Functional Outcome of Dorsal Plating in the Distal Radius: is the Extensor Pollicis Longus in Danger?

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ABSTRACT

Open reduction and internal fixation of distal fractures of radius using a dorsal plate is an accepted technique. Extensor tenosynovitis and rupture of the extensor pollicis longus tendon have been reported as complications after dorsal plating. The purpose of this study was to assess the extensor pollicis longus and the functional outcome of dorsally displaced fractures of distal radius treated by dorsal plating. A prospective study was performed on 36 patients with

dorsally displaced distal radius fractures (AO classification type C1 and C2) who underwent

open reduction and internal fixation with AO T dorsal plate. After fracture fixation, the extensor retinaculum was sutured over the plate and the extensor pollicis longus left superficial to it. The Mayo wrist score was used to assess the functional outcome after six months of surgery and the plate was removed. The mean age of the patients was 34 years. 21 patients were classified as AO type C1 and 15 patients as C2. All fractures had united at six months. There were no associated extensor pollicis longus ruptures. The incidence of tenosynovitis was 5.55%. The functional outcome at six months was rated as excellent or good.The functional outcome of dorsal plating has good to excellent results with minimal incidence of extensor tenosynovitis and the extensor pollicis longus is not at risk.

Key words: distal radius fractures; dorsal plating; functional outcome

INTRODUCTION

Fractures of the distal radius are common injuries among adults and comprise up to 20% of all fractures. The intraarticular fractures can heal with articular incongruity and result in post-traumatic arthrosis.[1] Hence, displaced, unstable intra-articular fractures of the distal radius are treated with reduction and fixation in an effort to allow restoration of radial length, volar and radial tilt, as well as articular congruency for the best chance of good functional outcome.[2,3] Theoretically, this will minimize the development of post-traumatic arthrosis.[1,3] Various fixation methods are described such as closed reduction and percutaneous pinning or external fixation or open reduction and internal fixation with plates and screws.[2,4]

Plating is performed by a dorsal or volar approach. The displaced and unstable distal radius fracture can be treated with either volar or dorsal approach regardless of the direction of fracture displacement[5] but the decision regarding selection of approach is often based on the direction of fracture displacement and extent of the metaphyseal comminution. The superiority of one approach over the other is not universal and various studies have shown varying results.Controversy exists regarding the effectiveness and resulting complications associated with dorsal plating for distal radius fractures,[6] though open reduction and internal fixation using a dorsal plate is an accepted technique[4 f]or the treatment of dorsally displaced fractures. The dorsal approach has the advantages of providing dorsal buttress to the dorsally displaced fragments. There are no major nerves in the way, and it provides direct visualization of the articular surface.[7] However, extensor tenosynovitis and rupture of the extensor pollicis longus (EPL) tendon has been reported as complications after dorsal plating.[6,8,9] For this reason this approach is not popular among orthopaedic surgeons.

The purpose of this study was to assess the EPL and the functional outcome of dorsally displaced fractures of distal radius treated by dorsal plating

METHODS

A prospective study was performed on forty adult patients with dorsally displaced distal radius fractures who presented to our hospital via the outpatient department and emergency room. They underwent open reduction and internal fixation with an AO T dorsal plate. The study duration was four years, from October 2012 to October 2016. Informed written consent was taken from all patients and ethical approval for the study was obtained from the Hospital ethical committee. Adult

patients with unstable intra-articular distal radius fractures with dorsal displacement (AO Classification type C1 and C2) presenting within two weeks was included. Severely comminuted fractures, pathological fractures, bilateral fractures, ipsilateral upper extremity injury, nerve injury, vascular injury, contralateral wrist arthritis, fractures in children and open fractures were excluded.

