Flexor Tendon Problems after Volar Plate Fixation of Distal Radius Fractures

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Abstract Four cases of flexor tendon problems which developed after volar plate fixation of distal radius fractures are presented. All cases were associated with close contact of the screws or distal edge of the plate with the flexor tendons. Poor bone stock or multiple bone fragments allowing loosening of the plate or non-locking screws cause the hardware to irritate the flexor tendons and ultimately lead to rupture. The flexor tendons involved include the flexor carpi radialis, flexor pollicis longus and flexor digitorum superficialis, and flexor digitorum profundus to the index and long fingers.

Keywords Flexor tendon · Distal radius fractures · Volar plate fixation

Introduction

Fractures of the distal radius are common and can be treated by a variety of surgical and non-surgical methods. In the past 10 years, an increasing interest in volar plate fixation for these fractures has evolved. Recent reports on the use of

volar fixed angle plates for the treatment of distal radius fractures state that volar plate fixation of these fractures may reduce the incidence of flexor and extensor tendon problems compared to dorsal plate fixation [6, 8, 10]. The presence of the pronator quadratus muscle between the plate and flexor tendons, and the concavity of the distal radius (for placement of the plate) may decrease or minimize flexor tendon problems [6, 7, 10].

Thirteen cases of complete tendon rupture after volar plate fixation of distal radius fractures have been reported in the literature to date [1–3, 5, 10]. Some have been attributed to plate or screw design [3], chronic steroid use, fracture collapse [1], sub-optimal placement [1, 3], or incorrect plate usage [5]. We report four patients whose flexor tendon complications after volar plate fixation were not attributed to these previously reported factors.

Case 1

A 75-year-old woman sustained bilateral distal radius fractures during a fall. She underwent open reduction and internal fixation (ORIF) of both distal radii with Hand Innovations distal radius plates (Hand Innovations LLC, Miami, FL now DePuy Orthopaedics Inc, Warsaw, IN). The right ulnar styloid was also fixed with a Kirschner wire.

One year postoperatively, she was referred to our institution with a 6-month history of inability to fully actively flex the right index finger. At presentation, she had soft tissue swelling of the volar forearm with loss of full active flexion of the index finger and limited flexion of the distal interphalangeal joint of the long finger. On lateral X-ray, the distal portion of the plate appeared to be separated from the distal radius (Fig. 1).

At surgery, she was found to have complete rupture of the flexor digitorum profundus (FDP) and flexor digitorum

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Figure 1 Case 1: distal portion of volar plate separated from distal radius on lateral X-ray, marked by an *arrow*.

superficialis (FDS) to the index finger. However, there was scar tissue holding the separated ends of the index finger FDS tendon in continuity. The FDP and FDS tendons to the long finger were partially ruptured. Upon removal of the hardware, one screw was noted to be slightly loose; the plate itself was well-seated. The area of tendon ruptures was found slightly proximal to the distal plate edge; the area of flexor tenosynovitis extended beyond it into the carpal tunnel (Fig. 2). A carpal tunnel release was performed with a tenosynovectomy. The flexor tendons were repaired with tendon grafts.

Case 2

A 42-year-old woman presented 2 days after sustaining intra-articular distal radius and ulnar styloid fractures

Figure 2 Case 1: intraoperative findings of flexor tenosynovitis, marked by an *arrow*.

Figure 3 Case 2: prominent distal portion of volar plate on lateral X-ray, marked by an *arrow*.

following a fall onto her outstretched left arm. She underwent ORIF of her fracture with a Viper volar plate (Kinetikos Medical Inc, Carlsbad, CA).

Four months later, she developed gradual swelling of the volar wrist followed by another “pop” and loss of flexion of the interphalangeal joint of the thumb. The distal plate edge was prominent on X-ray (Fig. 3). At surgery, the plate and all screws were noted to be loose. She was found to have complete rupture of the flexor pollicis longus (FPL) tendon and 80% rupture of the flexor carpi radialis (FCR) tendon. The areas of rupture of the involved tendons were in proximity to the prominent plate edge. The plate and screws were removed and the tendon was repaired with a tendon graft.

Case 3

A 64-year-old woman was referred to our institution 6 months after undergoing ORIF of a distal radius fracture with an Acumed volar distal radius plate (Acumed LLC, Hillsboro, OR). She had returned to full unrestricted use of the operative hand until 5 months postoperatively when she felt a “pop” in her distal forearm followed by weakness and pain with flexion of her thumb and index finger. Physical examination at our institution confirmed weakness of thumb and index finger flexion. X-rays showed maintenance of reduction without loosening of the plate (Fig. 4). The patient’s persistent pain and weakness with thumb and index finger flexion prompted a return to surgery. Surgical exploration revealed a partial rupture of the FPL tendon and tenosynovitis. Once again, the area of tendon injury was at the distal plate edge. A tenosynovectomy and plate removal was performed. The FPL tendon was repaired with a tendon graft.

