

**Comparative Study of Outcomes of Colles Fracture Treated by Closed Reduction POP Cast Application Versus K-Wire Fixation****Dhananjay Patel<sup>1</sup>, Priya Singh<sup>2</sup>, Mukesh Kumar Sharma<sup>3</sup>, Sachin Kumar<sup>4</sup>, Nirmal Kumar Dey<sup>5</sup>**<sup>1</sup>Senior Resident, Department of Orthopedic, Autonomous State Medical College Sonbhadra, Uttar Pradesh, India<sup>2</sup>Assistant Professor, Department of Pathology, Prasad Medical College and Hospital, Unnao, Uttar Pradesh, India<sup>3</sup>Consultant & Orthopedic Surgeon, Radiant Multispeciality Hospital Private Limited, Jaunpur, Uttar Pradesh, India<sup>4</sup>Assistant Professor, Department of Pulmonary & Critical Care Medicine, King George's Medical University Lucknow, Uttar Pradesh, India<sup>5</sup>Professor, Ex- Head of Orthopedic Department, JIMSH (Jagannath Gupta Institute of Medical Science and Hospital Budge Budge, Kolkata, West Bengal, India

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Conflict of interest: Nil

**Abstract****Background:** Distal radius (Colles') fractures are among the most frequently encountered fractures in adults. Despite their high incidence, the optimal treatment for extra-articular fractures remains a subject of debate, particularly when choosing between closed reduction with cast immobilisation and percutaneous K-wire fixation.**Objective:** To evaluate the radiological and functional outcomes of extra-articular distal radius fractures treated with either closed reduction and below-elbow plaster cast (manipulation under anaesthesia, MUA) or closed reduction and internal fixation (CRIF) using percutaneous K-wires with supplementary cast immobilisation.**Methods:** This prospective comparative study was conducted over an 18-month period at a single centre within the Department of Orthopaedic Surgery. Patients aged 18–75 years with extra-articular distal radius fractures were assigned to either the manipulation under anaesthesia (MUA) with cast group (n = 30) or the closed reduction and internal fixation (CRIF) with percutaneous K-wire and supplementary cast group (n = 30). Functional and radiological outcomes were evaluated using the Gartland and Werley demerit scoring system at 3, 6, and 12 weeks, and at 6 months. Statistical analysis was performed using SPSS version 27.0 and GraphPad Prism version 5, with a p-value of  $\leq 0.05$  considered statistically significant.**Results:** The study included 60 patients (33 men and 27 women), all of whom completed the follow-up period. The mean age was significantly lower in the CRIF group than in the MUA group ( $41.3 \pm 11.4$  vs.  $49.3 \pm 12.1$  years;  $p = 0.0109$ ). Patients treated with CRIF demonstrated significantly better functional outcomes, as indicated by lower mean Gartland and Werley scores at all follow-up visits:  $17.5 \pm 1.1$  versus  $19.5 \pm 1.5$  at 3 weeks,  $12.5 \pm 1.6$  versus  $17.2 \pm 1.9$  at 6 weeks,  $7.1 \pm 0.8$  versus  $11.4 \pm 1.4$  at 12 weeks, and  $3.1 \pm 0.8$  versus  $5.5 \pm 1.1$  at 6 months ( $p < 0.0001$  for all comparisons). In the MUA group, complications included malunion in three patients and wrist stiffness in two patients. In the CRIF group, two patients developed pin-tract infections, and three patients experienced pin loosening.**Conclusion:** In this study, percutaneous K-wire fixation with supplementary below-elbow cast immobilisation was associated with better radiological and functional outcomes than closed reduction and cast immobilisation alone for the management of extra-articular distal radius fractures. The two treatment groups also exhibited distinct complication profiles over the 6-month follow-up period.**Keywords:** Colles Fracture; Distal Radius Fracture; K-Wire Fixation; Plaster Cast Immobilisation; Gartland And Werley Score; Closed Reduction.**DOI:** 10.25258/ijcpr.18.6.309

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## Introduction

Distal radius fractures are among the most common fractures encountered in orthopaedic practice, accounting for approximately 17.5% of all adult fractures. Extra-articular fractures constitute the majority of these injuries (57–66%), while the remainder involve partial or complete articular extension. Most result from a fall onto an outstretched hand, with high-energy trauma occurring more commonly in younger adults and low-energy trauma typically affecting older individuals with osteoporotic bone[1,3].

