Case Reports: Volar Marginal Articular Fractures with Loss of Articular Apposition

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Abstract Five patients with a volar marginal articular fracture with dislocation (complete loss of apposition of the articular surfaces) were treated with open reduction and internal plate fixation. This is an unusual type of volar shearing fracture and represents the volar type of radiocarpal fracture–dislocation. The results of treatment were comparable to other volar shearing type fractures.

Keywords Volar shearing distal radius fracture · Radiocarpal fracture–dislocation

Introduction

The typical volar shearing fracture (known eponymically as volar Barton's fractures) features subluxation of the radiocarpal articulation. Either the volar fragment is large and the carpus subluxates volarly with the majority of the distal radius articular surface, or it is smaller, but there is some residual apposition or contact between the dorsal part of the distal radial articular surface and the articular surfaces of the scaphoid and lunate. Complete loss of apposition of the articular surfaces (dislocation) is very uncommon with

volar marginal articular fractures. We defined a volar marginal articular fracture with loss of articular apposition as any shearing fracture of the volar articular surface of the distal radius where 50% or more of the dorsal part of the distal radial articular surface remained intact (unfractured) and the lunate and scaphoid were completely dislocated from this surface (no articular apposition or contact; Figs. 1 and 2).

Whether or not to consider this injury pattern as a volar radiocarpal fracture–dislocation is debatable as reflected in the diversity of definitions of volar subluxations and dislocations as reported in the literature. A total of 12 prior cases designated as volar radiocarpal fracture–dislocations were identified in the published literature since 1901 [3, 6–9, 16–19]. It is unclear how many fractures might have been considered volar radiocarpal fracture–dislocations according to our definition.

In this study, we present five cases of volar marginal articular fractures with loss of articular apposition. These cases are pulled from a large prospective cohort study on plate fixation of unstable distal radius fractures using a titanium, precontoured, distal radius-specific T-shaped plate and 2.4-mm locking screws and/or a stainless steel standard oblique T-shaped plate with locking 3.5-mm screws. Each patient was evaluated according to the system of Gartland and Werley [10], completed the Disabilities of the Arm, Shoulder, and Hand (DASH) [14] questionnaire at 6 months, 1 year, and 2 years after initial surgery. Pain at rest and in motion was evaluated at each time point on a Visual Analogue Scale (VAS) between 0, representing no pain, and 10, representing the worst possible pain.

The purpose of reporting these cases is to clarify the definition of this injury pattern and raise the possibility that it may be more common than previously recognized.

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Figure 1 A 31-year-old man was injured in a motor vehicle collision (patient 1). **a, b** Lateral (**a**) and posteroanterior (**b**) wrist radiographs taken immediately after injury demonstrate dislocation of the radiocarpal articular surfaces and a volar marginal articular fracture. **c, d** Oblique lateral and posteroanterior radiographs of the wrist 2 years after open reduction and internal fixation of the fracture of the distal radius and ulnar styloid show healing of the fractures, no implant problems, and adequate alignment. The patient regained 125° of wrist flexion and extension and full forearm rotation.

Patients

Patient 1

A 41-year-old man, a consultant, injured his right dominant wrist when his motorcycle collided with a parked car. He

presented with wrist deformity, severe swelling, ecchymosis, and a skin abrasion on the dorsal aspect of the wrist. Radiographs showed a volar radiocarpal fracture–dislocation (AO type B3.3) of the wrist and a concomitant fracture at the base of the ulnar styloid. There were no other injuries to the ipsilateral limb. The fracture–dislocation was

Figure 2 The first available lateral radiograph for each of the other four patients. **a** Patient 2. A 43-year-old man injured in a game of soccer. **b** Patient 3. A 50-year-old man injured in a fall from his motorcycle. Radiograph after reduction of the fracture. **c** Patient 4. A 37-year-old man injured in a motor vehicle collision. **d** Patient 5. A 59-year-old man injured in a bicycle collision.

reduced in the emergency department and supported by a splint.

Eight days later, he had open reduction and volar plate (2.4-mm locking compression plate (LCP), Synthes, Paoli, PA, USA) fixation of the distal radius using Henry's approach through the sheath of the flexor carpi radialis [13]. The ulnar styloid base fracture was fixed with a Kirschner wire and figure-of-8 wire loop.

Two years after surgery, the patient had returned to his pre-injury level of work, the fracture was healed without loss of alignment or implant problems, and there were no complications. Physical examination showed a flexion–extension arc of 125° (or 89%), pronation–supination arc of 170° (or 94%), radio-ulnar deviation arc of 75° (or 94%), grip strength of 100% of the opposite arm, and a DASH score of 30 points. The patient reported minimal pain in motion (VAS 2). Radiographic evaluation revealed signs of slight joint space narrowing (Knirk and Jupiter grade 1) [15]. According to the Gartland and Werley score, his functional outcome was considered fair.

Patient 2

A 43-year-old man, a desk worker, injured his left nondominant wrist while participating in a game of soccer (AO B3.3). There were no injuries to the carpal ligaments, and there was no neurovascular dysfunction. There were no other injuries to the ipsilateral limb. The fracture–dislocation was reduced in the emergency department and supported by a splint. Two days later, the fracture was repaired with a volar T-shaped plate from the pi-plate set (Synthes) through Henry's exposure.

Six months after surgery, the fracture was healed without loss of alignment or implant problems, and the patient had returned to his pre-injury level of work. Physical examination showed a flexion–extension arc of 160° (or 100%), pronation–supination arc of 180° (or 100%), radio-ulnar deviation of 70° (or 100%), and grip strength 78% of opposite hand, and he reported no pain. Radiographic evaluation did not show signs of arthrosis. According to the Gartland and Werley score, his outcome was excellent.

