

FUNCTIONAL OUTCOME OF DISTAL END RADIUS FRACTURE TREATED WITH FRAGMENT SPECIFIC FIXATION

Amruthanand R¹, Ashok Nayak², Shrikant Kulkarni³, Prashant Kenganal³

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Corresponding Author:

Dr. Prashant Kenganal,

Email: kenganalprashant@gmail.com

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¹Junior resident 3rd year, Department of Orthopedics, Shri BM Patil Medical College, Hospital and Research Centre, Vijayapura, Karnataka India

²Professor, Department of Orthopedics, Shri BM Patil Medical College, Hospital and Research Centre, Vijayapura, Karnataka India

³Assistant Professor, Department of Orthopedics, Shri BM Patil Medical College, Hospital and Research Centre, Vijayapura, Karnataka India

Abstract

Background: One of the most frequent skeletal injuries that orthopedic surgeons treat are distal radius fractures. Roughly one-sixth of the fractures treated in ERs are caused by them. Treatment for these injuries is quite difficult, particularly if the trauma was high-energy and resulted in intra-articular involvement or comminution. This study evaluated the functional results and complications in patients treated with open reduction and internal fixation (ORIF) utilizing 2.7mm distal radius plates, as well as the patients' capacity to return to their regular activities. The investigation of particular problems associated with fragment-specific fixation was another goal of the study. **Materials and Methods:** 32 patients with distal radius fractures who underwent ORIF with fragment-specific locking plates were included in this prospective study. Between August 2022 and January 2024, the study was conducted at the Shri BM Patil Medical College and Hospital in BLDE. The patient-rated wrist evaluation (PRWE) score was used to evaluate the patients' functional results over a 6-month follow-up period following surgery. **Result:** The study's patients were primarily male (87.5%) and had an average age of 38.59 years. In 59.3% of cases, the afflicted wrist was the dominant right wrist. Accidents involving vehicles were the most frequent cause of injuries. It took an average of 7.06 days from the injury to surgery. The average PRWE score following six months of fixation was 16.53. Of the patients, 71.88% had excellent outcomes and 18.75% had good outcomes. The most frequent side effects, which affected two individuals each, were subsequent collapse, stiffness and numbness, and superficial infection. Thirty patients were able to resume their pre-injury activities within six months, and thirty patients experienced fracture union in less than three months. **Conclusion:** Based on the excellent PRWE scores, the study findings indicate that fragment specific fixation with 2.7mm distal radius plates provides robust and reliable fixation with good functional outcomes.

INTRODUCTION

First reported by Ponteau in 1783, and then by Abraham Colle in 1814, were fractures of the distal radius. For best functional results, appropriate therapy entails restoring radial length, radial inclination, and articular surface congruency. If near-anatomical reduction is not accomplished and maintained, degenerative arthritis, distal radioulnar and metacarpal instability, and ulnar nerve compression syndrome can cause discomfort, loss of movement, strength, and function.^[1]

Treatment strategies have changed as a result of an increase in high-energy vehicle trauma cases and patients' growing expectations for perfection. Treating complicated fractures requires understanding the fracture pattern and making sure that fixation is secure. To characterize fracture patterns, comminution, radial shortening, displacement, and soft tissue involvement, several classification schemes have been devised. Nevertheless, no single classification system considers every aspect of a single injury, necessitating a careful assessment by the surgeon.^[2]

The significance of enhancing the diagnosis and categorization of distal radius fractures for treatment—open reduction, where suitable—has been brought to light by recent research. Restoring wrist function is the major objective of treatment for unstable distal radius fractures, which entails encouraging early hand mobilization and upholding a precise and stable reduction. For unstable fractures or fractures with articular maladjustment that cannot be fixed by external treatment, open reduction with internal fixation (ORIF) is recommended.

