

Conclusion

Radiocarpal fracture dislocation is a complex injury and can be further complicated by associated adjacent injuries. All these injuries are inherently unstable. It is important to define the extent of the bony and ligamentous injuries. Surgical interventions in terms of closed or open reduction, internal fixation of fractures, and repair of the torn ligaments are frequently required to re-establish wrist extrinsic ligamentous stability and articular congruency. For Type 1 injury, ligamentous repair is warranted, whereas fracture reduction and fixation are usually indicated for Type 2 injury. For Type 3 injury, we should always address the adjacent injuries. The surgical approach should be selected according to the pathoanatomy of radiocarpal joint and adjacent injuries. Our classification serves to outline the principles of the management of this rare unstable injury.

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