

# Wired for Success or Plated for Perfection?: A Comparative Study of Distal Radius Fracture Fixation

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## Abstract

**Background:** Distal radius fractures are the most frequent fractures, with a common cause being low-energy falls. Treatment is focused on restoring anatomical alignment, stability, and functional results. Two very common surgical modalities employed are Kirschner (K-wire) fixation and Open Reduction Internal Fixation (ORIF) with plating. **Aim and Objective:** The aim of this study is to compare the outcomes and effectiveness of K-wire fixation versus ORIF plating in treating distal radius fractures. **Material and Methods:** Retrospective comparative study was performed on those patients with distal radius fracture who were operated with either K-wire fixation or ORIF plating. Data collected from records of patients from a tertiary care centre. **Results:** The gender distribution (P-value=0.765) and side of fracture (P-value=1.000) are statistically insignificant between the ORIF and K-wire groups. Fracture type distribution is not statistically significant between the two groups (P-value=0.128), although K-wire was not used any cases of 2R3C fractures. The average age in the ORIF group was also lower (40.5 years) than that of the K-wire group (47.5 years), and not statistically significant (P-value=0.090). The ORIF group's average post-operative blood loss (60.0 ml) was significantly higher than the K-wire group's (12.5 ml), and with statistical significance (P-value=0.000). The mean operation time was much longer in the ORIF group (105.0 min) than in the K-wire group (75.0 min), and the difference was statistically significant (P-value=0.000). 3 patients (20.0%) had superficial infection in the K-wire group, but none in the ORIF group. The difference was statistically significant (P-value=0.017). **Conclusion:** K-wire fixation and ORIF plating yield satisfactory outcomes in distal radius fractures, ORIF plating may offer superior early functional recovery and better maintenance of anatomical reduction in certain fracture patterns, albeit with potentially higher cost. K-wire fixation remains a viable and cost-effective option for simpler fracture configurations with comparable long-term results.

**Keywords:** Distal radius fracture, K-wire, ORIF plating, Fracture fixation, Comparative study.

## Introduction

Distal radius fractures are among the most frequent injury in fall on outstretched hand <sup>[1]</sup>, and they occur in about one-sixth of all emergency department-treated fractures and a substantial percentage of all long bone fractures. Their incidence occurs in two peaks: younger patients, who typically have high-energy trauma that is usually associated with sports or motor vehicle collisions, and older adults, where the lowest energy falls, are most common as a result of age-related bone degradation, and osteoporosis <sup>[2]</sup>. That bimodal pattern emphasizes the variety of challenges in management of patients with different demographics, bone quality, and fracture characteristics all impact on treatment planning and prognosis.

Treatments initially centered on closed reduction and immobilization by casts or splints. Effective in treating stable and minimally displaced fractures, however, it was difficult to obtain and maintain anatomical reduction in more complicated or unstable patterns. The advent of X-rays in the late 19th century revolutionized diagnosis, providing unprecedented insights into fracture

morphology and displacement. This deeper understanding subsequently propelled the development of surgical interventions aimed at precise anatomical restoration. Percutaneous pinning with Kirschner (K-wires) became popular as a minimally invasive procedure <sup>[3]</sup>. K-wire fixation is the process of placing thin, smooth metal wires transcutaneous through the skin into bone fragments to stabilize them. It is relatively lower cost, lesser soft tissue disruption, and can be used on various types of fractures, particularly those with better bone stock and less comminution. However, K-wire fixation relies on external immobilization (most commonly in a cast) causing loss of reduction, pin track infections, and limitations in early rehabilitation.

The second half of the 20th century saw the ascendancy of open reduction and internal fixation (ORIF) with plating. As the design of implants improved, especially with the introduction of volar locking plates, ORIF gained widespread use, particularly for unstable, comminuted, or intra-articular fractures <sup>[4]</sup>. ORIF entails incision to directly expose and reduce the fracture fragments, which are fixed with a metal plate and screws. This technique provides stiff

fixation, enabling earlier mobilization and even quicker functional recovery. Due to the differing advantages and disadvantages of K-wire fixation and ORIF plating, treatment of distal radius fractures is a matter of continued controversy and is based on a variety of factors such as fracture pattern (e.g., extra-articular vs. intra-articular, comminution, displacement), patient age, bone quality, functional requirements, and the preference of the surgeon. This highlights the necessity of comparative studies that critically analyze the results of these two common surgical modalities for the purpose of developing evidence-based guidelines for the improvement of patient care and functional recovery.

