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Original Research Article

Comparison of Clinical and Radiographic Outcomes of Open Reduction Internal Fixation versus Closed Reduction for Distal Radius Fractures

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Abstract:

Background: Distal radius fractures are common injuries that significantly impact wrist function and quality of life. They can be treated through various methods, including open reduction internal fixation (ORIF) and closed reduction. Understanding the comparative effectiveness of these treatment modalities is crucial for optimizing patient outcomes.

Objective: This study aims to compare the clinical and radiographic outcomes of ORIF versus closed reduction for distal radius fractures.

Method: A total of 100 patients with distal radius fractures were enrolled in this prospective study over an 18-month period. Patients were divided into two groups: 50 underwent ORIF, and 50 received closed reduction. Clinical outcomes, including pain, wrist function, range of motion, and grip strength, were assessed, along with radiographic parameters such as alignment, healing time, and bone union quality.

Results: The ORIF group demonstrated significantly lower pain scores (VAS 2.4 vs. 3.6), improved DASH scores (15.3 vs. 22.8), and better grip strength (85% vs. 70%) compared to the closed reduction group. Radiographically, the ORIF group showed superior alignment in radial inclination (22° vs. 19°), radial height (11 mm vs. 9 mm), and volar tilt (11° vs. 8°).

Conclusion: ORIF significantly outperforms closed reduction in terms of both clinical and radiographic outcomes for distal radius fractures, making it a preferred treatment option for unstable or intra-articular fractures. Further studies are needed to explore long-term implications and patient-reported outcomes.

Keywords: Clinical outcomes, distal radius fractures, Open reduction internal fixation (ORIF), Radiographic outcomes, Treatment comparison.

Introduction

Many orthopaedic injuries involve distal radius fractures, which are more common in younger persons due to high-energy trauma and older people due to osteoporosis [1]. These fractures induce discomfort and frequent ER visits, affecting wrist function and quality of life. Poor distal radius fracture healing can cause pain, limited range of motion, and grip weakness, affecting everyday activities and jobs. Since the wrist is functionally significant [2].

The severity, kind, and patient-specific criteria determine distal radius fracture treatment. Open and closed reduction internal fixing are the main ways. Open reduction and internal fixation (ORIF) surgically opens the fracture site to realign and stabilise the bone using screws and plates [3]. Better stability and faster functional recovery are benefits of this therapy. Unlike open reduction, closed reduction immobilises the shattered bone in a cast without surgery. It may cause less precise alignment and delayed healing, but it is safer. Comparing ORIF with closed reduction outcomes is important because the method's pros and cons affect clinical and radiological outcomes.

This study will evaluate the radiological and clinical outcomes of open reduction and internal fixation (ORIF) with closed reduction for distal radius fractures. The study provides functional recovery, alignment, and healing timeframes to help doctors make patient-specific therapy recommendations based on expected outcomes. This will suggest ways to improve therapy for this

prevalent injury. Distal radius fractures on the wrist are produced by high-energy trauma such sports injuries, car accidents, or falling on an outstretched hand. Osteoporosis considerably increases the risk of fracture in older patients, yet high-impact accidents are more common in younger people. The fundamental reason is the same for all age groups [4]. These injuries are classified as comminuted, intra-articular, and extra-articular distal radius fractures. Age, activity level, and fracture type and severity should be considered while choosing a treatment. ORIF and closed reduction are the main distal radius fracture treatments. Open reduction and internal fixation (ORIF) surgery involves a tiny incision to approach the fracture. This lets the surgeon precisely straighten and stabilise the bone with metal plates and screws. Complex or displaced fractures are commonly treated with this method to straighten bones and speed up rehabilitation. ORIF surgical risks include infection, nerve damage, and prolonged recovery due to post-operative care [5]. After external bone fragment manipulation, closed reduction immobilises the patient. This non-invasive approach is preferred for simpler fractures or when surgery is risky. Closed reduction avoids surgery, but also increases the risk of malunion and poor bone alignment, which might influence functional result and render the method unsuitable for difficult fractures [7]. Multiple studies have compared ORIF versus closed reduction for distal radius fractures radiologically and clinically. ORIF improves radiography outcomes, including alignment and joint surfaces, according to study. [8] found that ORIF enhanced intra-articular fracture function over closure reduction. Grip strength and wrist range of motion were especially affected.

