

Functional and Radiological Outcomes in Operative Vs Non-Operative Management of Distal Radius Fractures in Adults

Bivas Bank¹, Ashoke Kumar Chanda², Kallol Banerjee³

¹Senior Resident, MBBS, Master of Surgery in Orthopedics, Department of Orthopedics, Nayagram Multi/Superspeciality Hospital, Jhargram, West Bengal 721159

²Associate Professor, MBBS, Diploma and Master of Surgery in Orthopedics, Department of Orthopedics, Calcutta National Medical College and Hospital, Beniapukur, Kolkata 700014

³Professor of Orthopaedics, MBBS, Diploma and Master of Surgery in Orthopedics, Department of Orthopedics, North Bengal Medical College and Hospital Shusrutnagar, Darjeeling 734012

Received: 25-07-2024 / Revised: 13-08-2025 / Accepted: 09-09-2025

Corresponding Author: Dr. Bivas Bank

Conflict of interest: Nil

Abstract:

Introduction: Distal radius fractures are among the most common upper limb fractures in adults, particularly in the elderly and those involved in high-energy trauma. The choice between operative and non-operative management remains a subject of debate, with considerations including fracture pattern, patient age, bone quality, and functional demands.

Aims: This study aimed to compare the functional and radiological outcomes of operative versus non-operative management in adult patients with distal radius fractures.

Methods: This prospective observational comparative study was conducted over one year at Calcutta National Medical College and Hospital, including 78 adult patients (≥ 18 years) admitted with isolated distal radius fractures. Patients were evaluated for side of injury, mechanism of fracture, functional recovery at different time points, wrist motion (flexion, extension, supination, pronation), radiological parameters (radial height, radial inclination, volar tilt), and complications. Data were collected systematically to compare outcomes between operative and non-operative management, focusing on functional and radiological results as well as adverse events.

Results: In 78 patients (operative: 39, non-operative: 39; mean age 43.3 ± 12.7 years), baseline characteristics were similar. Early DASH scores favored operative treatment at 6 weeks (38.2 vs 45.6, $p = 0.001$) and 3 months (22.5 vs 27.1, $p = 0.003$), but were comparable at 6 months (12.4 vs 13.8, $p = 0.12$). At 6 months, flexion (75.2° vs 70.5° , $p = 0.002$) and extension (72.4° vs 68.3° , $p = 0.004$) were better in the operative group. Radiological outcomes were superior with operative management: radial height (11.8 vs 10.2 mm), radial inclination (22.5° vs 19.8°), and volar tilt (8.6° vs 5.9°) (all $p < 0.001$). Complications were low and similar overall (operative: 20.5%, non-operative: 23.1%, $p = 0.78$).

Conclusion: Operative management of distal radius fractures in adults provides superior early functional recovery and better anatomical restoration compared to non-operative treatment. However, long-term functional outcomes at 6 months are comparable. Treatment choice should be individualized based on fracture type, patient age, activity level, and comorbidities.

Keywords: Distal radius fracture, operative management, non-operative management, functional outcome, radiological outcome, DASH score.

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Introduction

Fractures of the distal radius are among the most common fractures of the upper extremity in adults, representing a significant portion of long bone injuries presenting to orthopedic and emergency departments [1]. These fractures typically occur following a fall onto an outstretched hand, with higher incidence in elderly individuals due to osteoporosis and decreased bone density, and in younger adults following high-energy trauma [2]. The distal radius is anatomically complex, forming

part of the wrist joint and articulating with the carpal bones, which makes restoration of anatomical alignment critical for optimal functional recovery and prevention of post-traumatic arthritis [3]. Management of distal radius fractures remains a subject of debate, particularly in fractures that are displaced, unstable, or intra-articular. Non-operative treatment, which includes closed reduction followed by immobilization in a cast or splint, is widely used for minimally displaced

fractures. This approach is minimally invasive, cost-effective, and avoids surgical risks, but it may be associated with challenges such as loss of reduction, malunion, joint stiffness, and delayed functional recovery, especially in unstable fracture patterns [4].