The management of distal radius fractures depends on several factors, including fracture stability, patient characteristics, and surgeon preference. Treatment options range from conservative management with closed reduction and cast immobilisation to operative techniques such as percutaneous K-wire fixation, external fixation, and open reduction with internal fixation (ORIF). Although closed reduction and cast immobilisation remain widely used because of their simplicity and avoidance of surgical intervention, maintaining fracture alignment can be challenging, particularly in unstable fracture patterns, thereby increasing the risk of secondary displacement. Percutaneous K-wire fixation is commonly performed to improve fracture stability and maintain anatomical reduction; however, it is associated with procedure-related complications such as pin-tract infection and pin loosening[1,3,5].

Despite numerous studies comparing these treatment approaches, no clear consensus has been reached regarding the optimal management of extra-articular Colles' fractures. Reported functional outcomes vary across studies because of differences in patient characteristics, fracture patterns, treatment protocols, and follow-up duration [2,4,7-13]. The Gartland and Werley demerit scoring system is a well-established outcome measure for distal radius fractures, providing a comprehensive assessment based on residual deformity, subjective symptoms, objective clinical findings, and treatment-related complications[6].

The present study aimed to compare the radiological and functional outcomes of extra-articular distal radius fractures managed with either closed reduction and a below-elbow plaster cast or closed reduction and internal fixation (CRIF) using percutaneous K-wires with supplementary cast immobilisation. Outcomes were assessed using the Gartland and Werley demerit scoring system at regular intervals over a 6-month follow-up period.

## Materials and Methods

**Study Design:** This was a single-centre, prospective comparative interventional study

conducted over a period of 18 months in the Department of Orthopaedic Surgery, including the outpatient and emergency departments, at Jagannath Gupta Institute of Medical Sciences and Hospital, Budge Budge, Kolkata, India. A total of 60 patients with extra-articular distal radius fractures who fulfilled the eligibility criteria were enrolled. Patients were managed with either closed reduction and below-elbow plaster cast (manipulation under anaesthesia, MUA) or closed reduction and internal fixation (CRIF) using percutaneous K-wires with supplementary cast immobilisation. All patients were followed for a minimum of 12 weeks, with clinical and radiological outcome assessments performed up to 6 months.

**Participants:** Patients aged 18–75 years with radiologically confirmed extra-articular distal radius fractures who were medically fit for treatment were eligible for inclusion in the study. Patients with intra-articular, pathological, or open fractures, polytrauma, presentation more than 3 weeks after injury, or unwillingness to participate were excluded. Written informed consent was obtained from all participants prior to enrolment.

**Sample Size:** A total of 60 patients were enrolled during the study period. Of these, 30 patients were treated with closed reduction and below-elbow plaster cast immobilisation (MUA group), while the remaining 30 underwent closed reduction and internal fixation (CRIF) using percutaneous K-wires with supplementary below-elbow plaster cast immobilisation. The sample size was based on the number of eligible patients available during the study period and was influenced by reduced patient recruitment during the COVID-19 pandemic.

## Interventions

**Group A (MUA)** (n = 30) underwent closed reduction under appropriate anaesthesia (sedation, brachial block, general anaesthesia, monitored anaesthesia care, or local anaesthesia, as clinically indicated), followed by immobilisation with a below-elbow plaster of Paris cast.

**Group B (CRIF)** (n = 30) underwent closed reduction and internal fixation (CRIF) using percutaneous 1.8-mm Kirschner wires inserted through the radial styloid and Lister's tubercle under image intensifier guidance, followed by supplementary below-elbow plaster cast immobilisation.

Both groups followed the same postoperative rehabilitation protocol. Radiographic evaluation was performed at 2, 7, and 14 days after treatment, while clinical follow-up was scheduled at 3 weeks, 6 weeks, 12 weeks, and 6 months. Active movements of the fingers, elbow, and shoulder

were encouraged throughout the recovery period. The plaster cast and K-wires were removed at 6 weeks, after which wrist mobilisation exercises and rehabilitation were continued until satisfactory functional recovery was achieved.

**Outcome Assessment:** The primary outcome measure was the functional and radiological recovery of patients, evaluated using the Gartland and Werley demerit scoring system (6) at 3 weeks, 6 weeks, 12 weeks, and 6 months after treatment. According to this scoring system, lower scores indicate better clinical outcomes, with scores of 0–2 classified as excellent, 3–8 as good, 9–20 as fair, and >20 as poor (6). Secondary outcome measures included the occurrence of pain, swelling, residual deformity, and treatment-related complications during the follow-up period.