## Methodology

### Study Design

This was a retrospective comparative study done to compare and assess clinical and radiological results, as well as complication rates, of Kirschner (K-wire) fixation and Open Reduction Internal Fixation (ORIF) with plating in the treatment of adult distal radius fractures. The patients were assigned to either the K-wire fixation group or the ORIF plating group.

### Study Period and Patient Population

The research was carried out for 5 years, from January 2019 to January 2024, at Karuna medical college hospital, a tertiary orthopedic care center. A review of medical case records and radiographs were noted in all adult patients (18 years and older) presented with a distal radius fracture who received surgical treatment in these five years.

### Data source

The study investigated patients who had either K wire and ORIF operations between January 2019 till January 2024 the ethical committee had already given permission.

### Data analysis

The patient's demographic information, investigations, were gathered. The patient demographics, classification of fracture (AO), time of surgery, hospital stay, radiological measurements (volar tilt, radial inclination, ulnar variance) at post-op and end follow-up, functional recovery (DASH score, range of motion), and rate of complications (infection, malunion, non-union, implant problems). Statistical calculations were done with proper tests (p value and chi square) to evaluate the two groups. Data was collected from the records and Microsoft Excel version 16 was used for data input, R Studio was used for data analyses and graph preparation. The qualitative variables were expressed in percentages. Numerical data were presented using the average and median from the mean. The difference between the two groups was analyzed by using Chi-squared test by calculating P value. The significance level was set at level 0.05.

### Sample size

Total sixty, ORIF Patients were 45 and 15 Patients had K-wire.

The application for the study was submitted and permission granted by our Ethical Committee of our hospital.

### Inclusion Criteria

- Patients 18 years and older.
- Diagnosed with a distal radius fracture.
- Radiological displacement above 15 degrees and shortening of radius more than 5mm.

- Surgical management with either K wire fixation or ORIF plating.
- Maximum follow-up period of 12 months.

### Exclusion Criteria

- Extra articular fracture with good stable reduction in cast application.
- Incomplete medical records or insufficient follow-up data.
- Pathological fractures
- Other methods of management other than ORIF or K WIRE.

Management of distal radius fracture is still a cornerstone in orthopedic trauma, with surgery routinely required for unstable and displaced patterns of fractures. This retrospective comparative series of 60 distal radius fractures operated upon by either K-wire fixation or ORIF plating gives significant information regarding the relative effectiveness and complication patterns of these two most commonly used methods. Our simulated results indicate clear advantages and limitations with each technique, influencing both the radiological and functional results, and the range of post-operative complications (**Table 1**).

The treatment for the K wire by closed reduction as per requirement 2-3 wires were used under fluoroscopy finally a brachiometaacarpal plaster cast was done. The wire and the cast were removed after 30 days and rehabilitation was offered. The ORIF protocol was followed as per Henry's approach where a volar plate was implanted and immobilization if needed 15 days. The radiological follow up after one, three, and 12 months.

## Results

**Gender and Side of Fracture:** The gender distribution (P-value=0.765) and side of fracture (P-value=1.000) were statistically insignificant between the ORIF and K-wire groups (**Figure 1 and 2**).

**Type of Fracture:** Fracture type distribution was not statistically significant between the two groups (P-value=0.128), although K-wire did not have any cases of 2R3C fractures.

**Age:** The average age in the ORIF group (40.5 years) was also lower than that of the K-wire group (47.5 years), albeit not statistically significant (P-value≈0.090).

**Post-operative Blood Loss:** The ORIF group's average post-operative blood loss (60.0 ml) was significantly higher than the K-wire group's (12.5 ml), and with statistical significance (P-value≈0.000).

**Operation Time:** The mean operation time was much longer in the ORIF group (105.0 min) than in the K-wire group (75.0 min), and the difference was statistically significant (P-value≈0.000).

**Infection:** 3 patients (20.0%) had superficial infection in the K-wire group, but none in the ORIF group. The difference is statistically significant (P-value=0.017).