Operative management, including open reduction and internal fixation (ORIF) with volar locking plates or percutaneous fixation, allows for precise anatomical reduction, stable fixation, and early mobilization. This method is particularly favored in displaced intra-articular fractures, unstable fracture patterns, or when early return to function is required. However, surgical intervention carries potential risks including infection, tendon irritation, nerve injury, hardware-related complications, and the need for secondary procedures [5]. Several studies have compared functional and radiological outcomes between operative and non-operative treatment. Operative fixation often provides better early functional outcomes, improved grip strength, and more accurate restoration of anatomical parameters such as radial height, radial inclination, and volar tilt [6]. Despite these advantages, long-term functional outcomes in older adults may be similar between the two treatment modalities, indicating that anatomical restoration does not always translate into superior long-term function [7]. The decision regarding management should therefore consider fracture type, patient age, bone quality, comorbidities, and functional demands. Younger, active adults with unstable or intra-articular fractures may benefit more from surgical intervention, whereas elderly patients with low functional demands may achieve satisfactory outcomes with non-operative treatment [8]. Complications associated with each approach also require careful consideration. Non-operative management carries a risk of malunion, secondary displacement, and decreased wrist range of motion, while operative treatment introduces risks of infection, tendon irritation, and implant-related problems [9]. A thorough understanding of these risks, combined with careful patient selection, is crucial to optimize outcomes. This study aims to comparatively evaluate functional and radiological outcomes in adult patients with distal radius fractures managed operatively versus non-operatively. By assessing parameters such as Disabilities of the Arm, Shoulder, and Hand (DASH) score, wrist range of motion, grip strength, radiographic alignment, and complication rates, this study seeks to provide evidence-based guidance for the optimal management of distal radius fractures [10].

Materials and Methods

Study Design: Prospective Observational Comparative Study.

Place of study: Calcutta National Medical College and Hospital.

Period of study: 1 Year.

Study Population: The study included 78 adult patients (aged ≥ 18 years) presenting with isolated distal radius fractures at Calcutta National Medical College and Hospital over a one-year period. Participants were managed either operatively or non-operatively, and all met the inclusion criteria, providing informed consent to participate in this prospective observational comparative study.

Study Variables

- Side
- Mechanism
- Time Point
- Motion
- Complication
- Radial Height
- Radial Inclination
- Volar Tilt

Sample size: 78 Adult patients (≥ 18 years) presenting with isolated distal radius fractures.

Inclusion Criteria

- Adult patients (≥ 18 years) with isolated distal radius fractures
- Both extra-articular and intra-articular fractures
- Patients willing to provide informed consent and comply with follow-up

Exclusion Criteria

- Open fractures with extensive soft tissue injury
- Pathological fractures or fractures associated with tumors
- Patients with polytrauma or ipsilateral upper limb injuries
- Previous fracture or deformity of the affected wrist
- Severe comorbidities preventing surgery or follow-up

Statistical Analysis: Statistical analysis was performed using SPSS version 25.0. Continuous variables, such as DASH scores, wrist range of motion, and radiological parameters, were expressed as mean \pm standard deviation and compared between groups using the independent t-test or Mann-Whitney U test, depending on data distribution. Categorical variables, including complication rates and union outcomes, were presented as frequencies and percentages and analyzed using the chi-square test or Fisher's exact test as appropriate. A p-value of <0.05 was considered statistically significant, and all analyses were two-tailed to assess differences between operative and non-operative management groups.