**Statistical Analysis:** All data were recorded in Microsoft Excel and analysed using SPSS version 27.0 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5. Continuous variables were summarised as mean  $\pm$  standard deviation (SD) and compared between the two groups using the independent-samples (unpaired) t-test. Categorical variables were expressed as frequencies and percentages, with comparisons performed using the chi-square test or Fisher's exact test, where appropriate. All statistical tests were two-tailed, and a p-value of  $\leq 0.05$  was considered statistically significant.

## Result

A total of 60 patients with extra-articular distal radius fractures were included in the study. Thirty patients were treated with closed reduction and internal fixation (CRIF) using percutaneous K-wires, while the remaining 30 underwent manipulation under anaesthesia (MUA) followed

by below-elbow plaster cast immobilisation. All patients completed the scheduled follow-up.

## Demographic and Baseline Characteristics

The study included 60 patients, comprising 33 men (55.0%) and 27 women (45.0%), resulting in a male-to-female ratio of 1.22:1. The distribution of sex was comparable between the two treatment groups, with no statistically significant difference ( $\chi^2 = 0.61$ ,  $p = 0.4362$ ). The right wrist was affected in 36 patients (60.0%), whereas the left wrist was involved in 24 patients (40.0%).

A fall onto an outstretched hand was the most common mechanism of injury, accounting for 38 cases (63.4%), while 22 patients (36.6%) sustained fractures following road traffic accidents. The mean age of patients was significantly higher in the MUA group than in the CRIF group ( $49.3 \pm 12.1$  vs.  $41.3 \pm 11.4$  years, respectively;  $p = 0.0109$ ). All fractures were classified as AO type 23-A2.

The type of anaesthesia used was similar in both groups, with no statistically significant difference ( $\chi^2 = 3.56$ ,  $p = 0.4695$ ). Sedation was the most frequently used anaesthetic technique in both the CRIF (73.3%) and MUA (69.0%) groups.

**Functional and Radiological Outcomes:** The functional and radiological outcomes were assessed using the Gartland and Werley demerit scoring system at 3 weeks, 6 weeks, 12 weeks, and 6 months after treatment.

At each follow-up visit, the CRIF group demonstrated significantly lower mean Gartland and Werley scores than the MUA group, indicating better clinical outcomes (Table 1). The differences between the two groups were statistically significant at all assessment time points ( $p < 0.0001$ ).

**Table 1: Comparison of mean Gartland and Werley demerit scores between the CRIF and MUA groups at each follow-up assessment. Lower scores indicate better clinical outcomes**

| Time point | CRIF (K-wire), n=30, mean $\pm$ SD | MUA (cast), n=30, mean $\pm$ SD | p-value |
|------------|------------------------------------|---------------------------------|---------|
| 3 weeks    | 17.47 $\pm$ 1.07                   | 19.50 $\pm$ 1.48                | <0.0001 |
| 6 weeks    | 12.50 $\pm$ 1.59                   | 17.17 $\pm$ 1.90                | <0.0001 |
| 12 weeks   | 7.10 $\pm$ 0.80                    | 11.37 $\pm$ 1.40                | <0.0001 |
| 6 months   | 3.13 $\pm$ 0.79                    | 5.50 $\pm$ 1.11                 | <0.0001 |

At the 3-week follow-up, most patients (53/60, 88.4%) had a fair outcome, while the remaining 7 patients (11.7%) were classified as having a poor outcome. By 6 weeks, nearly all patients (59/60, 98.3%) achieved a fair outcome. At 12 weeks, 31 patients (51.7%) had progressed to a good outcome, whereas 29 patients (48.3%) continued to have a fair outcome. By the end of the 6-month

follow-up, 53 patients (88.4%) had a good outcome and 7 patients (11.6%) achieved an excellent outcome. At the final follow-up, patients treated with CRIF achieved more favourable Gartland and Werley outcome grades than those treated with MUA Complications.

## Treatment-Related Complications

**Table 2: Treatment-related complications observed in the MUA and CRIF groups**

| Complication        | MUA (cast only) | CRIF (K-wire) |
|---------------------|-----------------|---------------|
| Malunion            | 3               | 0             |
| Wrist stiffness     | 2               | 0             |
| Pin-tract infection | 0               | 2             |
| Pin loosening       | 0               | 3             |

The MUA group experienced complications related to loss of reduction (malunion, wrist stiffness), whereas complications in the CRIF group were related to the percutaneous wires (pin-tract infection, pin loosening); no patient in the CRIF group developed malunion or stiffness, and no patient in the MUA group developed pin-related complications.

### Discussion

The present study demonstrated that patients treated with closed reduction and internal fixation (CRIF) using percutaneous K-wire fixation achieved significantly better functional and radiological outcomes than those managed with closed reduction and below-elbow plaster cast immobilisation alone. Lower Gartland and Werley scores were observed in the CRIF group at every follow-up assessment from 3 weeks to 6 months, indicating improved recovery throughout the study period.