To stop the carpal bones from subluxing and losing their reduction in volar marginal fractures, small buttress plates like the ones Ellis described are frequently utilized. There is ongoing debate over the most effective way to attain and preserve an accurate repair of the joint anatomy. The secret to an effective treatment plan is to identify patterns that are intrinsically unstable and need more focus. Distal radius fracture treatment is changing, with internal fixation replacing pins, bandages, and external fixation increasingly frequently. This study evaluated the functional outcomes of ORIF employing supported plates and screws in adult patients with distal radius fractures. One of the most frequent upper extremity fractures that orthopaedic trauma surgeons treat is a distal radius fracture. Of all fractures treated, they make up about 16% of those treated surgically and 1/6 of those treated in ERs. These fractures are more common as people age and are correlated with osteopenia in elderly persons. The incidence rises to 368 per 100,000 for women under 40 and 1,150 per 100,000 for women over 40, whereas for men 35 years of age and beyond, it is roughly 90 per 100,000 population annually.^[3,4]

Distal radius fracture treatment is still debatable. Whereas displaced fractures are reduced and then immobilized in a cast, nondisplaced fractures are often treated in a cast for four to six weeks. Surgical intervention may be necessary for unstable fractures. Methods include ORIF using dorsal or volar plates and locking screws, external fixation, and percutaneous fixation. Evaluating stability at the moment of injury is challenging. Even if initial reduction and casting are effective, some fractures subsequently displace.

Restoring wrist function to its maximum potential is the aim of treatment for distal radius fractures, which necessitates early postoperative mobilization and anatomic restoration. The prognosis for extra-articular fractures is often better than that of intra-articular fractures. Age, fracture architecture, displacement, repositionability, stability, and joint discrepancy are some of the variables that affect functional result. The anatomic reduction's quality holds greater significance than the fixing technique.^[5]

For unstable distal radius fractures, such as metaphyseal comminution (A3 and C2 fractures), locking volar compression plates work well. The most common type of fractures are distal radius

fractures, however even when skilled specialists follow evidence-based standard treatment, complication rates can reach 6% to 80%. From little swelling to severe painful deformity with loss of motion, complications might arise. Malunion, nonunion, hardware issues, tendon wear/rupture, and nerve injury are the most frequent complications.^[6]

utilizing the idea of fragment-specific fixation with or without K-wires, this study aims to assess the indications and functional results of open reduction and internal fixation utilizing a 2.7 mm low-profile distal radius plate either alone or in conjunction with strategic screw placement.

For unstable distal radius fractures, there is currently no evidence in the literature to support internal fixation over external fixation. The purpose of this research is to ascertain if fragment-specific fixation can improve functional results and facilitate a quicker return of patients—especially younger patients—to their regular lives.

MATERIALS AND METHODS

This Longitudinal study/ Prospective study is a series of 32 adult patients with distal radial fractures treated with ORIF using fragment specific fixation. This study was conducted over a period of one and a half year from 1st August 2022- 1st January 2024 in the Department of Orthopedics in B.L.D.E. (DEEMED TO BE UNIVERSITY) Shri B.M.Patil Medical College, Hospital and Research Centre, Vijayapura. Ethical clearance was taken from institutional ethical committee.

With anticipated Proportion of 17% outcome-based range of movements in patients with distal radius fractures, the study would require a sample size of 17 patients with 95% level of confidence and 15% absolute precision.

Sample size was calculated=32

Inclusion Criteria

- Age group: >18 years both male and female
- Intra-articular fracture distal end radius with or without ulnar styloid fracture.
- Closed intra-articular fractures.
- Fracture with trauma <3 weeks.

Exclusion Criteria

- Patients with comorbid conditions preventing surgical intervention
- Patients with local tissue conditions making the surgery inadvisable
- Pathological fractures.
- Compound fractures
- Multiple fractures in ipsilateral limb.

Method of collection of data:

- Patients admitted in Department of Orthopaedics in B.L.D.E (DEEMED TO BE UNIVERSITY) Shri B.M patil's medical college, Hospital and Research centre, with diagnosis of distal end radius fracture

- By Interview method and clinical examination using Semi-structured pretested and validated questionnaire.