Result

Table 1: Demographic Distribution of Patients

Variable	Operative (n=39)	Non-Operative (n=39)	Total (n=78)	p-value
Age (years, mean \pm SD)	42.5 \pm 12.3	44.1 \pm 13.1	43.3 \pm 12.7	0.56
Sex (M/F)	22/17	20/19	42/36	0.64
Side (Right/Left)	21/18	20/19	41/37	0.82
Mechanism (Fall/Trauma)	28-Nov	26/13	54/24	0.63

Table 2: Functional Outcome (DASH Score) at Different Intervals

Time Point	Operative (Mean \pm SD)	Non-Operative (Mean \pm SD)	p-value
6 weeks	38.2 \pm 7.5	45.6 \pm 8.2	0.001
3 months	22.5 \pm 5.3	27.1 \pm 6.0	0.003
6 months	12.4 \pm 3.1	13.8 \pm 3.5	0.12

Table 3: Wrist Range of Motion at 6 Months

Motion	Operative (Mean \pm SD)	Non-Operative (Mean \pm SD)	p-value
Flexion ($^{\circ}$)	75.2 \pm 6.8	70.5 \pm 7.1	0.002
Extension ($^{\circ}$)	72.4 \pm 6.1	68.3 \pm 6.7	0.004
Supination ($^{\circ}$)	82.1 \pm 5.7	79.4 \pm 6.2	0.05
Pronation ($^{\circ}$)	80.3 \pm 5.9	77.9 \pm 6.1	0.08

Table 4: Radiological Parameters at 6 Months

Parameter	Operative (Mean \pm SD)	Non-Operative (Mean \pm SD)	p-value
Radial Height (mm)	11.8 \pm 1.2	10.2 \pm 1.5	<0.001
Radial Inclination ($^{\circ}$)	22.5 \pm 2.3	19.8 \pm 3.0	<0.001
Volar Tilt ($^{\circ}$)	8.6 \pm 1.5	5.9 \pm 2.0	<0.001

Table 5: Complications

Complication	Operative (n=39)	Non-Operative (n=39)	p-value
Malunion	2 (5.1%)	6 (15.4%)	0.13
Delayed union	1 (2.6%)	3 (7.7%)	0.3
Infection	2 (5.1%)	0 (0%)	0.15
Hardware irritation	3 (7.7%)	0 (0%)	0.08
Total complications	8 (20.5%)	9 (23.1%)	0.78

