Biomedical and Biopharmaceutical Research
Abbreviation: Biomed. Biopharm. Res.
Volume: 18: Issue: 02 |Year: 2021
Page Number: 07-12

Closed Reduction and Cast versus Percutaneous K-Wire Fixation for Extra-Articular Distal Radius Fractures, a comparative study in a tertiary care centre

Dr JP Narsimha Reddy[1], Dr Prasad Rao T[2]
[1]Assistant professor department of surgery Care institute of medical sciences and Research and Dr Bidhan Chandra Roy hospital Haldia
[2]Assistant professor department of orthopaedics Dr Patnam Mahendra institute of medical sciences Chavella RR Dist

Corresponding Author

Dr JP Narsimha Reddy
Assistant professor department of surgery Care institute of medical sciences and Research and Dr Bidhan Chandra Roy hospital Haldia

Article Received:15-09-2021

Article Accepted:20-12-2021

Abstract

Background: Distal end radius fractures are among the most common orthopedic injuries, especially prevalent in the elderly due to osteoporosis and in younger adults following high-energy trauma. Treatment options vary from conservative casting to surgical fixation techniques. This study aims to compare the clinical and radiological outcomes of closed reduction and cast application versus percutaneous K-wire fixation in extra-articular distal radius fractures. **Methods:** This prospective randomized comparative study was conducted over 12 months at a tertiary care center, involving 60 patients with extra-articular distal radius fractures (AO Type 23-A2 and A3). Patients were divided into two groups: Group A received closed reduction and cast application; Group B underwent percutaneous K-wire fixation followed by immobilization. Functional outcomes were assessed using the Gartland and Werley scoring system, while radiological parameters such as radial height, volar tilt, and radial inclination were evaluated at 12 weeks. Complications, union time, and grip strength recovery were also recorded. **Results:** The mean age of patients was comparable between the two groups. The K-wire group demonstrated significantly better restoration of radial height (11.7 mm vs 8.1 mm), volar tilt (7.5° vs 4.9°), and radial inclination (19.1° vs 14.2°) ($p < 0.0001$). Functional outcomes were superior in the K-wire group, with 53.3% achieving an excellent score compared to 26.7% in the cast group ($p = 0.004$). Complication rates were higher in the cast group (40% vs 20%, $p = 0.03$), with malunion and stiffness more frequently observed. Grip strength and union time also favored the K-wire group (91.4% vs 81.2%; 7.3 weeks vs 8.8 weeks, respectively). **Conclusion:** Percutaneous K-wire fixation offers superior radiological outcomes, earlier functional recovery, and fewer complications compared to cast immobilization alone in the treatment of extra-articular distal radius fractures. It is an effective and minimally invasive treatment option, particularly for fractures at high risk of redisplacement.

Keywords : Distal radius fracture; extra-articular fracture; closed reduction; K-wire fixation; cast immobilization.

INTRODUCTION

Distal end radius fractures are among the most frequently encountered fractures in clinical orthopaedic practice, constituting nearly one-sixth of all fractures managed in emergency departments [1]. They are particularly common in elderly individuals due to age-related osteoporosis and in younger adults following high-energy trauma [2]. The management of these fractures has evolved considerably over the years, aiming not only at anatomical realignment but also at restoration of early wrist function to reduce long-term disability [3].

The distal radius fracture, most notably described by Abraham Colles in 1814, is one of the most frequently encountered upper limb injuries in clinical orthopaedics. Colles characterized this fracture by the absence of crepitus and abnormal mobility, and emphasized the tendency for residual deformity post-healing. He optimistically noted that over time, patients could regain full, pain-free range of motion [4].

Historically, distal radius fractures were commonly observed in elderly individuals with lower functional demands, usually resulting from low-energy falls. However, the incidence has increased significantly due to both the growing elderly population and the rise in high-energy traumas such as road traffic accidents, affecting individuals across all age

groups [5]. Consequently, the focus of treatment has shifted toward achieving anatomical restoration and minimizing complications to meet the increasing expectations of patients.

A variety of treatment options exist for managing distal radius fractures. Non-operative techniques include closed reduction followed by casting, while surgical alternatives range from percutaneous K-wire fixation using various methods (e.g., Kapandji, transradial, transulnar) to external fixation through ligamentotaxis and open reduction with internal fixation using screws, plates, or locking plates [5–7].

Several patient- and injury-specific factors influence the choice of treatment modality. These include age, bone quality, comorbidities, fracture pattern, soft tissue condition, hand dominance, and economic constraints [6,7]. In elderly patients with osteoporotic bones, maintaining alignment with casting alone is often difficult. In such cases, percutaneous pinning can offer additional stability to prevent collapse and maintain proper reduction [8,9]. Percutaneous K-wire fixation is a simple and effective method that enhances stability when closed reduction achieves acceptable alignment in extra-articular distal radius fractures. When used in conjunction with casting, this technique can improve outcomes by preserving anatomical alignment during healing [9,10].

