

Displaced Colles fractures: Functional outcome following closed reduction and stabilization with percutaneous K-wires

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ABSTRACT

BACKGROUND: Displaced Colles fractures are generally treated by manipulation and below elbow cast application. Malunion is a common complication resulting in pain, mid carpal instability and post-traumatic arthritis. Fracture stabilization by percutaneous pinning is a simple, minimally invasive technique which helps prevent dislodgment of the fracture thereby minimizing complications. The study aims to assess the amount of collapse after closed manipulation and percutaneous pinning with K-wires and its correlation with the functional outcome of the wrist after union.

METHODS: A prospective study was conducted from October 2006 to November 2009. Fifty adults (27 female, 23 male) with an average age of 40.72 years with type II fractures underwent closed manipulation and percutaneous pinning with crossed K-wires as the primary procedure. Serial radiographs were taken to document the amount of collapse. The functional outcome was assessed using Mayo Wrist Score.

RESULTS: At the final follow up of 6 months the collapse in the mean dorsal angle was 1.15 and mean ulnar variance 0.51. Functionally 25 patients (53.19%) had excellent, 17 patients (36.17%) good and 5 patients (10.63%) had satisfactory or fair outcome.

CONCLUSIONS: Displaced Colles fractures should be reduced and stabilized with percutaneous K-wires to achieve an excellent functional outcome.

KEY WORDS: *Colles fracture, percutaneous pinning, functional outcome*

INTRODUCTION

Fractures of the distal radius were considered uncomplicated injuries in the past. Initially, Abraham Colles¹ treated these fractures when there was no radiography, aseptic surgery or anaesthesia¹ and the amount of disability following malunion was not taken into consideration. Malunion results in pain, mid carpal instability and post-traumatic arthritis.²

The degree of disability after a fracture of distal radius has been shown to correlate with the amount of residual deformity.³ Permanent loss of the palmar angle and radial shortening of the distal radius are associated with persisting wrist pain.⁴ Treatment has changed over time because of occupational disability and the need for prolonged care in previously independent individuals.⁵

After manipulation and plaster cast application, many of these fractures redisplace.⁵⁻⁷ They are reduced initially but

frequently lose position because cast immobilization is an insufficient means of stabilization.⁸ Stable fractures can be managed conservatively by plaster cast treatment with good to excellent anatomical and functional results however, unstable fractures need operative stabilization.⁹

Stabilization in the form of percutaneous pinning is a simple, minimally invasive technique, which saves time and is performed under single anesthesia and helps prevent displacement of the fracture. The advantages are increased stability compared to cast treatment alone.¹⁰ Displaced fractures need manipulation and stabilization with percutaneous K-wires leading to preservation of anatomy and an excellent functional outcome.¹⁰

The aim of this prospective study was to assess the amount of collapse in Colles fractures after manipulation and percutaneous K-wire fixation and correlation with the function of the wrist.

MATERIALS AND METHODS

A prospective study was conducted from the period extending from October 2006 to November 2009. Fifty adults with type II fractures (Universal Classification of distal radius fractures)¹¹ underwent closed manipulation and percutaneous pinning with crossed K-wires as the primary procedure. Informed consent was taken from the patients. Three patients were excluded from the study. Two patients were irregular in their follow up and one had an unacceptable reduction and hence was treated with an external fixator. Patients with undisplaced or open fractures were excluded. Fracture displacement was characterized as displaced when there was dorsal angulation of $> 10^\circ$ and positive ulnar variance of $> 3\text{mm}$. An acceptable reduction following closed reduction was a fracture with dorsal angulation of $\leq 0^\circ$ and an ulnar variance of $\leq 3\text{mm}$.⁹ Radiographic measurements were made using a goniometer.

All procedures were performed in the operating theatre using either regional or general 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.

The reduction was accomplished by applying traction on the thumb and the other three lateral digits, to distract the fracture while counter traction was applied proximal to the elbow by an assistant. The traction on the thumb was sustained while the contra lateral hand was used to restore the normal volar tilt once distraction of the fracture was adequate.