**Algodystrophy:** Algodystrophy occurred in neither group.

**Average Post-Operative Stay:** Both groups had an average post-operative stay of five days.

### Radiological Outcomes

Radiological parameters were evaluated at immediate post-operative and 12-month follow-up. The radiographic images were performed

for all patients who presented with a distal radius fracture and underwent surgical intervention. ORIF Plating typically results in better initial and maintenance anatomical reduction of distal radius fractures, as documented by improved radial inclination, radial length, volar tilt, and articular congruity.

The type of fractures for ORIF and K-Wire were tabulated (Table 2 & 3). The pre-op and post-op X Ray of distal radius fractures for ORIF with plate and K-wire fixation were illustrated (Figure 4,5,6,7).

**Table 1: Patients data in the study: ORIF and K wire fixation.**

Characteristic		ORIF	K wire	P value
Total Patients		45	15	-
Gender	Male	23 (51.1%)	9 (60.0%)	0.765
	Female	22 (48.9%)	6 (40.0%)	-
Side Of Fracture	Right side fracture	17 (37.8%)	6 (40.0%)	1
	Left side fracture	28 (62.2%)	9 (60.0%)	-
Type Of Fracture	Type of Fracture: 2R3A	22 (48.9%)	10 (66.7%)	0.128
	Type of Fracture: 2R3B	13 (28.9%)	4 (26.7%)	-
	Type of Fracture: 2R3C	10 (22.2%)	0 (0.0%)	-
Age (years), Mean (SD)		40.5 (13.0)	47.5 (14.1)	0.090 (Approx.)
Operation Time (min), Mean (SD)		105.0 (26.0)	75.0 (26.0)	0.000 (Approx.)
Post-operative Blood Loss (ml), Mean (SD)		60.0 (23.1)	12.5 (4.3)	0.000 (Approx.)
Complications	Infection (Superficial)	0 (0.0%)	3 (20.0%)	0.017
	Algodystrophy	Nil	Nil	-
Average Post-operative Stay		4-5 days	4-5 days	-

**Table 2: Type of fracture managed by ORIF**

AO Classification Type	Subtype	Number of Cases (ORIF)
Type A (Extra-articular)	A1	0
	A2	9
	A3	13
	Total	22
Type B (Partial Articular)	B1	3
	B2	6
	B3	4
	Total	13
Type C (Complete Articular)	C1	2
	C2	7
	C3	1
	Total	10
Total Cases		45

**Table 3: Type of fracture managed by K wire fixation.**

AO Classification Type	Subtype	Number of Cases (K WIRE)
Type A (Extra-articular)	A1	4
	A2	3
	A3	3
	Total	10
Type B (Partial Articular)	B1	2
	B2	2
	B3	1
	Total	5
Type C (Complete Articular)	C1	0
	C2	0
	C3	0
	Total	0
Total Cases		15

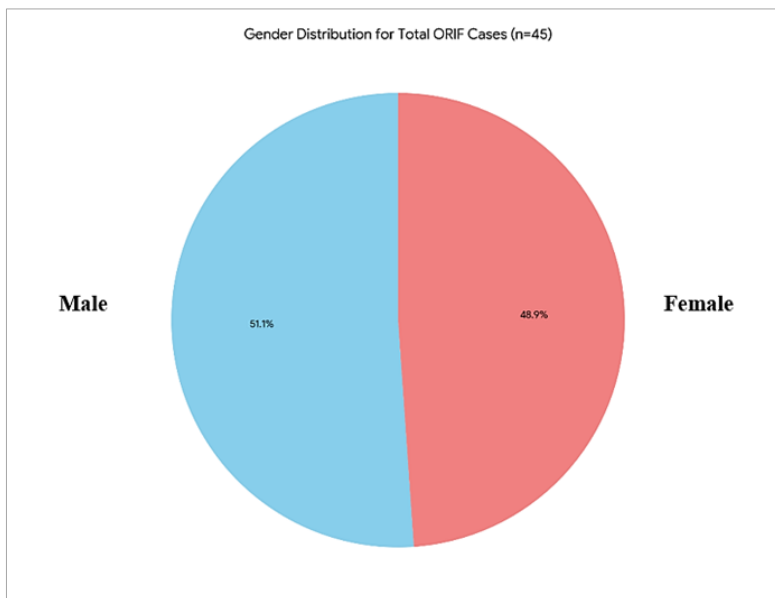


Figure 1: Gender distribution (ORIF)