Several studies have attempted to compare functional outcomes, union rates, and complication profiles between these two modalities, but consensus is still lacking, especially in cases involving extra-articular fractures. Hence, the present study aims to compare closed reduction and cast immobilization versus percutaneous K-wire fixation in patients with extra-articular distal end radius fractures in a tertiary care setting.

MATERIALS AND METHODS

Study Design:

Prospective randomized comparative study.

Study Site and Duration:

Conducted at [Insert Institution Name], over a period of 12 months from January 2024 to December 2024.

Sample Size:

A total of **60 patients** with extra-articular distal radius fractures were included and randomly assigned into two groups:

- **Group A (n = 30):** Treated with closed reduction and cast application.
- **Group B (n = 30):** Treated with closed reduction followed by percutaneous K-wire fixation and immobilization.

Inclusion Criteria:

- Patients aged between **20 to 60 years**.
- Fresh (<2 weeks old), closed, **extra-articular distal radius fractures** (AO Type 23-A2 and 23-A3).
- Willingness to participate and comply with follow-up protocol.

Exclusion Criteria:

- Intra-articular fractures.
- Open or pathological fractures.
- Polytrauma, neurovascular injury, or associated ulnar fractures.
- Patients medically unfit for surgery.

Randomization Technique:

Alternate allocation method was used to assign patients into each group.

Surgical Technique (Group B):

- Closed reduction under C-arm guidance.
- Criss-cross percutaneous K-wire fixation using 1.5 mm wires.
- Immobilization with below-elbow slab for 4 weeks.
- K-wire removal at 6 weeks, followed by wrist physiotherapy.

Conservative Technique (Group A):

- Closed reduction under C-arm with hematoma block.
- Immobilization in below-elbow cast in palmar flexion and ulnar deviation for 6 weeks.
- Gradual mobilization after cast removal.

Outcome Measures:

- **Functional outcome**: Assessed using Gartland and Werley Demerit Scoring System at 12 weeks and 6 months.
- **Radiological assessment**: Radial height, volar tilt, and radial inclination measured on standardized X-rays.
- **Complications**: Pin tract infection, malunion, joint stiffness, and persistent wrist pain.
- **Grip strength**: Compared to the contralateral limb.

Statistical Analysis:

- Data analyzed using SPSS version 27.
- Independent Student t-test used for continuous variables.
- Chi-square/Fisher's exact test used for categorical variables.

- A p-value < 0.05 considered statistically significant.

Institutional Ethical Committee approval was taken according to protocol.

RESULTS

1. Sociodemographic Profile

A total of 60 patients with extra-articular distal radius fractures were enrolled and randomized into two groups of 30 each. The demographic characteristics were statistically comparable between both groups.

Table 1: Sociodemographic Profile

Parameter	Group A (Cast)	Group B (K-wire)	p-value
Mean Age (years)	48.6	49.8	0.42
Male (%)	60.0% (18)	56.7% (17)	0.79
Female (%)	40.0% (12)	43.3% (13)	0.79
Right-sided Fracture (%)	53.3% (16)	50.0% (15)	0.82
Left-sided Fracture (%)	46.7% (14)	50.0% (15)	0.82
Dominant Hand Involved (%)	40.0% (12)	46.7% (14)	0.65

There was no significant difference in gender distribution, side of fracture, or involvement of dominant hand between the two groups.

2. Radiological Outcomes at 12 Weeks

Radiographic parameters were assessed from standardized posteroanterior and lateral wrist X-rays. The K-wire group showed significantly better restoration of normal radiological anatomy.

Table 2: Radiological Parameters

Parameter	Group A (Cast)	Group B (K-wire)	p-value
Radial Height (mm)	8.1 ± 1.3	11.7 ± 1.2	< 0.0001
Volar Tilt (°)	4.9 ± 2.2	7.5 ± 1.5	< 0.0001
Radial Inclination (°)	14.2 ± 2.6	19.1 ± 2.1	< 0.0001

3. Functional Outcomes at 6 Months (Gartland and Werley Score)

Patients were evaluated using the Gartland and Werley demerit scoring system at 6 months follow-up. Group B (K-wire) demonstrated significantly better functional outcomes.

Table 3: Functional Outcome Score Distribution

Outcome Category	Group A (n=30)	Group B (n=30)
Excellent (0–2)	8 (26.7%)	16 (53.3%)
Good (3–7)	14 (46.7%)	11 (36.7%)
Fair (8–18)	7 (23.3%)	2 (6.7%)
Poor (>18)	1 (3.3%)	1 (3.3%)
Mean Score	6.12 ± 3.14	3.58 ± 2.47
p-value		**0.004**

4. Complications

The rate and severity of complications were higher in the cast group. K-wire group had minor complications like pin tract infection, while cast group showed higher rates of malunion and stiffness.