The reduction was then evaluated in the antero-posterior and lateral planes with the image intensifier. Close 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 1.8mm smooth K-wires, inserted percutaneously with a power drill.(figure 1)

The first K-wire was inserted at the tip of the radial styloid process just dorsal to the first extensor canal, in the anatomical snuff box proximal to the radial artery, aiming to cross the fracture line in both planes under

image-intensifier control. This requires about a 45-degree angle with the long axis of the radius on the antero-posterior view, and aiming the wire 10 degrees dorsally on the lateral view.



Fig. 1: Insertion of first K-wire



Fig. 2: Insertion of the second K-wire

The second K-wire was inserted into the dorsal ulnar corner of the distal part of the radius between the fourth and fifth extensor canals. The correct line of aim that was required to cross the fracture was about 45 degrees on the antero-posterior view and 30 degrees dorsally on the lateral view.

Both K-wires are advanced to just penetrate the cortex of the proximal fragment. The accuracy of the reduction and of the placement of the K-wires was again assessed with the image intensifier. The stability was finally evaluated by performing flexion and extension of the wrist under fluoroscopy. Both K-wires were then cut above the skin

after bending them. Sterile gauze was placed over each pin site, and a padded short arm volar plaster slab was applied.

The patient was discharged from the hospital following antero-posterior and lateral radiographs of the wrist after the operation. The patients were instructed to actively mobilize their fingers, elbow and shoulder joints from the first post-operative day.

On the first follow up, the plaster slab was discarded and a forearm brace was applied. The patients were instructed to clean the pin sites with a spirit swab 4-6 times a day. At three weeks, radiographs were taken and assessed. At Table 1: Mayo Wrist Score

six weeks, all fractures had radiological union and the K-wires were removed and intermittent active motion of the wrist was begun. Patients were encouraged to resume wrist movements. Unlimited activities were allowed from the third month. The patient was seen at six months for a final clinical and functional assessment.

Radiographic measurements of the post-operative 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. A final clinical and functional assessment was made using Mayo Wrist Score¹² at six months.

Category	Points
Pain (25 points)	
None	25
Mild occasional	20
Moderate (with normal use, not at rest)	10
Severe, constant	0
Range of motion (25 points): Flexion+Extension (degrees)	
>140	25
100-140	20
70-99	15
40-69	10
<40	0
Grip strength (25 points)	
Normala	25
Diminished but >50% of normal	15
Less than 50% of normal	0
Activity (25 points)	
Same activities	25
Restricted activities caused by injured wrist	15
Change of work or sports caused by injured wrist	0

Excellent ≥ 95 points; Good ≥ 75 points; Fair ≥ 60 points; Poor < 60 points

^aNormal is the contralateral side (minus or plus 10% depending on dominance)

RESULTS

Fifty adults with type II fractures underwent closed manipulation and percutaneous pinning with crossed K-wires as the primary procedure. Three patients were excluded from the study. Two patients were irregular in their follow up and one had an unacceptable reduction and hence was treated with an external fixator.

Among forty seven adult patients there were 26 female and 21 male patients. Their ages ranged from 20-54 years.

The average age was 40.72 years. Fall on an outstretched hand was the commonest mode of injury (36 patients). The other causes being fall down the stairs and motor vehicle accidents. Three patients had associated injuries which were dealt with accordingly.

Two patients had median nerve compression after the injury which subsided after the reduction and stabilization.

The presentation of the patient prior to the operation ranged from 0-11 days (Average: 1.84 days). The

earlier presented fracture reduction was easier. The post operative hospital stay ranged from 1 to 12 days. The average 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.

Radiographic measurements were made using a goniometer to assess the amount of collapse. The pre-operative mean dorsal angle and the mean ulnar variance was 20.47 and 3.66. Following surgical correction, the mean dorsal angle and ulnar variance was -6.43 and 1.17. The amount of collapse measured at the 6 month final assessment in the mean dorsal angle and ulnar variance was 1.15 and 0.51. The data was analyzed using SPSS version 16.0. Means and standard deviations were calculated and unpaired t-test was used to compare them.