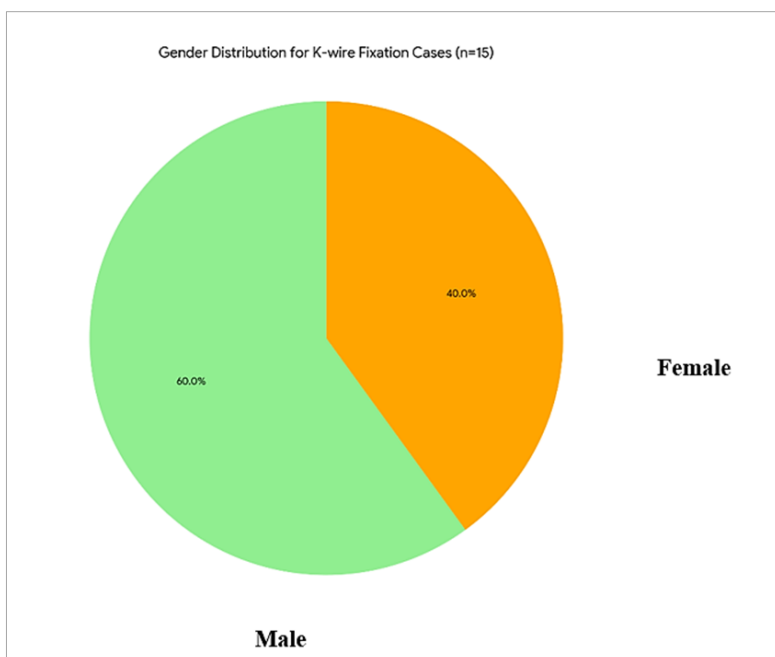


Figure 2: Gender distribution (k wire fixation)