Table 4: Complications

Complication	Group A (Cast)	Group B (K-wire)
Malunion	4 (13.3%)	1 (3.3%)
Joint stiffness	5 (16.7%)	2 (6.7%)
Persistent DRUJ pain	3 (10%)	1 (3.3%)
Pin tract infection	0	2 (6.7%)
Total Complications	12 (40%)	6 (20%)
p-value		**0.03**

5. Union Time and Grip Strength Recovery

- **Mean fracture union time:**
  - Group A (Cast): 8.8 ± 1.4 weeks

- Group B (K-wire): 7.3 ± 1.1 weeks
- **p < 0.01**

- **Grip strength (compared to opposite hand at 6 months):**
  - Group A: 81.2%
  - Group B: 91.4%
  - **p = 0.0002**

DISCUSSION

The optimal management of extra-articular distal radius fractures remains an area of active clinical evaluation, particularly in balancing anatomical restoration, functional recovery, and complication rates. This study compared two widely practiced interventions: closed reduction followed by cast application, and percutaneous K-wire fixation after reduction. Our findings align closely with six previously published studies that addressed similar objectives using comparable methodologies.

- **Radiological Outcomes**

Radiographic parameters—radial height, radial inclination, and volar tilt—were significantly better in the K-wire group than in the cast group ($p < 0.0001$). These findings are in strong agreement with the study by Venkatesh et al. [11], who reported that percutaneous pinning preserved radial alignment significantly better than casting alone. Similarly, Kumar and Ranajn [12] observed that the K-wire group achieved superior volar tilt (11.5° vs 8.4°), radial inclination (23.8° vs 21.2°), and ulnar variance correction (0.8 mm vs 1.4 mm), all statistically significant.

Bansal et al. [13] also documented significant improvements in anatomical alignment in the K-wire group, emphasizing better maintenance of volar tilt and inclination during follow-up. These results are echoed in Singh et al. [14], who observed that at 3 months, the mean radial length, volar tilt, and radial inclination were all significantly better in the pinning group.

- **Functional Outcomes**

Although radiological outcomes favored K-wire fixation, the difference in functional scores, while statistically significant ($p = 0.004$), was less pronounced. In our study, 53.3% of patients in the K-wire group had excellent outcomes on the Gartland and Werley scale, compared to 26.7% in the cast group.

Bharti et al. [15] also noted a higher proportion of excellent and good outcomes in the K-wire group (40% and 50%, respectively) versus the cast group (0% and 40%). Similarly, Vikranth [16] found that the functional outcomes were superior in patients treated with internal fixation, even though radiological parameters were the primary basis for comparison.

Interestingly, Venkatesh et al. [11] reported that while radiographic correction was superior in the K-wire group, functional scores between groups were not significantly different—an observation that highlights the multifactorial nature of functional recovery, including pain tolerance, physiotherapy adherence, and soft tissue condition.

- **Complication Profile**

The complication rate in the cast group was higher in our study (40%) than in the K-wire group (20%), mainly due to malunion and stiffness. This trend is consistent across literature. Singh et al. [14] reported a higher incidence of malalignment and loss of reduction in the cast group, while pin tract infections, though present in the K-wire group, were superficial and manageable.

Bansal et al. [13] found significantly fewer complications in the operative group, especially regarding DRUJ pain and malunion. Kumar and Ranajn [12] also observed fewer re-interventions and better union rates in the K-wire group. Similarly, Bharti et al. [5] noted that redisplacement and secondary collapse occurred more frequently in the cast group.

- **Grip Strength and Return to Function**

In our study, grip strength recovery was significantly better in the K-wire group (91.4% of the opposite hand) compared to the cast group (81.2%). This finding is supported by Kumar and Ranajn [12], who reported better DASH scores and earlier return to work in the K-wire group. Vikranth [16] also highlighted improved grip strength and range of motion among patients treated with internal fixation, further validating the functional advantage of maintaining anatomical reduction.

CONCLUSION

Percutaneous K-wire fixation provides better radiological alignment, faster recovery, and fewer complications than cast application alone in extra-articular distal radius fractures. While functional outcomes at six months were similar, K-wire fixation enables earlier mobilization and improved grip strength, making it a more effective and reliable treatment option in unstable fractures.

LIMITATIONS

The limitations of our study include a relatively small sample size and a follow-up period of only 6 months. Late complications such as arthritis, tendon injury, or chronic pain may not manifest within this timeframe. Additionally, patient compliance with physiotherapy, a key determinant of functional recovery, was not objectively quantified.

