

# Comparative Study of Functional Outcome in Colles' Fracture Treated Conservatively by Closed Reduction and Cast and Closed Reduction, Kirschner Wire and Cast

## ABSTRACT

Displaced Colles' fractures are generally treated by closed reduction and below elbow cast application. Malunion is a common complication resulting in pain, mid carpal instability and post-traumatic arthritis. Fracture stabilization by Kirschner wire is a simple, minimally invasive technique, which helps to prevent displacement of the fracture thereby minimizing complications.

**Aim** To study comparative evaluation of functional outcome in Colles' fracture treated conservatively by closed reduction and cast and closed reduction, Kirschner wire and cast.

**Materials and Methods** Thirty adult patients with Colles' fracture were assigned into two groups after informed consent. Group 1 cases were treated with closed reduction and plaster cast application, and Group 2 cases were treated with closed reduction, Kirschner wire and plaster cast application. The functional outcome of cases was assessed by Mayo wrist score (0 to 100 points) as modified by Cooney and Bussey and the functional as well as radiological outcome were assessed by the Demerit scoring system modified by Saito.

**Results** According to Mayo functional score in Group 1, we had 2 good, 10 satisfactory and 3 poor results, and in Group 2, we had 8 excellent results, 6 good and 1 satisfactory results. According to a Modified demerit point system of Saito in Group 1, we had 12 fair and 3 poor results and in Group 2 we had 9 excellent and 6 good results.

**Conclusion** We conclude that percutaneous Kirschner wire pinning is a minimally invasive technique that provides an effective method of maintaining fracture reduction.

**KEYWORDS** Colles' fracture, cast, Kirschner wire

## INTRODUCTION

Colles' fracture is a common injury affecting 17% of women over the age of 50 years.<sup>1</sup> In 1814, it was first described by Abraham Colle of Dublin in Ireland, after whom it is named. Colles' fracture usually results from low energy trauma in the elderly with low functional demand<sup>2</sup>. As the population is aging and activity level of older population is also on the increase, the presence of osteoporosis places this population at a much higher risk for Colles' fractures<sup>3,4</sup>. There are many treatment modalities of Colles' fracture which includes closed reduction and casting, closed reduction and percutaneous pinning by different methods such as Kapandji intra focal pinning, trans radial styloid pinnig, pinning via the Lister's tubercle or trans ulnar pinning. Also closed reduction and external fixation, open reduction and internal fixation by different approach such as dorsal approach, volar approach<sup>5-7</sup>. In Colles' fracture when prolonged immobilization is required, often reduction is lost in early treatment. In many patients, incomplete restoration of radial length or secondary loss of reduction results in the complications of Colles' fracture<sup>8</sup>. Malunion which is a known complication of Colles' fracture results in pain, mid carpal instability and post-traumatic arthritis<sup>9</sup>. This prompted us to undertake a comparative study to determine the functional outcome with clinico-radiological analysis of patients with Colles'

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fractures treated with closed reduction and cast versus closed reduction, Kirschner wire fixation and cast.

## MATERIALS AND METHODS

In the present prospective study, we are reporting our experience in 30 cases where comparative evaluation in the measurement of the radial height, radial inclination, and ulnar angle was done in Colles' fractures treated conservatively by closed reduction and cast and closed reduction, Kirschner wire, and cast technique. The duration of this study was from January 2014 to January 2016. Written consent was taken from the patients prior to enrolling them in the study.

## INCLUSION CRITERIA

1) Patients of both genders and more than 18 years of age, 2) All patients with Colles' fracture (type 1 Frykman).

## EXCLUSION CRITERIA

1) Patients below 18 years of age, 2) Patients with open fractures of distal radius, 3) Presence of infection, 4) Colles' fractures with neurovascular injury, 5) Patients with Frykman Type-II to VIII or comminuted fractures of distal radius, 6) Patients with old Colles' fracture (>3 weeks).

## Pre-operative

A total of 30 cases with Colles' fractures were studied. On admission, a detailed history clinical examination of patient was done. Antero-posterior and lateral radiographs of the affected wrist joint were taken and their radiological parameters like radial height, radial inclination, and ulnar angle were measured (Figs. 1, 2). Primary splinting in the form of above elbow slab was given. All routine blood investigations for anesthesia fitness were done. After taking an informed, valid and written willful consent, patients were posted for closed reduction and cast or closed reduction, Kirschner wiring and cast.



Fig. 1 Group 1 - Preoperative X-ray of wrist joint AP and lateral view.



