Original article:

Non-comminuted extra-articular fractures of distal radius treated with Percutaneous pinning

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Abstract

Background: Various treatment modalities have been described for the treatment of extra-articular distal radius fractures eachwith its own merits and demerits. Most of the work done with percutaneous pinning has shown a significant residual stiffness ofthe hand and wrist. Our technique involves percutaneous pinning of the fracture and immobilization in neutral position of the wristfor three weeks. This study's aim was to examine the functional outcome of percutaneous K-wiring of these extra-articular distal radius fractures with immobilization in neutral position of the wrist.

Materials and Methods: This is a prospective study of 40 patients aged between 18 and 60 years with extra-articular distal radius fracture. Patients were treated with closed reduction and percutaneous pinning using two or three K-wires. A below- elbow plaster of parisdorsoradial slab was applied in neutral position of the wrist for 3 weeks. At the end of 3 weeks, the slab was removed and wrist physiotherapy started. The radiographs were taken postoperatively, at 3 weeks, 6 weeks and 3 months. The functional evaluation of the patients was done at 6 months follow-up. We used Sarmiento's modification of Lindstrom criteria and Gartland and Werley's criteria for evaluation of results.

Results: Excellent to good results were seen in 87.5% of the cases while 12.5% had fair results. The complications observed were pin loosening (n=10), pin tract infection (n=2), malunion (n=2), wrist joint stiffness (n=2), reduced grip strength (n=2) and injury to the superficial radial nerve (n=1).

Conclusion: Percutaneous pinning followed by immobilization of the wrist in neutral position is a simple and effective method to maintain reduction and prevent stiffness of wrist and hand.

Key words: Extraarticular distal radius fracture, immobilization with wrist in neutral position, percutaneous pinning

Introduction

Fractures of the distal radius represent one-sixth of all fractures treated in emergency department.[1] Closed reduction and cast immobilization has been the mainstay of treatment of these fractures, but invariably it results in malunion, poor functional and cosmetic outcome.[2] .Restoration and maintenance of anatomy correlates well with function. The residual deformity of the wrist as a result of malunion is unsightly. It adversely affects wrist motion and hand function by interfering with the mechanical advantage of the extrinsic hand musculature.[35] -In many cases there is weakness of handgrip and return to preinjury activity level becomes impossible. Closed reduction and cast immobilization[6,7] often leads to collapse of the radius. Percutaneous K-wire fixation provides additional stability and is one of the earliest forms of internal fixation.[8-10]. Depalma described ulno-radial pinning drilled at 45° angle, 4 cm proximal to ulnar styloid. Kapandji[11.] described

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double intrafocal pinning into the fracture surface and Rayhack[12] described ulno-radial pinning with fixation of distal radioulnar joint. Bridging external fixators[13,14] and ligamentotaxis indirectly reduce the fracture. Ruch*et al*,[15] and many others described open reduction and internal fixation of distal radius fracture. Doi*et al*. recommended it for comminuted intra-articular fractures.[16]. Most of the work done with percutaneous pinning emphasizes that there is significant residual stiffness of the hand and wrist.[17,18] The acute palmar flexed position of the wrist during the postoperative immobilization period was blamed as the main reason for stiffness.[19] This study was conducted to examine the functional outcome of noncomminuted extra-articular distal end radius fractures treated with closed reduction and percutaneous K-wire fixation with immobilization in neutral position of the wrist and early physiotherapy.

Materials and Methods

40 consecutive patients with extra-articular distal radius fractures were prospectively enrolled for the study between July 2013 and july 2015. 22 patients were male and 14 were female. The mean age of patients was 40.4 years (range 18-60 years). In 22 patients, the fracture involved the dominant hand. Only patients with non-comminuted extra – articular distal radius fractures were included in the study. All patients with intra- articular distal radius fractures, comminuted distal end radius fractures, presenting later than 2 weeks of injury, patients in whom ulnar shaft was not intact, polytrauma patients, patients with open fractures and patients with open fractures were excluded. Out of the 40 patients enrolled for the study, none of them were lost to follow-up.

The mode of trauma was a simple fall on the outstretched hand in 22 patients and a sports-related injury in 18 patients. All were closed fractures. Fractures were classified according to the AO classification, using the preoperative anteroposterior and lateral roentgenogram [Figure 1]. All 40 patients had AO type A2 fractures. Additionally radial length, palmar tilt and radial angulation were measured.