Operative Technique

A longitudinal incision was made centered over the Lister's tubercle. The skin and subcutaneous tissue was incised in the same plane. The extensor retinaculum was exposed and divided in a Z shaped fashion (Fig 1).The extensor pollicis longus tendon was identified and the Lister's tubercle was excised. The second as well as fourth compartments were then dissected sub-periosteally from the dorsal capsule. The fracture was reduced and fixed with a T buttress dorsal plate and screws (Fig 2).Intraoperative use of C-arm and a radiolucent hand table was used to assess the length of metaphyseal cancellous screws which otherwise may result in irritation of flexor tendons anteriorly and an appropriately placed plate can be visualized. When necessary, the capsule was opened through a T shaped incision and fragments were directly reduced. Bone graft, if required for metaphyseal bone loss was inserted prior to plate application. In some of the cases, supplementary fixation with a K-wire was used; the wire was bent and left outside the skin and removed after four weeks. The extensor retinaculum was sutured over the dorsal plate and the extensor pollicis longus left superficial to this, its compartment being reconstituted over the retinaculum (Fig 3). A short arm volar slab was applied. The limb was elevated and an intravenous antibiotic was given for 48 hours, dressings changed and the patient was discharged. Stitches were removed after two weeks and mobilization was started. The wrist was placed in a wrist and forearm splint and weekly hand therapy sessions were commenced staring with early active movement and progressing to passive movements by four weeks. The patients were followed up at 2, 4, 8, 12 and 24 weeks. All patients were followed up for a minimum of six months. The Mayo wrist score10 (Table 1) was used to evaluate the functional outcome after six months and then the plate was removed.

The statistical analysis was done using SPSS version 20. Categorical variables and baseline demographic data are described using frequencies as percentages. Spearmann ranks correlation was used to assess the association between the continuous variables. Independent sample t test was used to calculate the p value to compare the association between two groups. The significance was set as p value of 0.05.

Table 1. Mayo wrist score

Parameter	Score
Pain	
No pain	25
Mild, occasional	20
Moderate, tolerable	15
Severe, intolerable	0
Functional status	
Regular job	25
Restricted employment	20
Able to work but unemployed	15
Unable to work due to pain	0
Range of movement (% of normal side)	
100%	25
75-99%	15
50-74%	10
25-49%	5
0-24%	0
Grip strength (% of normal side)	
90-100%	25
75-89%	15
50-74%	10
25-49%	5
0-24%	0

Interpretation: 91-100 Excellent, 81-90 Good, 61-80 Satisfactory, < 60 Poor

RESULTS

A total of forty patients underwent open reduction and internal fixation with dorsal plates. Four patients were irregular in follow up and were excluded from the study. The study group consisted of thirty-six patients: 12 females and 24 male. The mean age was 34 years (range: 18-48 years). The right side was involved in 20 patients and left in 16 patients. The commonest mode of injury was fall from standing height seen in 25 patients (69.44%), followed by road traffic accident (7 patients), one patient fell down a flight of stairs, one fell from a height of about 6 feet, one had a football injury and one patient was hit by a buffalo. According to the AO classification 21 patients were classified as C1 and 15 patients as C2.

The time interval from the injury to surgery was 5 days (range: 2-9 days). The post-op hospital stay was 3 days (range 2-10 days). Most patients were discharged 48

hours after surgery (range: 2-10 Days). Two patients had an associated fracture of the ulnar styloid process and one had a fracture of the superior and inferior rami of the pelvis. The associated co-morbidities caused delays in their operative intervention and discharge from the hospital.

All fractures had united at six months. There were no associated EPL problems. Two patients (5.55%) had extensor tendon tenosynovitis. Four patients underwent supplemental fixation with a K wire for a displaced fragment on the radial side, which could not be held with the radial screw via the plate as the distal transverse portion of the plate had only three holes.

Bone graft was used in two patients to fill the void left in the metaphyseal bone by the fracture. It helped restore the radial length and correct the dorsal angulation. Two patients had infection: one was a superficial infection and it resolved with dressing and antibiotics. Pin tract infection was seen in one patient with the K-wire fixation. A functional assessment was performed at six months using the Mayo wrist score. The score assessed pain, functional status, range of movement and grip strength (Table 2).

DISCUSSION

Radius fractures with metaphyseal comminution typically collapse in a dorsal direction. Standard orthopaedic thinking would be to provide structural support of the same cortex to prevent the collapse. Open dorsal approach to plating a distal radius fracture has advantages that there are no major nerves in the way and it leads to an open arthrotomy of the joint for evaluation of articular reduction.[11]

Leung, Kwan and Fang,[12] have concluded that a dorsal approach and dorsal plate fixation may be required in some cases when a volar approach alone cannot achieve anatomical articular reduction and stable fixation. A careful CT evaluation of the fracture pattern before surgery is therefore recommended to determine whether a dorsal approach would be necessary.