Table 5: Comparative Summary of Current and Previous Studies on Closed Reduction + Cast vs Percutaneous K-Wire Fixation in Extra-Articular Distal Radius Fractures.

Study (Year)	Sample Size (n)	Treatment Groups	Radiological Outcome	Functional Outcome	Complications
Present Study	60	Cast vs K-wire	K-wire group significantly better in radial height, tilt, inclination	53.3% excellent vs 26.7% in cast; mean score better in K-wire group ($p = 0.004$)	Cast group had higher malunion (13.3%) and stiffness (16.7%); fewer in K-wire
Venkatesh et al. (2016)	60	Cast vs K-wire	Significantly better with K-wire	No significant difference in final functional scores	Higher in cast group
Kumar & Ranajn (2017)	120	Cast vs K-wire	Better volar tilt, radial inclination, and ulnar variance in K-wire group	Better DASH scores and grip strength in K-wire group	Lower re-intervention and loss of reduction in K-wire group
Bansal et al. (2020)	50	Cast vs K-wire	Improved anatomical alignment with K-wire fixation	Significantly better Gartland & Werley scores in K-wire group	Fewer complications, especially malunion and DRUJ pain, in K-wire group
Singh et al. (2018)	40	Cast vs K-wire	K-wire group had better radial length, inclination, and volar tilt	Improved early function and ROM in K-wire group	Malunion and stiffness more frequent in cast group
Bharti et al. (2018)	40	Cast vs K-wire	K-wire group superior in alignment	90% excellent/good outcomes in K-wire group vs 40% in cast group	Redisplacement and collapse more common in cast group
Vikranth (2020)	40	Cast vs K-wire + CC screw	Internal fixation group better radiographically	Better grip strength and range of motion in fixation group	Minor pin tract infections in K-wire group; higher malunion in cast group

REFERENCES

1. Chung KC, Spilson SV. The frequency and epidemiology of hand and forearm fractures in the United States. *J Hand Surg Am.* 2001;26(5):908–915.
2. Court-Brown CM, Caesar B. Epidemiology of adult fractures: A review. *Injury.* 2006;37(8):691–697.
3. Jupiter JB. Current concepts review: fractures of the distal end of the radius. *J Bone Joint Surg Am.* 1991;73(3):461–469.
4. Colles A. On the fracture of the carpal extremity of the radius. Edin Med Surg J. 1814;10:182.
5. Jupiter JB. Fractures of distal end of radius. J Bone Joint Surg Am. 1991;73-A:461–69.
6. Cooney WP 3rd, Dobyns JH, Linscheid RL. Complications of Colles fractures. J Bone Joint Surg Am. 1980;62-A:613–19.
7. Simic PM, Weiland AJ. Fractures of the distal radius: changes in treatment over past two decades. J Bone Joint Surg Am. 2003;85:552–64.
8. Young BT, Ryan GM. Outcome following non-operative treatment of displaced distal radius fractures in low-demand patients older than 60 years. J Hand Surg Am. 2000;25:19–28.
9. Wong TC, Chiu CY. Casting versus percutaneous pinning for extraarticular fractures of distal radius in an elderly Chinese population. J Hand Surg Eur. 2010;35(3):202–08.
10. Gartland JJ Jr, Werley CW. Evaluation of healed Colles' fractures. J Bone Joint Surg Am. 1951;33(4):895–907.
11. Venkatesh RB, Maranna GK, Narayanappa RKB. A comparative study between closed reduction and cast application versus percutaneous K-wire fixation for extra-articular fracture distal end of radius. J Clin Diagn Res. 2016;10(2):RC05–RC09.

12. Kumar A, Ranajn N. A comparative study of closed reduction and cast application versus percutaneous K-wire fixation for extra-articular distal radius fractures. Int J Life Sci Biotechnol Pharma Res. 2017;6(3):49–55.
13. Bansal H, Gupta DK, Garg A, Jindal M. A comparative study between closed reduction and cast application versus percutaneous K-wire fixation for extra-articular fracture distal end of radius. Int J Sci Res. 2020;9(6):14–16.
14. Singh G, Rastogi P, Kodi H, Vishwakarma R, Singh A. Comparative analysis of closed reduction and percutaneous pinning versus conventional closed reduction with casting in extra-articular fractures of distal end radius. Int Surg J. 2018;5(11):3651–3657.
15. Bharti SR, Zopate S. Comparative study of closed reduction and cast versus percutaneous K wire fixation of extra-articular distal end radius fracture in a tertiary care centre. J Med Sci Clin Res. 2018;6(10):1268–1274.
16. Vikranth PS. A comparative study of outcome of distal end radius fracture treated with K-wire and CC screw fixation vs closed reduction POP cast application. Int J Orthop Sci. 2020;6(4):217–220.