Operative procedure

Closed reduction of the fracture was achieved by longitudinal traction and direct pressure over the displaced fragment under anesthesia. Hyperextension or flexion manoeuvres to disimpact the fragments were not recommended.Reduction was checked under image intensifier in both anteroposterior and lateral planes. As an assistant held the wrist with fracture in the reduced position, the first K-wire of 1.5-2.0 mm was inserted from the dorsolateral aspect of the distal radius fragment across the fracture and into the proximal fragment under image intensifier guidance. A second K-wire was passed from the dorsomedial aspect of the distal fragment across the fracture into the proximal fragment. After checking the stability of the fracture under image intensifier, if required, a third K-wire was passed from dorsolateral aspect from distal to proximal fragment. The wires were drilled to engage the opposite cortex. K-wires were bent at a right angle and cut short outside the skin for easy removal. A sterile dressing including sponge padding was applied to prevent skin irritation. With the wrist in the neutral position, a dorsoradial below elbow plaster of Paris slab was applied up to the knuckles. Postoperative radiographs are obtained in the anteroposterior and lateral planes. Postoperatively the limb was kept elevated for 24 hours. Active finger, shoulder and elbow mobilization was started at the earliest. Patients were discharged 24 hours post surgery after ensuring good distal circulation of fingers. At 3 weeks follow-up, X-rays were taken, both in the anteroposterior and

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lateral planes to check the position of the fracture. The slab was removed and active finger, wrist exercises and forearm pronation and supination exercises were started. Handgrip was improved by using soft ball exercises. At 6 weeks, anteroposterior and lateral view radiographs were repeated. K-wires were then removed without anaesthesia. Wrist physiotherapy and handgrip exercises were continued for another 2 to 4 weeks [Figure 2]. Results were evaluated clinically and radiologically at 6 months using Sarmiento's modification of Lindstrom criteria[20] and by the Sarmiento *et al*, modification of the demerit point system of Gartland and Werley[21]

Results

All fractures healed. Restoration of anatomy was excellent in 25 patients (62.5%) and 10 patients (25%) had a good anatomical outcome while 5 (12.5%) had fair results. Preoperative radiographic assessment showed that the average radial height was 2.66 mm (range 1–4 mm) and volar tilt was -12.34° (range 8 to -18o). Assessment of postoperative radiographs revealed that the average radial height was 10.46 mm (range 8-14 mm) and volar tilt was 11.16o (range 8-16o) on the immediate postoperative X-rays. At the time of pin removal at 6 weeks, radial height was 9.36 mm (range 5-13 mm) and volar tilt 10.06° (range 4-16o). The radial height was 7.56 mm (range 2-12 mm)

Discussion

Distal radius fracture is a common injury. The importance of anatomic reduction has been demonstrated by clinical studies as well as by laboratory assessment of force and stress studies.[22,23] In fractures with articular displacement greater than 2 mm, radial shortening greater than 5 mm or dorsal angulation greater than 20°, suboptimal results have been reported in previously published studies.[21] Accurate reduction of the fracture is the first step in the treatment of distal radial fractures. Many options are available to maintain this initial reduction. The most common traditional method is closed reduction and cast immobilization, but this often fails to prevent early radial collapse and is associated with a high risk of malunion,joint stiffness and painful wrist. Hence, this method is for low-demand elderly patients.[24,25]

External fixators can maintain radial length and radial inclination by ligamentotaxis, but cannot effectively maintain palmar tilt.[26] Also complication rates as high as 60% have been reported with the use of external fixators.[27] These mainly include pin loosening, pin tract infection, reflex sympathetic dystrophy, radial sensory neuritis and delayed union. Thus, external fixators are better avoided in noncomminuted extra-articular distal radial fractures.[28] Open reduction and internal fixation[15] and arthroscopic reduction16 techniques should be reserved for partial and complex intra-articular distal radius fractures. Percutaneous pinning with K-wires was first recommended by Green[29] as a simple and inexpensive procedure. Various techniques of percutaneous pinning are available. Most studies attribute poor results of this technique to radial shortening, wrist stiffness and reflex sympathetic dystrophy.[17,18] The authors are of the view that wrist stiffness and reflex sympathetic dystrophy occur because of the palmar-flexed position of the wrist in which postoperative immobilization of the fracture is done. Prolonged immobilization of the wrist for greater than 3 weeks increases the magnitude of the problem.