Data Analysis and Statistical methods applied:

Data was entered into an MS Excel spreadsheet and analysed using Epi-Info software. The descriptive data has been presented using descriptive tables, cross tables, bar diagrams, and pie charts in the form of percentages, proportions, and means. Tests like the student t-test and Chi-square/Fisher exact tests were applied to analyse the analytical data and found the association and difference between the two factors/ variables. The alpha error was set at $p=0.05$, indicating that results with a p-value less than 0.05 were considered statistically significant. Using a goniometer, the wrist's range of motion was determined.

The wrist's range of motion is contrasted with the typical range listed below: Dorsiflexion: $0^\circ - 75^\circ$

Palmar flexion: $0^\circ - 80^\circ$

Radial deviation: $0^\circ - 20^\circ$

Ulnar deviation: $0^\circ - 35^\circ$

Pronation: $0^\circ - 70^\circ$

Supination: $0^\circ - 85^\circ$

Range of movement is scored on 26 point scale and were graded as excellent, good, fair and poor based on the total score.⁷

Scoring of the active range of movements in the wrist

	Dorsiflexion	Palmar flexion	Ulnar deviation	Radial deviation	Pronation	Supination
Max Score	6	5	3	2	5	5
0	< 10	< 10	< 5	< 5	< 10	< 10
1	≥ 10	≥ 10	≥ 5	≥ 5	≥ 10	≥ 10
2	≥ 20	≥ 20	≥ 15	≥ 15	≥ 20	≥ 20
3	≥ 30	≥ 30	≥ 25		≥ 40	≥ 40
4	≥ 40	≥ 40			≥ 60	≥ 60
5	≥ 50	≥ 60			≥ 70	≥ 70
6	≥ 70					

OM SCORE	Result
≥ 24	Excellent
20-23	Good
16-19	Fair
≤ 15	Poor

The Patient-rated Wrist Evaluation (PRWE) questionnaire was used to evaluate the functional outcome. The result was rated as excellent, good, fair, and poor based on the PRWE score.

Questionnaire for Patient-rated Wrist Evaluation (PRWE)

There are 3 steps to score PRWE.

Step 1: Calculate each item's pain score out of five.

1. PAIN													
Rate the average amount of pain in your wrist over the past week by circling the number that best describes your pain on a scale from 0-10. A zero (0) means that you did not have any pain and a ten (10) means that you had the worst pain you have ever experienced or that you could not do the activity because of pain.													
RATE YOUR PAIN: Sample Scale **													
	No Pain	0	1	2	3	4	5	6	7	8	9	10	Worst Ever
At rest		0	1	2	3	4	5	6	7	8	9	10	
When doing a task with a repeated wrist movement		0	1	2	3	4	5	6	7	8	9	10	
When lifting a heavy object		0	1	2	3	4	5	6	7	8	9	10	
When it is at its worst		0	1	2	3	4	5	6	7	8	9	10	
How often do you have pain?	Never	0	1	2	3	4	5	6	7	8	9	10	Always

Step 2: Divide the function score obtained from each of the 10 components by 2.

2. FUNCTION													
A. SPECIFIC ACTIVITIES													
Rate the amount of difficulty you experienced performing each of the items listed below - over the past week, by circling the number that describes your difficulty on a scale of 0-10. A zero (0) means you did not experience any difficulty and a ten (10) means it was so difficult you were unable to do it at all.													
Sample scale --	No Difficulty	0	1	2	3	4	5	6	7	8	9	10	Unable To Do
Turn a door knob using my affected hand		0	1	2	3	4	5	6	7	8	9	10	
Cut meat using a knife in my affected hand		0	1	2	3	4	5	6	7	8	9	10	
Fasten buttons on my shirt		0	1	2	3	4	5	6	7	8	9	10	
Use my affected hand to push up from a chair		0	1	2	3	4	5	6	7	8	9	10	
Carry a 10lb object in my affected hand		0	1	2	3	4	5	6	7	8	9	10	
Use bathroom tissue with my affected hand		0	1	2	3	4	5	6	7	8	9	10	
B. USUAL ACTIVITIES													
Rate the amount of difficulty you experienced performing your usual activities in each of the areas listed below, over the past week, by circling the number that best describes your difficulty on a scale of 0-10. By "usual activities", we mean the activities you performed before you started having a problem with your wrist. A zero (0) means that you did not experience any difficulty and a ten (10) means it was so difficult you were unable to do any of your usual activities.													
Personal care activities (dressing, washing)		0	1	2	3	4	5	6	7	8	9	10	
Household work (cleaning, maintenance)		0	1	2	3	4	5	6	7	8	9	10	
Work (your job or usual everyday work)		0	1	2	3	4	5	6	7	8	9	10	
Recreational activities		0	1	2	3	4	5	6	7	8	9	10	