Figure 4 Case 3: volar plate appears well-seated on X-ray.

Case 4

An 85-year-old woman was referred to our institution with pain in the right wrist, stiffness of the index and long fingers and paresthesias in the median nerve distribution. Six years prior to this presentation, she had undergone ORIF of a comminuted intra-articular fracture of the right distal radius with bone grafting and a Synthes volar plate (Synthes Inc, West Chester, PA). A fractured radial styloid was also fixed via a dorsal approach with a Kirschner wire and cannulated screw. She also underwent open carpal tunnel release.

Examination showed diffuse soft tissue swelling at the volar wrist with restriction of digital flexion and inability to actively make a fist. Nerve conduction studies were suggestive of carpal tunnel syndrome. On lateral X-ray, the plate appeared to be well-seated (Fig. 5). The pain, loss of tendon function, and carpal tunnel syndrome prompted a return to surgery. Surgical findings included flexor tenosynovitis extending beyond the plate edge and hematoma. She underwent retrieval of the

Figure 5 Case 4: volar plate appears well-seated on X-ray.

Figure 6 Case 4: intraoperative findings of hematoma and flexor tenosynovitis.

hardware, tenosynovectomy of all flexor tendons and recurrent carpal tunnel release (Fig. 6). The patient was taking a daily aspirin, which along with the chronic irritation, was thought to be the cause of the hematoma.

Discussion

A stated advantage of volar plate fixation for distal radius fractures is a decreased incidence of tendon problems. There are, however, case reports and small series of patients with tendon problems after volar plate fixation. Thirteen complete ruptures [1–3, 5, 10] and three partial ruptures [1, 2] have been reported. A series of four patients with flexor tendon injuries was reported by Bell et al. [1]. Three complete FPL tendon ruptures and one each partial rupture of the FPL tendon or FDP tendon to the long finger after volar plate fixation with either a low contact T-buttress plate, five-hole volar T-plate, or six-hole volar buttress plate were reported. The ruptures were attributed to distal plate edges that were initially placed too distally or became prominent following fracture collapse.

In a recent retrospective study by Letsch and associates [4] comparing the outcomes of volar and dorsal plating of 122 distal radius fractures, there were no cases of tendon irritation or rupture reported for either approach.

A recent retrospective study by Rozental and Blazar [9] reviewed the functional outcomes and complications of 41 patients with dorsally displaced distal radius fractures treated with volar plating. At an average of 12 months postoperative, three patients (7%) required hardware removal for soft tissue complications. Two patients had flexor carpi radialis tendon irritation with FPL tendon subluxation over the plate.

Volar plate fixation of distal radius fractures was developed as an alternative to dorsal plate fixation in order to avoid tendon complications. In addition, the volar approach may improve fracture healing as it avoids disruption of the dorsal

retinaculum [6, 8] and is less likely to disturb the blood supply to distal fracture fragments [7, 8]. Also, maintaining the integrity of the dorsal periosteum, tendons, and retinaculum may facilitate indirect fracture reduction [6, 10]. Placement of the distal pegs in the stable subchondral bone is advantageous in osteoporotic bone, and may be easier to accomplish with a volar approach [7, 10]. The volar cortex is usually less comminuted and may result in more rigid fixation [7]. Finally, this approach allows for release of the pronator quadratus muscle if it is trapped in the fracture site [6].

As with any fracture fixation method, appropriate patient selection and careful surgical technique are necessary for preventing complications including injury to the flexor tendons. Proper placement of the volar plate is essential. In each of the cases reported here, whether the plate was found to be loose or not, the irritated flexor tendons were found in close contact with its distal edge. The distal radius has a “watershed” line where the concavity of the distal radius ends and the flexor tendons are in contact with the bone [7]. Placement of the plate in this concavity with its distal edge well proximal to the “watershed” line negates the possibility of contact between it and the flexor tendons. Repair of the pronator quadratus muscle provides soft tissue coverage between the plate and flexor tendons. However, some have observed that this muscle can be flimsy, especially in middle-aged women, and not provide significant plate coverage [2]. Early plate retrieval should be done if reduction or fixation is lost to prevent possible tendon irritation [1, 7].

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