Preceding reports have enumerated extensor tenosynovitis and tendon rupture as the most common complications following dorsal plating. Chiang *et al* reported on twenty patients who had been treated with a titanium Pi plate.[13] The plate was removed from nine of the twenty patients because of dorsal wrist pain. The authors identified tendon fraying in two of the patients but did not state whether the wrist pain decreased after plate removal. In a similar study, Kambouroglou and Axelrod[14] noted five cases of extensor tenosynovitis and two cases of extensor tendon rupture among eight patients who had been treated with a titanium Pi plate.Two other case reports documented extensor tenosynovitis and rupture in association with titanium P plates.[15] In a larger series, Ring *et al*, [9] reported a 22% rate of hardware-related complications in patients who had been treated with a titanium Pi plate. The Pi plate was often cut during implantation and the resulting edges caused irritation to tendons. In a large series involving only low-profile plates, Carter *et al* [4] reported a 19% prevalence of extensor tenosynovitis requiring hardware removal. So the low profile dorsal plates that were subsequently developed to address these complications still had quoted rates of 19%[4] and 22%[9] extensor tenosynovitis, respectively. Herron, 3 reported that extensor tendon irritation was more common with low profile designs but a conclusion could not be reached, as the number of patients was small. The phenomenon may be independent of implant size and be due to disruption of the dorsal tendon vasculature. It has been suggested that implant loosening may pre-dispose to tendon rupture. The functional results at the final follow-up, according to the Green and O'Brien score were 60% excellent or good and 93% excellent or good by the Gartland and Werley score. Matzon evaluated hardware related complications in 110 patients who were followed up for one year. [16] Though low profile titanium plates were used, his results showed that six patients (5%) still had extensor tenosynovitis but no extensor tendon ruptures. He concluded that the technique of dorsal plating was safe and effective. Kamath, [6] concluded that patients

Table 2: Assessment parameters showing number of patients (Mayo wrist score at 6 months)

Pain	Functional status	Range of movement (% of normal side)	Grip strength (% of normal side)
No pain: 18	Regular job: 36	100%: 25	90-100%: 28
Mild: 18	Restricted job: 0	75-99%: 11	75-89%: 8
Moderate: 0	Able to work but unemployed: 0	50-74%: 0	50-74%: 0
Severe: 0	Unable to work due to pain: 0	25-49%: 0 0-24%: 0	25-49%: 0 0-24%: 0

Out of the total, 21 patients were graded as excellent and 15 as good. The implant was removed after six months. The EPL was seen to be intact in all cases

could expect to regain about 80% of their ROM and strength. Ninety-three percent will have good to excellent functional outcomes with minimal impairment in activities of daily living. In concordance with prior studies, he concluded that dorsal plating complications may be a result of the specific plate type and thickness, rather than the dorsal approach itself. Ruptures of extensor pollicis longus can even occur after minimally displaced fractures because the attachment of extensor retinaculum to Lister's tubercle remains intact and together with formation of callus, leads to narrowing of the third compartment.[17] This can cause reduction in the blood supply to the tendon, degenerative necrosis and eventual rupture.[18] In our series, four patients were supplemented with K wire for displaced fragment on the radial side. These would not be necessary if plates with four holes in the transverse plane were available. This would have prevented infection in one patient in our study where a K wire was left outside the skin. The AO T buttress plate was used, as low profile plates were locally unavailable at the time when the study was commenced. Implant removal after union is common practice in our scenario. Removal of implants are advised by some authors due to a high rate of tendon attrition and rupture,[19] and a more significant improvement in function has been reported after implant removal. In our study two (5.55%) patients had extensor tenosynovitis. No problems with the EPL were found. The EPL was released from its compartment and placed above the plate. The implant was removed at six months. This may have been the reason why there was no incidence of EPL ruptures. The functional outcome of dorsal plating has good to excellent results with minimal incidence of extensor tenosynovitis and the extensor pollicis longus is not at risk.

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