Step 3: Score the function and discomfort together. Total Score = Sum of pain+ function scores (Best Score = 0, Worst Score = 100) Low score = better outcome.

PRWE SCORE	RESULT
0-25	Excellent
26-50	Good
51-75	Fair
76-100	Poor



A. Tourniquet applied, b. Painted and draped

Approaches:



A. Volar –Henry incision, b. Dorsal Incision, c. Direct lateral incision

Exposure and reduction



A.FCR retracted and pronator quadratus exposed, b. Pronator quadratus cut and distal radius exposed



A.Reduction using K-wire, b. Reduction held with multiple k wires

Plate fixation



A. Plate in position with help of C Arm, b. Plate fixed using drill sleeve and screws



Plate/s with screws in situ & final reduction



A. Pronator quadratus closed, b. Sub-cutaneous closure



Skin Stapled

RESULTS

In this research, we analyzed the data from 32 patients with distal radius fractures who were treated at BLDE's Shri BM Patil Medical College between August 2022 and January 2024. We followed up with these cases regularly for a minimum of 6 months, from 2022 to 2024, in order to assess their functional outcomes and results. After analyzing the data, we obtained the following findings.

The largest group was 26-35 years old (28.1%), followed closely by 36-45 years (25%) and <25 years (21.88%). The 46-55 age group made up 21.8%, while only 6.25% were 56-65 years old. The average age was 38.59 years, with a range of 20-65 years. This indicates that distal radius fractures in this study primarily affected younger and middle-aged adults, with fewer cases in older adults.

Out of 32 patients, 28 (87.5%) were male and only 4 (12.5%) were female. This significant gender disparity suggests that males in this population may be at higher risk for distal radius fractures, possibly due to occupational or lifestyle factors.

With the right side (dominant wrist) affected in 59.3% of cases and the left side in 40.7%. This slight predominance of right-sided injuries could be related to handedness or the mechanics of injury.

Road traffic accidents (RTA) were the predominant cause, accounting for 71.88% of cases, while falls on outstretched hands (FOOH) caused 28.12% of injuries. This highlights the significant role of vehicular accidents in causing these fractures in the study population.

Type B3 fractures were most common (34.37%), followed by C1 (31.25%). Types B1 and B2 each accounted for 9.38%, C2 for 12.5%, and C3 for 3.12%. This distribution indicates a prevalence of

partial articular (type B) and complete articular (type C) fractures in the study group.

Most patients (53.12%) had surgery 6-10 days after injury, 34.37% within 0-5 days, and 12.5% after 10 days. The average time to surgery was 7.06 days, suggesting that most patients received treatment within a week of injury.

Functional Assessment: A patient-rated wrist evaluation questionnaire was used to evaluate the functional findings. The questionnaire investigated how patients assessed their level of pain in different contexts and how it affected their ability to do both routine and targeted tasks.

Grades Based on PRWE scores as excellent, good, fair and poor.

This table presents the functional outcomes of the 32 patients in the study, as assessed using the Patient-Rated Wrist Evaluation (PRWE) score. The PRWE is a validated tool that measures wrist pain and disability from the patient's perspective. The results are categorized into four groups:

- Excellent: 24 patients (75%)
- Good: 5 patients (15.6%)
- Fair: 2 patients (6.25%)
- Poor: 1 patient (3.12%)

The data shows that the vast majority of patients (90.6%) achieved excellent or good functional outcomes according to the PRWE score. This suggests that the fragment-specific fixation technique used in this study was highly effective in restoring wrist function for most patients. Only a small proportion of patients (9.37%) had fair or poor outcomes.