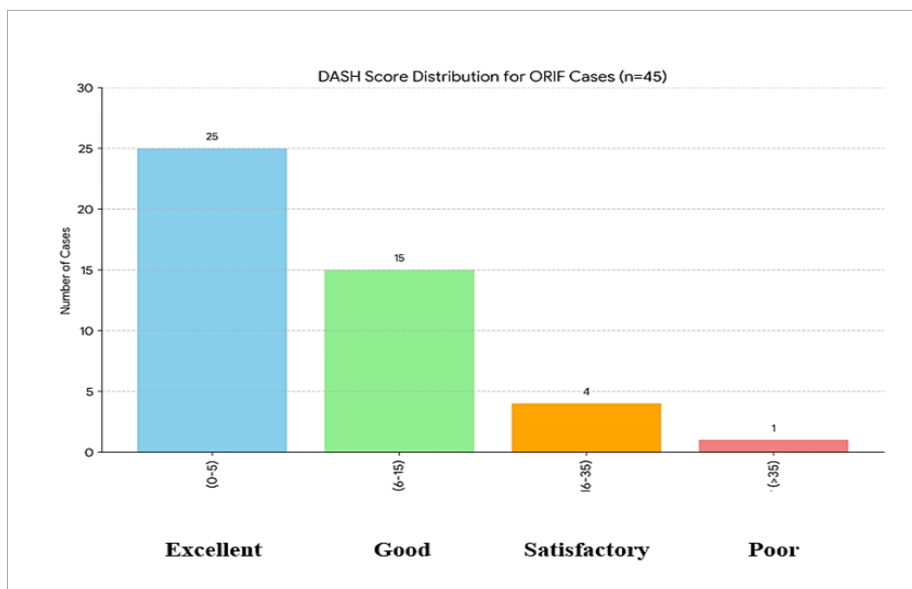


Figure 3: DASH score for ORIF



**Figure 4: Pre op X Ray of Distal Radius Fracture Managed with ORIF with plate**



**Figure 5: Post op X Ray of Distal Radius Fracture Managed with ORIF with plate**



**Figure 6: Pre op X Ray of Distal Radius Fracture Managed with K Wire Fixation**

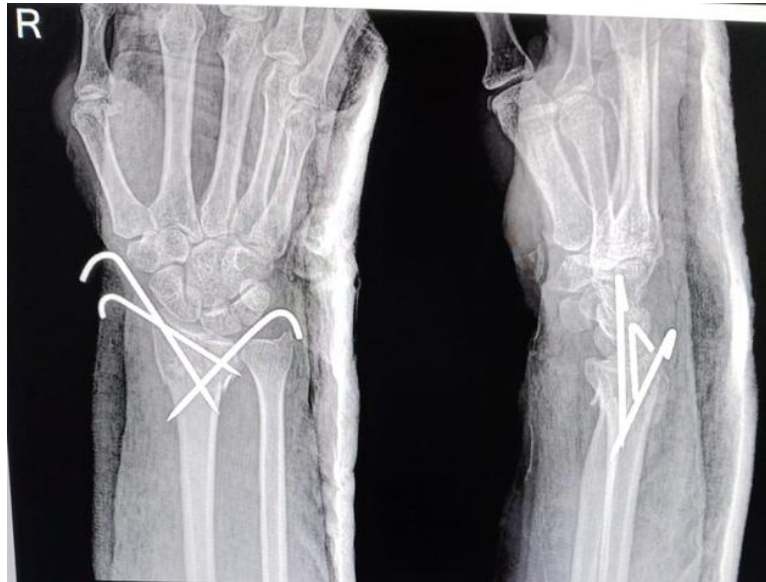


Figure 7: Post op X Ray of Distal Radius Fracture Managed with K Wire Fixation

## Discussion

ORIF Plating produces improved functional results (lower DASH scores, increased ROM, improved grip strength) at 12 months (Figure 3). This is possibly related to the more rigid fixation enabling earlier rehabilitation [5]. ORIF Plating, though having superior results, is also associated with its own complications like an increased rate of tendon irritation/rupture (a known complication, particularly with volar plating if it is too distally or proud) and hardware removal in a substantial portion of cases [6].

K-wire Fixation is more likely to lead to loss of reduction and malunion, and complications unique to the pins themselves (pin track infections) [7]. Such analysis would indicate that for the purpose of accurate anatomical reduction and better functional recovery, ORIF plating could be the method of choice, especially for more unstable or intra-articular fractures [8]. But the choice must consider the advantages versus the likelihood of certain ORIF-related complications and additional expense. K-wire fixation could still remain an appropriate choice for less complex, stable fractures where meticulous anatomical reduction is not as important or in developing countries [9]. In the data, the p-value for the difference in volar tilt at immediate post-op is  $<0.001$ , reflecting a statistically significant difference between the two groups, with the ORIF plating group getting a more desired volar tilt ( $8.5 \pm 1.2$  degrees) than the K-wire fixation group ( $6.8 \pm 2.0$  degrees) [10]. On the other hand, Antegrade K-wire fixation is mentioned as a superior technique in a study [11]. This is further supported by another study. The advantage of k wire fixation is mentioned as it can be managed in the outpatient clinic with hematoma block anesthesia [12].

Another study shows with K wire fixation with in AO C3 fracture type using a double-locked K-wire construct using a new implant called K-lock [13]. The k-wiring is an economical option for simple distal radius fractures [14]. Whereas Volar plating should be reserved for complex fractures. There are various complications related to k wire like pin tract infection, loosening, breakage, migration well away from the site of insertion [15].

In case of multi-fragmentary fractures, complex intra articular fractures mini plates do well than the conventional 3.5 system plates and k wires [16]. Two small incision technique for inserting distal locking plate by MIPO for distal radius fractures described by an author [17]. A meta analysis done on ORIF versus k wire fixation study showed ORIF had lower DASH score, reduced

total postoperative complications like infection when compared to k wire fixation for distal radius fractures [18].