Patient 3

A 50-year-old man, a copy shop worker, injured his right dominant wrist after a fall from his motorcycle. He presented with wrist deformity, severe swelling, ecchymosis, and a skin abrasion on the volar aspect of the wrist. Radiographs showed a volar radiocarpal fracture–dislocation (AO type B3.3) of the wrist, a concomitant ulnar styloid base fracture, and a scapholunate dissociation.

Five days after injury, the fracture was repaired with a 2.4-mm LCP plate. The scapholunate interval was reduced

and secured with two Kirschner wires. The ulnar styloid base fracture was left untreated. Complications of the surgical procedure were not reported.

Two years after surgery, the patient had returned to his pre-injury level of work, the fracture was healed without loss of alignment or implant problems, and there were no complications. Physical examination showed a flexion–extension arc of 110° (or 85%), pronation–supination arc of 180° (or 100%), radio-ulnar deviation of 60° (or 86%), grip strength of 68% of the opposite hand, and a DASH score of 0, and he reported no pain. Radiographic evaluation revealed marked joint space narrowing (grade 2). According to the Gartland and Werley score, his outcome was excellent.

Patient 4

A 37-year-old man, a police man, injured his right dominant wrist in a motor vehicle collision. He presented with a severe deformity of the wrist, swelling, ecchymosis, and an abrasion of the skin on the dorsal aspect of the wrist. Radiographs showed a volar radiocarpal fracture–dislocation (AO type B3.3) of the wrist and an ipsilateral nondisplaced transverse fracture of second proximal phalanx. The fracture–dislocation was manually reduced at the emergency department and supported by a splint.

Three days later, he had open reduction and volar plate fixation using a small fragment T-plate (Synthes). The fracture of the proximal phalanx was supported by a tape bandage. Complications of the surgical procedure were not reported.

Two years after surgery, the patient had returned to his pre-injury level of work, the fracture was healed without implant problems, and there were no complications. Physical examination showed a flexion–extension arc of 150° (or 97%), pronation–supination arc of 180° (or 100%), radio-ulnar deviation of 75° (or 94%), grip strength of 92% of the opposite hand, and a DASH score of 0, and he reported no pain. Radiographic evaluation showed a 2-mm ulnar translocation [4] of the carpus, likely reflecting rupture of the radioscaphocapitate ligament, but without signs of arthrosis. According to the Gartland and Werley score, his functional outcome was fair.

Patient 5

A 59-year-old librarian injured his right dominant limb when his bicycle collided with a car. He presented with wrist deformity, swelling, ecchymosis, and an abrasion of the skin. In addition, there was marked tenderness and swelling on the lateral end of the clavicular bone. Radiographs showed a volar radiocarpal fracture–dislocation (AO type B3.3) of the wrist and a fracture at the lateral end of the clavicular bone. The fracture–dislocation was reduced at the emergency department and supported by a splint.

Three days later, he had open reduction and volar plate (3.5-mm LCP, Synthes) fixation of the distal radius. Two years after surgery, the patient had returned to his pre-injury level of work, the fracture was healed without loss of alignment or implant problems, and there were no complications. Physical examination showed a flexion–extension arc of 150° (or 94%), pronation–supination arc of 180° (or 100%), radio-ulnar deviation of 75° (or 94%), grip strength 92% of opposite hand, and a DASH score of 0, and he reported no pain. Radiographic evaluation did not show signs of radiocarpal arthrosis. According to the Gartland and Werley score, his outcome was excellent.

Discussion

Our five patients were similar to the 12 prior cases reported as volar radiocarpal fracture–dislocations in the literature in that they largely resulted from high-energy injuries such as falls from height and motor vehicle collisions [2]. All five patients had isolated injuries, and none had open wounds or neurovascular problems. Open reduction and internal fixation resulted in satisfactory function in three of five patients according to the Gartland and Werley score, and specific complications were not encountered.

These fractures would seem to be a variant of a volar Barton's fracture–subluxation. The majority of these injuries featured relatively small fractures of the volar articular margin of the distal radius, with one involving the lunate facet alone. It is now recognized that a substantial number of volar shearing or volar Barton's injuries are actually complete articular (AO Type C) injuries [11]—in other words, there is a concomitant fracture of the dorsal metaphysis. We speculate that either rotation of this dorsal fracture fragment inferiorly or impaction of central articular fragments (another common variation of volar Barton's fractures) substitutes for complete dislocation of the radiocarpal articulation in many instances.

A volar marginal articular fracture with loss of articular apposition that involves the entire volar lip will maintain the intact volar radiocarpal ligaments attached to the fracture fragments. The patient with the fracture of the lunate facet fracture alone probably ruptured the radioscapohcapitate ligament, although this was not clearly described in the operative note (Fig. 2). We suspect the dorsal wrist capsule and the dorsal radiocarpal ligaments are almost certainly torn in this injury. The volar lunate facet has the important radiolunate ligament origins. The volar projection of the lunate facet is a thin and vulnerable structure that can be challenging to secure with internal fixation [1]. For very

small fracture fragments involving the volar lunate facet, a wire or suture loop [5] or Kirschner wire or wire-form (Medoff R; poster presented at the Annual Meeting of the Orthopaedic Trauma Association 2000) may be of particular help. Loss of fixation of this fragment can lead to complete dislocation of the radiocarpal joint [12]. Larger fragments are easily supported with a volar buttress plate. Provided that the radiocarpal joint is held reduced by supporting the volar articular margin, the results of treatment of complete volar marginal articular fractures with loss of articular apposition seem comparable to other types of volar Barton's fractures. These injuries are often due to high-energy mechanisms in relatively young patients and do not seem to feature either dorsal fracture lines or central articular impaction. Some degree of permanent impairment is to be expected even with an excellent radiographical result.

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