Table 2: Variations in the dorsal angle and ulnar variance

	Mean	Std. Deviation	Range
Pre-operative dorsal angle	20.47	2.376	15-25
Pre-operative ulnar variance	3.66	0.628	3-5
Post-operative dorsal angle	-6.43	2.174	-11 to -3
Post-operative ulnar variance	1.17	0.637	0-2
Dorsal angle at 6 months	-5.28	2.756	-10-0
Ulnar variance at 6 months	1.68	0.594	1-3

Table 3: Comparison of changes in the dorsal angle and ulnar variance at the post-operative period and 6 months

	Mean	Std. Deviation	Range
Change in dorsal angle post-op vs 6 months	-1.1489	1.33480	-4 - 0
Change in ulnar variance post-op vs 6 months	-0.5106	0.58504	-2 - 0



Fig. 2A Pre-operative radiograph



Fig. 2B Immediate post-operative radiograph



Figure 2C: Radiograph at final assessment at 6 months

Using the Mayo Wrist Score, a clinical and functional assessment was made at six months. 25 (53.19%) patients

were found to have an excellent outcome, 17 (36.17%) had a good outcome and 5 (10.63%) had a satisfactory or fair outcome.



Fig. 3A Extension at 6 months



Fig. 3B Flexion at 6 months

Two patients developed superficial pin site infection which resolved with a course of antibiotics.

DISCUSSION

Differing from the affirmation made by Colles that plaster stabilization prevents deformity, there is considerable evidence that re-displacement is common and cosmetic results are far from perfect.^{13,14} 70% of cases undergoing conservative treatment are associated with considerable displacement.¹⁵

Various methods of internal and external stabilization devices have come into vogue over the years to prevent displacement in unstable fractures such as external fixation, the Roger Anderson device,¹⁶ use of rush pins¹⁷ and plaster techniques.¹⁸ Their objectives are targeted at restoration and stabilization of the anatomy of the distal radius.

In our study the patients underwent closed manipulation and stabilization by percutaneous pinning primarily with two K-wires. No manipulation was performed prior to the procedure. The fractures were reduced and stabilized under the same anesthesia.

Kurup et al¹⁹ studied the late collapse of distal radius fractures after K wire removal and its significance. They found that the fractures did not suffer significant loss of reduction after removal of wires. Loss of dorsal tilt was 2.6 and ulnar variance 1.3 mm. There has been no functional correlation in their study and whether the collapse affects the function was questionable.

Excellent results were reported by Stein and Katz²⁰ in their comparative study which involved percutaneous pinning of distal radius fractures and casting alone. They confirmed decrease in the radial shortening, maintenance of the normal volar tilt and superior range of motion with percutaneous pinning.

Dixon, Allen and Bannister⁷ documented that the radial shortening improved after manipulation and casting to less than 3mm in 86% of patients (79/92), but were maintained in 48% (44/92) after 3 months. They concluded that there was room for improvement in the treatment of this common fracture as there was a 73% risk of failure following manipulation and plaster cast fixation.

Anatomical reduction which is achieved by manipulation under anesthesia is an integral part of the management of this fracture. After the anatomy is restored the maintenance of the accomplishment has to be secure. Percutaneous pinning is an excellent technique.¹⁰

The patients received their treatment under a single exposure to anesthesia. This helped decrease the morbidity. In patients that presented earlier the reduction was easier to perform, so early intervention is of help in the management.

In our study the ends of the K-wires were bent and left outside the skin. Clancey²¹ cut the K-wires and allowed the ends to retract subcutaneously. The patients required anesthesia to remove the K-wires later. Our patients were taught pin site cleaning which they performed 4-6 times a day. It helped reduce the pin site complications and we encountered only two cases of superficial tract infection which subsided with a course of antibiotics. The advantages of the ends of the K-wires being outside were easy removal and were performed by residents saving the surgeon's time in the out-patient clinic.

Based on our findings we would like to conclude that unstable Colles fractures must be reduced acceptably. Percutaneous pinning is an excellent technique for stabilization. The functional outcome was excellent in 26 (52%) patients, good in 18 (36%) and satisfactory in 6 (12%).

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