Fig. 2 Group 2- Pre-operative X-ray of wrist joint AP and lateral view.

## SURGICAL PROCEDURES

### Group 1: Closed reduction and casting

Process done under regional anesthesia or short general anesthesia. The patient was taken on a radiolucent operating orthopaedic table with side hand rest in the supine position. Closed reduction was done under image intensifier. After sustained traction and counter traction, the fracture was reduced with disimpaction followed with reduction with locking the fracture with pronation and finally applying the below elbow plaster of paris cast in palmar flexion and ulnar deviation.

### Group 2: Closed reduction, cross Kirschner wire and casting

Done under all aseptic precautions under supra-clavicular block or general anesthesia. The patient was taken on a radiolucent operating orthopaedic table with side hand rest in the supine position. After painting and draping sustained traction and counter traction, the fracture was reduced with disimpaction followed with reduction. Two cross Kirschner wires were inserted under image intensifier in radius, first from radial styloid across the fracture site piercing the opposite cortex and another from the dorsal aspect just medial to the lister's tubercle across the fracture site piercing the opposite cortex. A third trans fixation wire was passed from the ulna to the radius. The reduction was checked under C- arm in antero-posterior and lateral views. Below elbow plaster of paris cast in palmar flexion and ulnar deviation was given after pin tract dressing.

### Post-operative management

Limb elevation was given immediately post-operative. Postoperative check X-rays, antero-posterior and lateral views of wrist joint to check fracture alignment and reduction was done. Anti-inflammatory and analgesic drugs were given. Physiotherapy for finger, elbow, and shoulder movements was advised on the same post-operative day. The patient was discharged with the

following instructions: Regular finger, elbow, shoulder range of movement exercise. In case there is severe pain, blackening or bluish discoloration with cold and clammy finger review back immediately.

### Follow up

Patients were followed up in the outpatient department at 3 weeks, 6 weeks, 3 months and 6 months. At 3 weeks, plaster condition and range of movements of fingers, elbow, and cast shoulder were assessed clinically. At 6 weeks, for group 1, cast was removed and for group 2, cast and Kirschner wire was removed. Physiotherapy for finger, wrist joint, elbow joint, and shoulder range of movements was advised after cast removal. Post-operatively at 6 weeks, radiological parameters, that is, radial height, radial inclination, and ulnar angle were measured on X-rays wrist joint in Antero-posterior and lateral views (Figs. 3, 4). The functional outcome of cases was assessed by Mayo wrist score (0 to 100 points) as modified by Cooney and Bussey<sup>10</sup> and the functional as well as the radiological outcome was assessed by the Demerit scoring system modified by Saito<sup>11</sup>.

Mayo score, Excellent (90–100), Good (80–90), Satisfactory (60–80), Poor (Below 60).

A demerit scoring system of Saito- Excellent (0–3), Good (4–9), Fair (10–15), Poor (16–26) was measured.



**Fig. 3** Group 1- Post-operative X-ray of wrist joint AP and lateral view at 6 weeks.



**Fig. 4** Group 2- Post-operative X-ray of wrist joint AP and lateral view at 6 weeks.

## RESULTS

### Age incidence

In our study, the age of the patients ranged from 25 to 70 years with an average age was 42 years.

### Sex incidence

In our study, there were 18 (60%) male patients and 12 (40%) female patients.

### Side incidence

In our study, we had 18 (60%) patients with right side Colles' fracture and 12 (40%) patients had left side Colles' fracture.

### Incidence of the mechanism of injury

In our study, the predominant mechanism of injury was fall on outstretched hand. 17 (56.66%) patients had fallen on an outstretched hand and 13 (43.33%) patients had road traffic accident.

### Incidence of associated injuries

In our study, 6 (20%) patient had other associated injuries in which 2 patients had tibia fracture, 2 patients had intertrochanteric fracture femur and 2 patients had shaft femur fracture.

### Incidence of dominant/ Non-dominant hand

In our study, 16 (53.33%) patients had a Colles' fracture on the dominant hand and 14 (46.66%) patients had on the non-dominant hand.

### Incidence of complication

In group 1, 2 (13.33%) patient had wrist joint stiffness and 3 (20%) patient had malunion. In group 2, 1 (6.66%) patient had wrist joint stiffness, and 1 (6.66%) patient had a pin tract infection, 1 (6.66%) patient had pin loosening. Pin tract infections were treated with a short course of oral antibiotics and sterile dressings.

### Radiographic measurements

At 6 weeks, post-operative mean radial height, mean radial inclination and mean palmer angle for group 1 was 8 mm, 13 degrees, 8 degrees and for group 2 was 11 mm, 20 degrees, 11 degrees.