The findings of the present study are consistent with previous comparative studies evaluating the management of extra-articular distal radius fractures. Several authors have reported that percutaneous K-wire fixation provides better maintenance of anatomical reduction and superior functional outcomes than cast immobilisation alone, particularly in unstable fracture patterns. Similar improvements in Gartland and Werley scores and a higher proportion of good and excellent outcomes following K-wire fixation have also been reported in comparative studies of extra-articular distal radius fractures. The improved outcomes observed in the present study are likely related to the additional mechanical stability provided by percutaneous K-wire fixation, which helps maintain fracture reduction during healing and reduces the risk of secondary displacement [2,4,5,7–13].

The demographic characteristics of the present study were comparable with those reported in previous literature. Although a slight male predominance was observed, several epidemiological studies have demonstrated a higher incidence of distal radius fractures among women, particularly in older individuals, owing to osteoporosis and low-energy falls. In the present study, a fall onto an outstretched hand was the most common mechanism of injury, which is consistent with the recognised epidemiology of distal radius fractures described in earlier studies [1,3].

The pattern of complications differed between the two treatment groups. Patients treated with cast immobilisation experienced complications related to loss of fracture reduction, including malunion and wrist stiffness, whereas complications in the CRIF group were limited to pin-related problems, namely pin-tract infection and pin loosening. Similar complication profiles have been reported in previous comparative studies, suggesting that although percutaneous K-wire fixation carries a small risk of pin-site morbidity, it provides improved fracture stability and reduces the likelihood of secondary displacement. Long-term follow-up studies have also demonstrated satisfactory radiological outcomes following percutaneous pinning, supporting its role as an effective treatment option for appropriately selected distal radius fractures[2,5,7–13].

Overall, the findings of the present study support the use of CRIF with percutaneous K-wire fixation for unstable extra-articular distal radius fractures, where maintaining fracture reduction is a major concern. Nevertheless, closed reduction and cast immobilisation remain an appropriate treatment option for stable, minimally displaced fractures. Further multicentre studies with larger sample sizes and longer follow-up are required to confirm these findings and evaluate long-term functional and radiological outcomes.

**Strengths and Limitations:** A major strength of this study is its prospective design, with direct comparison of two commonly used treatment modalities for extra-articular distal radius fractures. Functional and radiological outcomes were evaluated using the validated Gartland and Werley demerit scoring system at multiple clinically relevant follow-up intervals over a 6-month period, allowing assessment of recovery over time. The study also has several limitations. The sample size was relatively small (60 patients), primarily because patient recruitment was affected during the COVID-19 pandemic. In addition, the single-centre design may limit the generalisability of the findings. A baseline difference in age was observed between the two treatment groups, with patients in the MUA group being older on average than those in the CRIF group. As age and bone quality may independently influence fracture healing and functional recovery, this difference could have acted as a potential confounding factor. Furthermore, although the study prospectively

compared two treatment approaches, no formal method of random sequence generation or allocation concealment was documented, which may have introduced selection bias. Finally, follow-up was limited to 6 months, preventing assessment of long-term outcomes such as post-traumatic degenerative changes, persistent functional impairment, or late complications.

### Conclusion

The present study demonstrated that closed reduction and internal fixation (CRIF) using percutaneous K-wire fixation with supplementary below-elbow plaster cast immobilisation resulted in better functional and radiological outcomes than closed reduction and cast immobilisation alone in patients with extra-articular distal radius fractures. While both treatment modalities were associated with specific complications, CRIF provided superior overall clinical outcomes during the 6-month follow-up period. These findings suggest that CRIF is an effective treatment option for appropriately selected patients, particularly those with unstable extra-articular distal radius fractures.

### Declarations

**Ethics Approval and Consent to Participate:** The study was approved by the Institutional Ethics Committee (Human Studies), Jagannath Gupta Institute of Medical Sciences and Hospital, Kolkata, India (Approval No. JIMSH-IEC-15-2020). Written informed consent was obtained from all participants before enrolment in the study.

**Consent for Publication:** Not applicable.

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**Conflict of Interest:** The authors declare that they have no competing interests.

### Author Contributions

**Dhananjay Patel:** Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – Original Draft, Visualization.

**Debarshi Jana:** Formal analysis, Statistical analysis, Validation, Writing – Review & Editing.

**Nirmal Kumar Dey:** Conceptualization, Methodology, Supervision, Project administration, Writing – Review & Editing.

**Data Availability:** The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

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