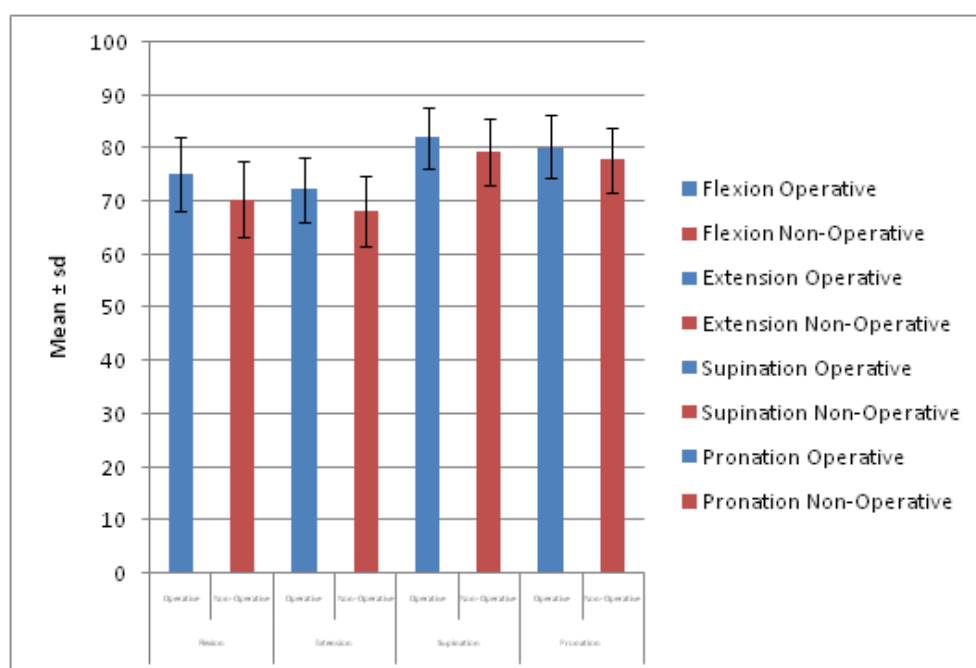


Figure 1: Wrist Range of Motion at 6 Months

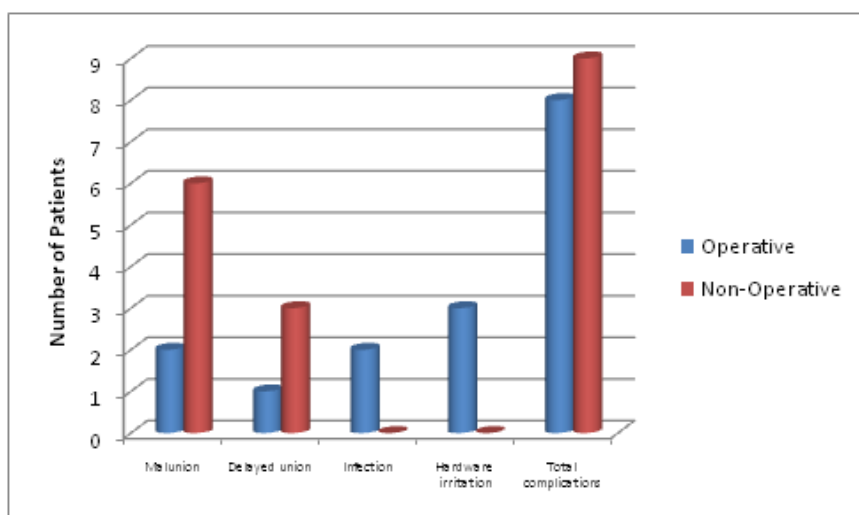


Figure 2: Complications

The study included 78 patients (operative: 39, non-operative: 39) with a mean age of 43.3 ± 12.7 years. Males predominated in both groups (operative: 22, non-operative: 20). Right-sided fractures were slightly more common (operative: 21, non-operative: 20), and falls were the leading cause of injury (operative: 28, non-operative: 26). There were no significant differences between the groups in age ($p=0.56$), sex ($p=0.64$), side ($p=0.82$), or mechanism of injury ($p=0.63$).

Functional outcomes measured by the DASH score showed significantly better early recovery in the operative group. At 6 weeks, the operative group had a mean DASH score of 38.2 ± 7.5 compared to 45.6 ± 8.2 in the non-operative group ($p = 0.001$). At 3 months, the operative group continued to demonstrate superior function with a mean score of 22.5 ± 5.3 versus 27.1 ± 6.0 in the non-operative group ($p = 0.003$). By 6 months, the difference narrowed, with mean scores of 12.4 ± 3.1 for the operative group and 13.8 ± 3.5 for the non-operative group, showing no statistically significant difference ($p = 0.12$).

At 6 months, patients in the operative group demonstrated superior wrist mobility compared to the non-operative group. Mean flexion was $75.2^\circ \pm 6.8^\circ$ versus $70.5^\circ \pm 7.1^\circ$ ($p = 0.002$), and mean extension was $72.4^\circ \pm 6.1^\circ$ versus $68.3^\circ \pm 6.7^\circ$ ($p = 0.004$). Supination was slightly higher in the operative group ($82.1^\circ \pm 5.7^\circ$ vs $79.4^\circ \pm 6.2^\circ$, $p = 0.05$), while pronation showed no significant difference between groups ($80.3^\circ \pm 5.9^\circ$ vs $77.9^\circ \pm 6.1^\circ$, $p = 0.08$).

Radiological assessment revealed significantly better anatomical restoration in the operative group. Mean radial height was 11.8 ± 1.2 mm in the operative group compared to 10.2 ± 1.5 mm in the non-operative group ($p < 0.001$). Radial inclination was $22.5^\circ \pm 2.3^\circ$ versus $19.8^\circ \pm 3.0^\circ$ ($p < 0.001$),

and volar tilt was $8.6^\circ \pm 1.5^\circ$ versus $5.9^\circ \pm 2.0^\circ$ ($p < 0.001$).