[9] found that ORIF patients recovered faster and were less uncomfortable, but they had increased surgical risks. [10] revealed that closed reduction can produce functional outcomes equivalent to ORIF in some patients, particularly with extra-articular fractures, suggesting the necessity for specific treatment strategies. Open reduction and open reduction in fractures (ORIF) are well-documented, but few research have examined their long-term effects on clinical and radiological outcomes for different distal radius fracture types. These approaches have not been adequately studied in respect to patient-specific characteristics including age and bone quality. To address these gaps, our 18-month study detailed ORIF and closure reduction outcomes in a diverse patient population. This study seeks to help doctors identify the optimal distal radius fracture treatment depending on patient characteristics and fracture type. It analyses clinical function and radiographic alignment. The ultimate goal is to improve fracture care individually.

Methodology

Study Design: A prospective observational research compares the radiological and clinical effects of open reduction internal fixation (ORIF) with closed reduction for distal radius fractures. Data is collected at baseline, intermediate, and study completion over 18 months. Clinical and radiological data can be obtained in real time using a prospective design, improving outcome comparisons and reducing remembrance bias.

Sample Size and Selection: The study included 100 distal radius fracture patients. Strict inclusion and exclusion criteria for patient selection ensure a representative sample and control for confounding factors. Participants must be adults (18–75 years old) with a distal radius fracture who are willing to participate in all follow-up examinations and have no wrist fractures or localised surgeries. This surgery is not suitable for patients with polytrauma, open fractures, diabetes, osteoporosis, or other bone health issues, or who cannot follow postoperative rehabilitation guidelines. Based on fracture complexity and patient-specific factors, treating physicians divide patients into two therapy groups. Open reduction and internal fixation (ORIF) and closed reduction are performed on 50 patients each.

Procedure

1. Open Reduction Internal Fixation (ORIF):

ORIF surgery is performed under general anaesthesia. A volar or dorsal approach is chosen based on the fracture pattern, and an incision is made to access and view the fracture. Metal plates and screws stabilise fractures after reduction. Vertebral locking plates are popular for intra-articular and comminuted fractures due to their stability. Intraoperative fluoroscopy checks placement and alignment to rebuild the joint surface. Early mobilisation after dressing and closing the wound aids healing.

2. Closed Reduction

A closed reduction is performed under local or regional anaesthesia. A plaster cast or splint immobilises the fractured bone after external manipulation for optimal alignment. This method decreases surgical risks and is suitable for non-articular fractures with minor displacement. Just after the procedure, radiographs are taken to check placement and alignment. After immobilisation, radiographs are collected every 4–6 weeks to track healing. After the wound heals, the cast is removed and physical therapy begins to restore movement.

Outcome Measures

Symptoms, wrist mobility (flexion, extension, pronation, and supination), grip strength, and clinical outcomes are assessed. The VAS measures

pain, and the DASH score measures wrist function. We measure grip strength and range of motion at each follow-up to assess your functional recovery. Radiographs show fracture orientation, healing, and bone union quality. Standard anteroposterior and lateral radiographs are acquired before, after, and after the procedure. Disparities in radial height, inclination, and volar tilt reveal an incorrect alignment. Each phase of the healing process is documented and the bone union is evaluated for delayed union or nonunion.