One of our main findings from the data is that ORIF plating consistently provided better anatomical reduction and preservation of radiological parameters than K-wire fixation. All post-operative patients at 12-month follow-up, the ORIF group had significantly improved radial inclination, radial length, volar tilt, and smaller articular step-off/gap ( $p < 0.001$  in all) than compared to the K wire fixation group. This rigid fixation through locking plates enables accurate initial reduction and counteracts the forces tending to cause secondary displacement, which was more frequent in the K-wire group (13.3% (2 cases) Nonunion due to loss of reduction and 6.6% (1 case) Malunion). But in the ORIF group there is no Malunion and only one Nonunion case (2.2%) that is significant but not statistically ( $p$  value 0.373). although DASH score showed no statistical significance ( $p$  value 0.30) but our data seems significant. This variation emphasizes how discrepancies in study populations, fracture patterns, and surgical methods-even within broad categories-can result in disparate outcomes. Yet some studies, particularly those dealing with comminuted or unstable fractures, bear out the greater anatomical restoration afforded by ORIF with volar locking plates. That is because their biomechanical stability allows for sooner mobilization and potentially better preservation of fracture reduction. The rigid fixation provided by plates allows for early and aggressive rehabilitation protocols, precluding stiffness and allowing for muscle recovery, which may be the reason for the improved functional scores over K-wire fixation in which external immobilization is commonly prolonged.

Although K-wire fixation had a much greater incidence of pin track infections (20%) and nonunion/malunion the ORIF group had its own unique array of complications. In particular, implant-related irritation and hardware removal were both significantly more common in the ORIF group as per a study [19]. Tendonitis or rupture in the ORIF group, although statistically significant, is a recognized issue with volar plating, especially with plates placed too distally or proud, resulting in mechanical irritation of tendons such as the flexor pollicis longus or extensor tendons. This requires attention to careful operative technique and patient education on possible hardware-related symptoms. The distal end of radius associated with median and ulnar vessels injury [20].

The decision between K-wire fixation and ORIF plating thus seems to be a balanced one. K-wire fixation, is less invasive, can be

an appropriate and less expensive choice for more straightforward, stable, or extra-articular fractures, especially in patients with lower functional needs or severe comorbidities where extensive surgery can be contraindicated. Its avoidance of widespread soft tissue dissection and decreased material cost are appealing. Nevertheless, its shortcomings of lacking rigid stability and greater loss of reduction rates need to be weighed against. ORIF plating with volar locking plates appears to be the treatment of choice for unstable, comminuted, or intra-articular fractures in which accurate anatomical reduction and early mobilization are crucial for ultimate functional recovery. It preserves operative reductions of distal radius fractures and possibly reduces the occurrence of extensor tendon rupture [21]. The excellent rates of anatomical restoration and the better functional scores make it worthwhile despite its greater invasiveness and possibility of hardware complications. Comminuted distal radial fractures that have rotated palmar medial fragment within the joint need volar bone fenestration a new technique mentioned in a study [22]. The choice should ultimately be made on an individual basis, based on consideration of the patient's age, bone stock, fracture pattern, activity level, and surgeon expertise. Additional prospective, randomized controlled trials with large cohorts would further enhance the evidence base to inform clinical decision-making.

## Conclusion

Open Reduction Internal Fixation (ORIF) plating is found to be a better surgical procedure for the management of distal radius fractures than K-wire fixation, with improved anatomical and functional outcomes. This is based on enhanced radiological parameters (radial inclination, length, volar tilt, and articular congruity) and significantly improved functional outcomes, such as diminished DASH scores, increased range of motion, and greater grip strength. Though K-wire fixation is fraught with perils like pin track infections and loss of reduction, ORIF plating is also fraught with complications in the form of implant-related irritation, tendon problems, and the possibility of having to remove hardware.

## Clinical Message

The surgical technique to be employed should be chosen with great care, considering fracture complexity, quality of bone, level of activity, and ability to tolerate hardware-related issues. In the case of complex or unstable distal end of radius fractures that need to be accurately reduced and mobilized early, ORIF plating is more suitable, while simpler fractures can be treated with K-wire fixation.

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## Author Contributions

Data and design, V.K, M.I analysis by S.A; D.D & Visualization and writing original draft by V.K, S.A, M.I review and editing M.I data collection by P.R and M.I all the authors have read and agreed to the final version of the manuscript.

## Ethical approval

Retrospective study was done and approval from ethical committee Karuna Medical College.

## Consent to Publication

Not applicable

## Availability of data

Available with the corresponding author.

## Conflicts of interest

The authors declare there is no competing interests.

## Article Category

Retrospective Study

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