These results indicate that the surgical technique employed in this study led to satisfactory functional outcomes for the majority of patients with distal radius fractures. The high percentage of excellent outcomes (75%) is particularly noteworthy, suggesting that many patients regained a high level of wrist function post-surgery.

Based on the degree of dorsiflexion, palmar flexion, radial deviation, ulnar deviation, pronation, and supination, the range of motion was rated on a 26-point scale. The final score was then classified as excellent, good, fair, or poor.

Twenty (62.5%) of the 32 patients in our series had exceptional range of motion, nine (28.12%) had good range, one (3.13%) had fair range, and two (6.25%) had poor range of motion.

The typical wrist motion was identified as follows: 59.22° extension (range: 10-75°), 72.35° pronation (range: 50-83°), 75.5° supination (range: 30-90°), and 28.94° ulnar deviation (range:15-38°).

This table presents the outcomes based on the range of motion (ROM) achieved by patients after surgery. The ROM was scored on a 26-point scale, considering various wrist movements such as dorsiflexion, palmar flexion, radial deviation, ulnar deviation, pronation, and supination. The outcomes are categorized as follows:

- Excellent: 21 patients (65.6%)

- Good: 8 patients (25%)
- Fair: 1 patient (3.12%)
- Poor: 2 patients (6.25%)

Similar to the PRWE scores, the range of motion outcomes were predominantly positive. 90.6% of patients achieved excellent or good range of motion, which aligns closely with the functional outcomes measured by the PRWE score.

Union of fracture and back to work: Thirty-one of the thirty-two patients had fracture union within three months, and the patient with the delayed union had a good functional result and union at the end of six months after a short time of immobilization. Thirty of the thirty patients (93.75%) were able to resume their pre-injury daily activities. One of the two patients who did not recover well required a secondary fixation treatment and did not resume their pre-injury level of activity. Due to weak grip strength and discomfort and stiffness, the other patient—a manual labour—was unable to do all the activities as intended.

Complications:

Intra-operative: There were no intraoperative complications. Post-operative:

Superficial infection: After receiving a course of antibiotics, two individuals with superficial infections achieved great results.

Secondary collapse of fracture with stiffness: Two patients experienced this as a result of improper load bearing and mobilization, and after being immobilized for extended periods of time, they became stiff. They were followed up with physiotherapy and had fair to poor outcomes.

Tingling and numbness: Two patients who received 75 mg of pregabalin once daily experienced brief tingling and numbness, which they recovered from in eight weeks.

Tourniquet palsy: Within 12 weeks, a patient with tourniquet palsy made a full recovery. The patient achieved outstanding functional results and a good range of motion.

Persistent pain: One patient complained of ongoing pain, which was treated with the right amount of analgesics.

The majority of male patients (85.6%) were under 45 years old, with the highest concentration in the 26-35 age group (32.1%), followed closely by the 36-45 age group (28.5%) and the <25 age group (25%). There were fewer male patients in the older age groups.

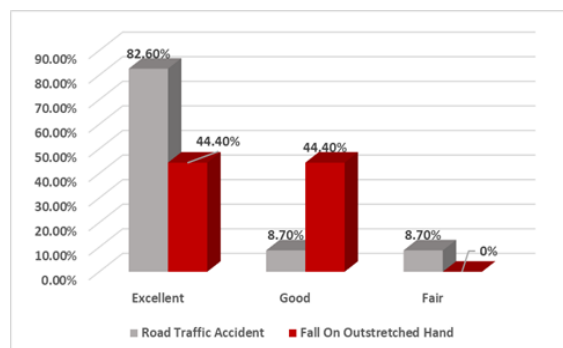
Age distribution in females: All female patients were over 45 years old, with 75% in the 46-55 age group and 25% in the 56-65 age group.

Gender disparity: There's a notable absence of female patients in the younger age groups (<45 years), while male patients are predominantly younger.

Statistical significance: The p-value for this distribution is 0.0036, as determined by Fisher's exact test. This very low p-value (<0.05) indicates that the observed difference in age distribution

between males and females is statistically significant.