Hence we developed our protocol for the treatment of extra-articular distal radius fractures. Fracture reduction was achieved by longitudinal traction and

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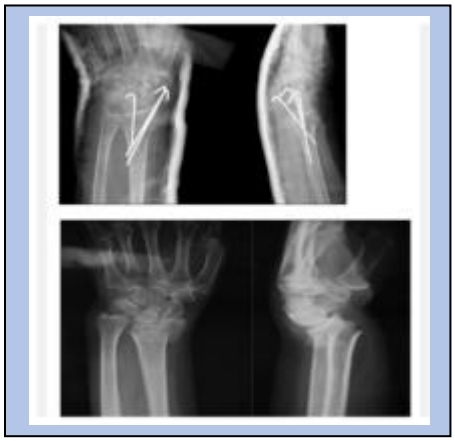
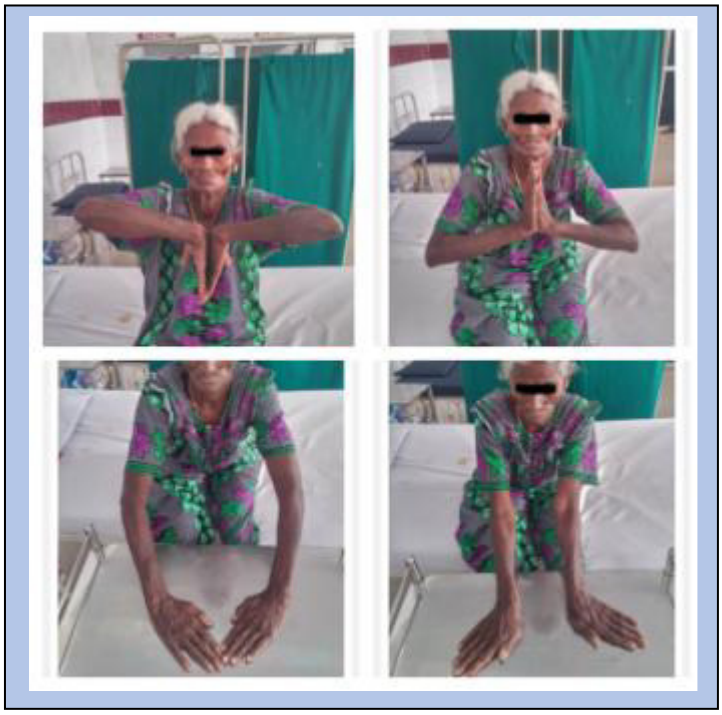
direct pressure over the displaced fragment followed by percutaneous pinning. Instead of circumferential cast, dorso-radial plaster of Paris slab was applied in neutral position of the wrist. Active finger mobilization was started immediately. In our study we did not encounter reflex sympathetic dystrophy while 2 cases had wrist stiffness which required mobilization exercises under the supervision of physiotherapist. Significant radial shortening was observed in 2 cases only. Radial shortening remains the main displacement in distal end radius fractures, especially intra-articular and comminuted fractures.[30] In our opinion, percutaneous pinning maintains radial length adequately in extra-articular distal radial fractures. Two cases in our series had pin tract infection, but this was superficial and did not necessitate early removal of the pins.

The infection subsided with removal of the pins at 6 weeksin both the cases. These 2 patients also had malunion with significant radial shortening, wrist joint stiffness and reduced grip strength. The functional result obtained in these patients at the end of follow-up period was fair.

Loosening of one of the K-wires was observed in 10 cases at the time of removal of the pins, but it did not jeopardize the fracture alignment. Circumferential cast for additional immobilization was not necessary. One case had injury to sensory branch of radial nerve. This can be avoided by using a limited incision for lateral pin insertion. In conclusion, percutaneous pinning and immobilization of the fracture with wrist immobilized in neutral position for 3 weeks and early physiotherapy is a simple procedure for extra-articular noncomminuted distal radius fractures.

It provides anatomic fracture reduction and fixation and allows earlier rehabilitation without jeopardizing the fracture alignment.





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