### Post-operative scores

#### Mayo functional score

Group 1–2 good, 10 satisfactory and 3 poor results.

Group 2–8 excellent results, 6 good and 1 satisfactory results.

Modified demerit point system of Saito–Group 1–12 fair and 3 poor results.

Group 2–9 excellent and 6 good results.

## DISCUSSION

Colles' fracture is a common injury. The importance of anatomic reduction has been demonstrated by clinical studies and by laboratory assessment of force and stress studies<sup>12,13</sup>. In fractures with articular displacement greater than 2 mm, radial shortening greater than 5 mm, dorsal angulation greater than 20 degrees, sub-optimal results have been reported in previously published studies<sup>14</sup>. Permanent loss of the Palmar angle and radial shortening of the distal radius are associated with persisting wrist pain<sup>15</sup>. After manipulation and plaster cast application, most of Colles' fractures redisplace<sup>16–18</sup>. They are reduced initially but frequently lose position because cast immobilization is not sufficient means of stabilization<sup>19</sup>. Stabilization in the form of percutaneous pinning is a simple, minimally invasive technique and helps prevent displacement of the fracture. The Kirshnerwire and cast give increased stability compared to cast treatment alone<sup>20</sup>.

The average age in our study is 42 years which is comparable to the studies of John K. Bradway et al. (1989)<sup>21</sup>, Jesse B. Jupiter et al. (1996)<sup>22</sup> and Harish Kapoor et al. (2000)<sup>23</sup> who had an average age of 40 years, 42 years and 39 years, respectively.

In our study, 43% of the patients had a road traffic accident and 57% had a fall on the out stretched hand. John K. Bradway et al. (1989)<sup>21</sup> and Louis Catalano III et al. (1997)<sup>24</sup> reported fall on the outstretched hand as the most common mode of injury. Jesse B. Jupiter et al. (1996)<sup>22</sup> and Harish Kapoor et al. (2000)<sup>23</sup> reported road traffic accident as the most common mode of injury.

We encountered a complication rate of 26.66%, out of which in group 1 the complication rate was 16.66% and in group 2 it was 10%. Modinikunj et al.<sup>25</sup> in there study reported.

A complication rate of 24%, in which closed reduction and cast was 16% and closed reduction Kirschnerwire and cast was 8%.

In our study, at 6 weeks post-operative mean radial height, mean radial inclination and mean palmar angle for group1 was 8 mm, 13 degrees, 8 degrees and for group 2 was 11 mm, 20 degrees, 11 degrees. Akhter Baig et al.<sup>26</sup> in there study of Colles' fracture treated with percutaneous Kirschner wire reported mean radial angle  $20 \pm 1.92$  degrees, radial length  $10.39 \pm 0.86$  mm and palmar angle 12.54 degrees. Benoist and Freeland<sup>27</sup> reported an average 24.75 degrees radial angle and a mean radial shortening of 2.3 mm in 61 consecutive patients, while Fuji<sup>28</sup> reported 20.7 degrees in 22 patients.

Kurup et al.<sup>29</sup> studied the late collapse of distal radius fractures after Kirschner wire removal and its significance.

They found that the fractures did not suffer significant loss of reduction after removal of wires.

As measured by Mayo functional score, we had in Group 1, 2 good, 10 satisfactory, 3 poor results and in Group 2, 8 excellent results, 6 good and 1 satisfactory results. Excellent results were reported by Stein and Katz<sup>30</sup> 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 Bannister<sup>18</sup> documented that the radial shortening improved after manipulation and casting to less than 3 mm in 86% of patients, but were maintained in 48% 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. Manandhar et al.<sup>31</sup> reported functional outcome excellent in 26 (52%) patients, good in 18 (36%) and satisfactory in 6 (12%). Modinikunj et al.<sup>25</sup> reported in group A (closed reduction and cast) we had 10% excellent, 24% good, 12% fair and 4% poor result. In group B (closed reduction and Kirschner wire) 10% had excellent 26% had good and 14% had fair results and 0% with poor result.

## CONCLUSION

We conclude that percutaneous Kirschner wire pinning is a minimally invasive technique that provides an effective means of maintaining anatomical fracture reduction. It does not require highly skilled personnel or sophisticated tools for application. It is a suitable method for fixation of Colles' fracture. Kirschner wire and cast stands an upper hand over the closed reduction and cast for Colles' fractures with respect to the near anatomical restoration of the radial height, radial inclination, and ulnar angle.

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