There was a significant difference in age distribution between genders ($p=0.0036$), with males being younger on average (mean age 34.52 years) compared to females (mean age 53 years). This difference was statistically significant ($p<0.05$)



Graph 1: Functional outcome based on injury

The Cramer's V test results from the table show that a greater proportion of patients with RTA (82.6%) than those who experienced a fall (44.4%) had favorable outcomes. However, no patient with RTA had a poor outcome, compared to a lower percentage of patients (11.1%) who sustained a fall. This disparity might be explained by the fact that most of our patients were male younger patients who participated in RTAs, which produced superior results. This correlation's computed p value of .029 shows that the result is statistically significant.

The [Table 5] above makes it evident that every patient under the age of 35 had a traumatic brain injury (RTA), and 66.70% of patients between the ages of 46 and 65 had an injury caused by falling on an outstretched hand. At $p = 0.012$, this was statistically significant.

The data shows a clear trend of better outcomes in younger patients. All patients (100%) in the 36-45

age group achieved excellent outcomes, followed by 87.50% in the 26-35 group, and 71.40% in the under-25 group. The outcomes begin to decline in older age groups, with only 50% achieving excellent results in the 46-55 group, and no excellent outcomes in the 55-65 group. Notably, poor outcomes only appear in the oldest age group (55-65), affecting 33.30% of these patients. The 46-55 age group shows an even split between excellent and good outcomes (50% each). This age-related trend is statistically significant ($p=0.018$), suggesting that age is a crucial factor in predicting functional outcomes after distal radius fracture treatment.

It is clear aforementioned evidence that there is a correlation between range of motion and functional outcome. Better ROM scores translate into more functional results for patients. Cramer's V test was used to evaluate the aforementioned data, and the statistical significance was $p = 0.000$.

It is evident that patients with unfavorable outcomes had higher PRWE scores at three months, comparable to those with good outcomes, whereas patients with positive results have lower PRWE ratings after three months and improved scores after six months. But over the course of the three months, their scores steadily decline, leading to subpar functional outcomes.

The following characteristics did not significantly correlate with each other in our study: The relationship between age and ROM, age and AO type, AO type and functional outcome, surgical time and functional outcome, and age and injury etiology. The presence of an ulnar styloid fracture had no effect on the final functional result.

The ultimate ROM or functional result was unaffected by the type of implant utilized alone or in combination.

Table 1: Fracture classification based on AO

AO type	No. of cases	Percentage(%)
B1	3	9.38
B2	3	9.38
B3	11	34.37
C1	10	31.25
C2	4	12.5
C3	1	3.12
Total	32	100

Table 2: Functional outcome based on PRWE score

Functional outcome	Number of cases	Percentage
Excellent	24	75
Good	5	15.6
Fair	2	6.25
Poor	1	3.12
Total	32	100

Table 3: Complications.

Complications	No. of cases	Percentage(%)
Superficial infection	2	6.25
Secondary collapse and stiffness	2	6.25
Tingling and numbness	2	6.25

Tourniquet palsy	1	3.12
Persistent pain	1	3.12

Functional outcome evaluation

Table 4: Association between Gender and Age groups

Age	Male	Female	P -value (Fisher exact test applied)
<25	7 (25%)	0	0.0036 Significant
26-35	8 (32.1%)	0	
36-45	8 (28.5%)	0	
46-55	4 (14.25%)	3 (75%)	
56-65	1 (3.5%)	1 (25%)	
Total	28 (100%)	4 (100%)	

Table 5: Relationship between age and mechanism of injury

Age	<25	26-35	36-45	46-55	55-65	P value (Fisher exact test applied)
Road Traffic Accident(RTA)	100.00%	100.00%	62.50%	33.30%	33.30%	0.012 Significant
Fall On Outstretched Hand(FOOSH)	0.00%	0.00%	37.50%	66.70%	66.70%	

Table 6: Functional outcome based on age

Age	<25	26-35	36-45	46-55	55-65	P -value (Fisher exact test applied)
Excellent	71.40%	87.50%	100.00%	50.00%	0.00%	0.018 Significant t
Good	14.30%	0.00%	0.00%	50.00%	66.70%	
Fair	14.30%	12.50%	0.00%	0.00%	0.00%	
Poor	0.00%	0.00%	0.00%	0.00%	33.30%	

Table 7: Correlation between PRWE scores and functional outcome

Functional outcome	PRWE at 3 months	PRWE at 6 months
Excellent	18.7391	6.8261
Good	33.5	31.6667
Fair	41.5	53
Poor	35	76

DISCUSSION

The findings provide valuable insights into the effectiveness of surgical management, particularly using volar locking plates, and how various factors influence patient outcomes.