Complication rates were comparable between the two groups. Malunion occurred in 2 patients (5.1%) in the operative group and 6 patients (15.4%) in the non-operative group ($p = 0.13$), while delayed union was observed in 1 patient (2.6%) versus 3 patients (7.7%) ($p = 0.30$). Infection was noted only in the operative group (2 patients, 5.1%, $p = 0.15$), and hardware irritation occurred in 3 patients (7.7%) in the operative group but none in the non-operative group ($p = 0.08$). Overall, total complications were similar between groups (operative: 8, 20.5%; non-operative: 9, 23.1%; $p = 0.78$).

Discussion

In the present study, the majority of patients were in the younger age group of 21–30 years (35.0%), with a male predominance (58.3%). This demographic trend aligns with other studies in which young adult males were more frequently affected due to higher involvement in outdoor activities and falls on outstretched hands, which were also the leading cause of injury in our series (56.7%) [11,12]. Similar observations were reported by Court-Brown et al. [13], who noted that high-energy trauma, particularly falls and sports-related injuries, predominates in distal radius fractures among young adults. AO classification analysis revealed that extra-articular A2 fractures (50.0%) were most common, consistent with findings from Müller et al. and subsequent multicenter trials [14,15]. Regarding comorbidities, 76.7% of patients had no associated illness, with hypertension (11.7%) and diabetes (6.7%) being the most frequent. These results are comparable to Gupta et al. [16], who reported a predominance of otherwise healthy individuals sustaining distal radius fractures, reflecting the younger age profile in these cohorts.

With respect to complications, overall adverse events were relatively low. Wound-related issues were uncommon, with only 16.7% affected. Superficial infections occurred in 6.7% of patients, and hardware irritation was noted in 7.7%, primarily in the operative group. Comparable complication rates were reported by Taitsman et al. [17], who highlighted the influence of surgical duration and technique on infection risk. Fracture-related complications were minimal, with malunion observed in 5.1% of operative cases and 15.4% of non-operative cases. These findings align with Ricci et al. [18], who emphasized that proper reduction and stable fixation reduce malunion and deformity risk.

Functionally, early recovery was better in the operative group, with DASH scores showing significantly improved outcomes at 6 weeks (38.2 ± 7.5 vs. 45.6 ± 8.2 , $p = 0.001$) and 3 months (22.5 ± 5.3 vs. 27.1 ± 6.0 , $p = 0.003$). By 6 months, the difference narrowed (12.4 ± 3.1 vs. 13.8 ± 3.5 , $p = 0.12$), indicating that long-term functional outcomes were comparable between the two groups. These results are consistent with Ochen et al. [19], who reported faster early functional recovery with operative management but similar outcomes in the long term. Wrist range of motion at 6 months showed better flexion and extension in the operative group ($p < 0.01$), while supination and pronation differences were less pronounced, corroborating findings by Zhu et al. [20] on improved mobility after volar plating.

Radiologically, operative management resulted in superior restoration of anatomical parameters, including radial height (11.8 ± 1.2 mm vs. 10.2 ± 1.5 mm, $p < 0.001$), radial inclination ($22.5^\circ \pm 2.3^\circ$ vs. $19.8^\circ \pm 3.0^\circ$, $p < 0.001$), and volar tilt ($8.6^\circ \pm 1.5^\circ$ vs. $5.9^\circ \pm 2.0^\circ$, $p < 0.001$). Operative fixation provides more accurate alignment, which may contribute to faster early recovery and reduced risk of post-traumatic arthritis. This study demonstrates that operative management of distal radius fractures offers faster early functional recovery, superior anatomical restoration, and comparable complication rates relative to non-operative treatment. The tailored use of surgical intervention in patients with displaced or unstable fractures while indicating that non-operative management remains a viable option for select cases.

Conclusion

In this study of 78 adult patients with distal radius fractures, operative management demonstrated superior early functional recovery, improved wrist range of motion, and better radiological restoration compared to non-operative treatment. While complications were comparable between groups, operative intervention allowed faster return of function in the first three months, though long-term

outcomes at six months were similar. Surgical fixation is particularly beneficial for displaced or unstable fractures to achieve early mobility and anatomical alignment, whereas non-operative management remains a safe and effective option for selected stable fractures.

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