Original Research Article

Percutaneous pinning for non-comminuted extraarticular fractures of distal radius

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Abstract

Background: Displaced Colles' fractures are treated by manipulation and below elbow cast application. Fracture stabilization by percutaneous pinning is a simple, minimally invasive technique that helps prevent displacement of the fracture, thereby minimizing complications. Various treatment modalities have been described for the treatment of extra-articular distal radius fractures each with its own merits and demerits. Our technique involves percutaneous pinning of the fracture and immobilization in neutral position of the wrist for 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. **Method:** This is a prospective study of 28 patients aged between 20 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 paris dorsoradial slab was applied in neutral position of the wrist for 4 weeks. At the end of 4weeks, the slab was removed and wrist physiotherapy started. The radiographs were taken postoperatively, at 4 weeks, 6 weeks. **Results:** Excellent to good results were seen in 93.75% of the cases while 6.25% had fair results. The complications observed were pin loosening (n=6), pin tract infection (n=1), malunion (n=1), wrist joint stiffness (n=1), reduced grip strength (n=1). **Conclusions:** Displaced extraarticular distal end radius fractures should be reduced and stabilized with percutaneous K-wires to achieve an excellent functional outcome.

Keywords: Extraarticular distal radius fracture, immobilization with below elbow popcast, percutaneous pinning.

Introduction

Colles' fracture is a common fracture presentation in the orthopedic emergency department. 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 [4]. 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 [5-7]. The degree of disability after a fracture of the distal radius has been shown to correlate with the amount of residual deformity [8]. Permanent loss of the palmar angle and radial shortening of the distal radius are associated with persisting wrist pain[9]. Closed reduction and cast immobilization[10] often leads to collapse of the radius treatment has changed over time as it has become more of a concern because of occupational disability and the need for prolonged care in previously independent elderly individuals[11]. After manipulation and plaster cast application, many of these fractures were displaced[12]. They reduce initially well, but there is a frequent loss of reduction as cast immobilization is a relatively inefficient means of stabilization[13]. Stable fractures can be managed conservatively by plaster cast immobilization alone with good to excellent anatomical and functional results[14].

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Percutaneous K-wire fixation provides additional stability and is one of the earliest forms of internal fixation[15-16]. Depalma described ulno-radial pinning drilled at 45° angle, 4 cm proximal to ulnar styloid. Kapandji[17] described double intrafocal pinning into the fracture surface and Rayhack[18] described ulno-radial pinning with fixation of distal radioulnar joint. Bridging external fixators[19-20] and ligamentotaxis indirectly reduce the fracture. Percutaneous pinning has been recommended as a simple way of providing additional stability as compared to immobilization in a cast which is unstable.Most of the work done with percutaneous pinning emphasizes that there is significant residual stiffness of the hand and wrist[24] This study was conducted to examine the functional outcome of non comminuted 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

28 patients with extra-articular distal radius fractures were prospectively enrolled for the study between February 2020 and March 2021. The mean age of patients was 37.8 years (range 20-60) years) twenty eight patients underwent closed manipulation and percutaneous pinning with crossed K-wires as the primary procedure. Cases presenting to emergency and outpatient department of department of orthopaedics fulfilling the inclusion criteria were selected for the study. Out of the 28 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 20 patients and a sports-related injury in 08 patients. All were closed fractures. Fractures were classified according to the AO classification, using the preoperative anteroposterior and lateral x rays.

Informed consent was obtained from all the patients included in the study. Fracture displacement was characterized as displaced when there was dorsal angulation of > 10° and positive ulnar variance of > 3 mm. An acceptable reduction following closed reduction was a

fracture with dorsal angulation of ≤ 0° and an ulnar variance of ≤ 3 mm. Radiographic measurements were made using a goniometer[1].

Operative procedure

All procedures were carried out in the operation theater under general anesthesia or regional anesthesia. The upper extremity was prepared and draped free from the elbow. The surgeon and assistant were gowned and gloved. To allow easier access for the C-arm of the image intensifier, a hand table was used to support the limb.