The distal radius fracture was initially documented by Abraham Colles in 1814. These fractures are the most frequently occurring upper extremity fractures, comprising 17 percentage of all fractures and 75 percentage of all forearm fractures. It's noteworthy that this type of fracture is particularly challenging to treat for surgeons.

Anatomical alignment of the joint surface using strong fixation is the primary objective when treating intra-articular fractures. Studies have demonstrated that any remaining joint incongruity can result in long-term posttraumatic arthritis. Improved understanding of wrist anatomy and function from recent research, along with higher patient expectations, has broadened the scope for surgical intervention.

In the case of irreducible compression fractures of the joint surface (also known as pilon fractures of the distal radius, or C3 fractures), open reduction, stable internal fixation, and functional after-treatment have replaced the previous therapeutic strategies of pins, bridging external fixation, and bone grafting.

The use of the mini plating system is beneficial for reducing both larger and smaller fragments. This promotes adequate reduction of articular fragments and lowers the possibility of subsequent difficulties by making it simple to reduce fragments while immediately examining them. Depending on the particular plate being used, several surgical techniques may be chosen.

The average age of participants in our research was 38.59 years, which is younger than the findings of Rizzo et al. (48 years for the ORIF group) and Anakwe et al. (48 years), but similar to Raamji et al. (39.90 ± 10.84 years). This variance may be due to the higher incidence of road traffic accidents (RTAs) in our study group, which generally involve younger individuals. The gender distribution in our study (87.5% male) is notably different from other research, such as Anakwe et al. (38% male). This difference could be a result of regional disparities in road usage habits and occupational exposures.^[8-10]

The majority of injuries in our research were caused by road traffic accidents (RTAs), which aligns with the findings of Raamji et al. who also reported a high percentage of RTA-related injuries. The prevalence of RTAs in our study could be linked to the higher occurrence of intricate fracture patterns, particularly Type B3 (34.37%) and C1 (31.25%) as per the AO classification. In contrast, Anakwe et al. found a greater number of more complex C2 and C3

fractures. These variations in fracture patterns may impact the overall results and complication rates.^[9,10]

Our research showed that 75% of patients had excellent functional outcomes, and 15.6% had good outcomes, as determined by the Patient-Rated Wrist Evaluation (PRWE) score. These results are similar to those reported by Paramesha KC et al., who found 71.88% excellent and 18.75% good outcomes. However, it should be noted that Paramesha KC et al. used a different scoring system, which may limit direct comparison. The average PRWE score at 6 months in our study was not explicitly stated, but Paramesha KC et al. reported an average score of 16.53 at 6 months. Javed et al. reported mean PRWE scores of 14 ± 18 for low-risk fractures and 19 ± 22 for high-risk fractures at one year. Our study's overall favorable outcomes align with these findings, implying that volar locking plate fixation is an effective treatment approach for distal radius fractures.^[11,12]

The results of our investigation revealed an average extension of 59.22° , flexion of 65.10° , ulnar deviation of 28.94° , and radial deviation of 17° . These findings are similar to those documented by Rizzo et al. for their ORIF group (extension 69° , flexion 64° , ulnar deviation 34° , radial deviation 23°) and slightly superior to their external fixation group. The resemblance in results implies that volar locking plate fixation can accomplish a range of motion that equals or surpasses other fixation techniques. Raamji et al. recorded slightly lower average values for palmar flexion ($56.77^\circ \pm 3.51^\circ$) and dorsiflexion ($62.90^\circ \pm 3.21^\circ$) compared to our study, which may be attributed to disparities in rehabilitation protocols or patient demographics.^[8,10] The study we conducted found a complication rate of 25%, which included superficial infection (6.25%), secondary collapse and stiffness (6.25%), and tingling and numbness (6.25%). This rate is higher than what Anakwe et al. reported, as they did not encounter any cases of wound infection or tendon injury/irritation. However, our complication rate is similar to the one reported by Javed et al. (23%), although the types of complications were different. The higher complication rate observed in our study compared to some others may be due to the complexity of fractures, as a significant portion of our cases were Type B3 and C1 fractures. Javed et al. noted higher complication rates in high-risk fractures (33%) compared to low-risk fractures (18%), which is consistent with our findings.^[9,12]

Our study found significant associations between age, gender, and functional outcomes.

Younger patients and those injured in RTAs had better outcomes, which is a novel finding not extensively discussed in the compared studies. This could be due to better bone quality and healing potential in younger patients, as well as potentially less severe injuries in RTA cases compared to falls in older patients.

The strong correlation between range of motion and functional outcomes in our study underscores the importance of postoperative rehabilitation. This finding is consistent with general principles of fracture management but was not specifically reported in the compared studies.

In our research, 31 out of 32 individuals experienced bone mending within a 3-month period, which aligns with the results of Anakwe et al. and Paramesha KC et al. The high percentage of patients returning to their pre-injury activity levels (93.75% within 6 months) in our study is also similar to the findings reported by Paramesha KC et al. (93.75% within 6 months). These results indicate that using a volar locking plate for fixation enables early mobilization and a return to normal function, which are vital for patient satisfaction and economic considerations.^[9,11]

Conclusion: Distal radial fractures are most frequently seen in individuals aged 20 to 50 years, with a higher incidence in males due to their participation in physically demanding activities. Younger individuals often sustain these fractures from motor vehicle accidents or high-energy trauma, resulting in displaced fractures that involve the joint. In contrast, older individuals may experience distal radial fractures from minor falls onto an outstretched hand, causing fractures that are located outside of the joint and are more common in those with osteoporosis.

Distal radial fractures are frequently observed in individuals aged 40 to 60 years, and our study focused on the effectiveness of surgical management using a specific fixation method for these fractures. We specifically included cases that required surgery caused by high-energy trauma in younger individuals, specifically those with comminuted and intra-articular fractures.

Either accident or falling on an outstretched hand were the most common ways injuries occurred. Fractures in the distal radius that resulted from accidents, which are considered AO type B or C fractures with high energy trauma were typically displaced, unstable, partly articular or intra-articular. In this investigation, type A fractures were not taken into account.

The use of mini plates, either alone or in combination, is an effective method for treating unstable fractures of the distal radius, particularly those involving the joint. This approach allows for proper alignment of the bones and early movement of the joint due to the strong fixation provided by the plates. The plates can be placed close to the joint and can be screwed in different orders, which gives them biomechanical advantages. The volar approach, which involves accessing the distal radius with minimal surgical trauma and fixing the fracture with better adaptation to surrounding tissues, was the most commonly used and successful in achieving anatomical alignment, regardless of the direction of fracture angulation. The majority of patients in the study were young adults and

experienced a 90% recovery, allowing them to return to their daily activities.

The most important factor is achieving stable fixation and ensuring that the joint surface is properly aligned to reduce any discrepancy. The choice of plate used, whether a single plate or a combination, is not as important as achieving a good reduction and stable fixation. It is crucial to select the appropriate plate based on the fracture pattern and the needs of each individual patient. The outcomes of the procedure can also vary based on the surgical techniques employed and the experience of the surgeon. Fixing the fragments of the distal radius specifically can yield excellent results and effectively restore and maintain the anatomy of the area.

The utilization of mini plates in the treatment of distal radius fractures allows for faster recovery of joint mobility and overall daily functioning.

CONCLUSION

Based on the excellent PRWE scores, the study findings indicate that fragment specific fixation with 2.7mm distal radius plates provides robust and reliable fixation with good functional outcomes

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