Closed reduction of the fracture was achieved by longitudinal traction and direct pressure over the displaced fragment under anesthesia. Reduction was checked under image intensifier in both anteroposterior and lateral planes. As an assistant held the wrist with fracture in the reduced position, Scrutiny towards the apposition and alignment of the volar surface of the fracture was one key feature in assessing the reduction. Once the length and the dorsal angle of the radius were restored, the fracture was fixed by two crossed 1.8 mm smooth K-wires, inserted percutaneously with a power drill. 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. The stability was finally evaluated by performing flexion and extension of the wrist under fluoroscopy. 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 4 weeks follow-up, X-rays were taken, both in the anteroposterior and 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.

Radiographic measurements of the postoperative dorsal angle and the ulnar variance were recorded and compared with the radiographs taken at the final assessment at six months to document the amount of collapse. We followed the method described by WP Cooney for functional evaluation (modified from the Green and O'Brien score). A final clinical and functional assessment was made using Cooney Wrist Score at six months

Figure 1: (a) Preoperative anteroposterior view and (b) Preoperative lateral view of the wrist

Figure 2: Post-operative anteroposterior and lateral views showing good reduction, K-wires *in situ* and back slab

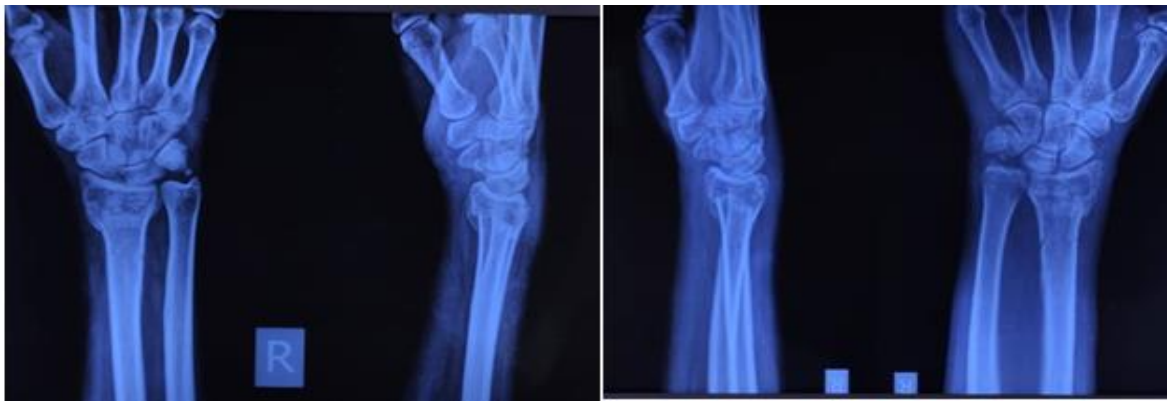

Figure 3: 6 weeks Post-operative anteroposterior and lateral view

Figure 4: 6 Months Post-operative anteroposterior and lateral view

Results

Twenty eight patients with Type II fractures underwent closed manipulation and percutaneous pinning with crossed K-wires as the primary procedure. Among the 28 patients, there were 18female and 10 male patients. Their ages ranged from 20 to 60 years. The average age was 37.8 years. The right wrist was involved in 11patients, whereas the left wrist was involved in 17patients. Falling on an outstretched hand was the commonest mode of injury.

The presentation of the patient before the operation ranged from 0-6 days (average: 1.84 days). The earlier presented fracture reduction was easier. The postoperative hospital stay ranged from one to 2 days. The average hospital stay was 1.66 days. Most patients were

discharged the following morning after the surgery. The associated medical co-morbidities in some patients caused delays in their operative intervention and their discharge from the hospital.

The mean pre-reduction dorsal angulation and ulnar variance were 21.95 degrees and 3.72 mm, respectively. After surgery, the mean dorsal angulation and ulnar variance were -6.17 degrees and 1.10 mm, respectively. At six months follow-up, dorsal angulation was -5.43 degrees and the ulnar variance was 1.51 mm (Table 3).

Changes in the mean dorsal angulation and ulnar variance after surgery and at the six-month follow-up were -0.91degrees and -0.50 mm, respectively

Pin loosening was encountered in 6 cases. Pin tract infection (n=1), malunion in (n=1), joint stiffness (n=1), reduced grip strength (n=1) , were the other complications observed. Reflex sympathetic dystrophy was not encountered. Post-traumatic arthritis of wrist, subluxation of distal radio-ulnar joint and penetration of vessel were not seen.

Table: 1 Cooney Wrist score used for the assessment and functional evaluation of the wrist at final outcome
Excellent: ≥ 95 points; Good: ≥ 75 points; Fair: ≥ 60 points; Poor: < 60 points
DF: dorsiflexion; PF: palmar flexion

Functional Evaluation	Total Points		Points
Pain	25	No pain	25
		Mild occasional	20
		Moderate tolerable	15
		Severe to intolerable	0
Functional status	25	Return to regular employment	25
		Restricted employment	20
		Able to work, unemployment	15
		Unable to work because of pain	0
Range of motion (Percentage of normal side)	Percentage of normal side	100%	25
		75 – 100%	15
		50 – 75%	10
		25-50%	5
		0-25%	0
	DF-PF arcs of injured wrist	120 degrees or more	25
		90 – 120 degrees	15
		60 – 90 degrees	10
		30 – 60 degrees	5
		30 degrees or less	0
Grip strength (Percentage of normal side)	25	100%	25
		75% - 100%	15
		50 – 75%	10
		25 – 50%	5
		0 – 25%	0

Table 2: Variations in the Dorsal Angle and Ulnar Variance

	Mean	Std. Deviation	Range
Pre-reduction dorsal angle	21.95	7.712	12 - 25
Pre-reduction ulnar variance	3.72	0.619	3 - 5
Postoperative dorsal angle	-6.17	1.21	-11 to -3
Postoperative ulnar variance	1.10	0.598	0 - 2
Dorsal angle at 6 months	-5.43	2.692	-10 to 0
Ulnar variance at 6 months	1.51	0.601	1 - 3

Table 3: Comparison of Changes in the Dorsal Angle and Ulnar Variance at the Postoperative Period and Six Months

	Mean	Std. Deviation	Range
Change in dorsal angle postop vs six months	-0.91	0.579	-4 - 0
Change in ulnar variance postop vs six months	-0.50	0.658	-2 - 0

Discussion

Distal radius fracture is a very common injury. The importance of anatomic reduction has been demonstrated by clinical studies as well as by laboratory assessment of force and stress studies. 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[25].

Accurate anatomical reduction of the fracture is the first crucial 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. There is considerable evidence that re-displacement is common and cosmetic results are far from perfect . Seventy percent of cases undergoing conservative treatment are associated with significant displacement[26].

Percutaneous pinning with K-wires was first recommended by Green[27] as a simple and nonexpensive procedure. Various methods of percutaneous pinning are available. In our study, the patients underwent closed manipulation and stabilization by percutaneous pinning primarily with two K-wires. No manipulation was performed before the procedure. The fractures were reduced and stabilized under the same anesthesia. In patients that presented earlier, the reduction was easier to perform so early intervention is of help in the management

Excellent results were reported by Stein and Katz in their comparative study, which involved percutaneous pinning of distal radius fractures and casting alone [28]. They confirmed the decrease in the radial shortening, maintenance of the normal volar tilt, and superior range of motion with percutaneous pinning. Dixon, Allen, and Bannister documented that the radial shortening improved after manipulation and casting to less than 3 mm in 86% of patients (79/92) but was maintained in 48% (44/92) after three months . Azzopardi, et al. performed a prospective randomized study on 57 patients, older than 60 years of age with unstable, extra-articular fractures of the distal radius to compare the outcome of immobilization in a cast alone with closed reduction percutaneous pinning

Our patients were taught pin site cleaning, which they performed four to six times a day. It helped reduce the pin site complications, and we encountered only two cases of superficial tract infection that subsided with a course of antibiotics. The advantage of the ends of the K-wires being outside was their easy removal.

one 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 weeks in both the cases. These 1 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 6 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. In conclusion, percutaneous pinning and immobilization of the fracture with wrist immobilized in neutral position for 4 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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