Data Collection and Analysis

At the start of the trial, immediately after the procedure, at 6, 3, 6, and 12 months, and at 18 months, data is collected. We measure predefined parameters and record functional scores and pain levels at every consultation. Radiologists evaluate radiographs to ensure accurate bone healing and alignment assessments. The data analysis plan uses descriptive and inferential statistics. Descriptive statistics (means, medians, and standard deviations) describe each group's radiographic measurements, clinical scores, and baseline characteristics. Researchers utilise independent t-tests or Mann-Whitney U tests for continuous variables and chi-square tests for categorical data. We compare the two groups' time-varying clinical and radiological results using a repeated-measures ANOVA. All analyses were done in SPSS, and p-values under 0.05 are statistically significant. This method compares ORIF and closed reduction clinical and radiographic data to aid distal radius fracture treatment decisions.

Results

Patient Demographics: Fifty closed reduction and fifty ORIF patients had distal radius fractures, totalling 100. The closed reduction group averaged 50.2 years old, while ORIF averaged 48.7.

Gender distribution was balanced with 27 men and 23 women in closed reduction and 26 men and 24 women in ORIF. Two fracture kinds existed: intra-articular and extra-articular. 62% of the fractures were intra-articular and required surgery to align, whereas 40% had closed reduction.

Table 1: Demographic Details

Outcome Measure	ORIF Group (n=50)	Closed Reduction Group (n=50)
Average Age (years)	48.7 ± 10.2	50.2 ± 9.8
Gender (Male/Female)	26/24	27/23
Intra-Articular Fractures (%)	62%	40%

Clinical Outcomes: Clinical findings were assessed by range of motion, grip strength, functional scores, and pain. ORIF patients had decreased VAS pain at 6 weeks. The ORIF group had an average VAS score of 2.4 at the last follow-up, while the closed reduction group had 3.6. The faster pain decrease after surgery suggests ORIF patients enjoyed faster pain alleviation. This assessment used the wrist DASH score. At 18 months, the ORIF group showed better functional recovery with a DASH score of 15.3 compared to the closed reduction group's 22.8. The ORIF group saw faster functional improvements in the first six months after therapy. The ORIF group had a far larger range of motion in all four directions than the control group regardless of time interval. Last follow-up, closed reduction patients had 65% range of motion, while ORIF patients had nearly full range, with average flexion-extension levels at 75% of normal. ORIF's precise anatomical restoration and early mobilisation certainly helped ORIF patients recover pronational and supinational motion better. On average, the ORIF group had restored 85% of their pre-injury grip strength after 18 months, compared to the closed reduction group. ORIF improves wrist stability and function in this version.

Table 2: Clinical Outcomes

Outcome Measure	ORIF Group (n=50)	Closed Reduction Group (n=50)	p-value
Pain (VAS Score, Final)	2.4 ± 1.1	3.6 ± 1.3	< 0.01
DASH Score (Final)	15.3 ± 3.5	22.8 ± 4.1	< 0.05
Range of Motion (% of Normal)	75% (Flex-Ext)	65% (Flex-Ext)	< 0.05
Grip Strength (% of Normal)	85%	70%	< 0.05

Radiographic Outcomes

Results were determined radiographically by alignment, healing period, and bone union quality.

The ORIF group had good alignment with an average of 22 degrees, 11 mm, and 11 degrees for radial inclination, height, and volar tilt. In contrast, the closed reduction group averaged 19 degrees of radial inclination, 9 mm of radial height, and 8 degrees of volar tilt with small variations. These closed reduction anomalies suggest that, while successful, closed reduction does not preserve optimal alignment over time. The closed reduction group had faster callus and fracture consolidation

healing (12 weeks on average) than the ORIF group (14 weeks). Due to the lack of surgery, closed reduction may allow the skin to heal naturally without artificial materials. Although the closed reduction group healed faster on radiographs, functional recovery was later. At the last follow-up, 96% of both groups had adequate bone union. Due to the higher rate of mild malunion (12%) in the closed reduction group compared to ORIF (4%), some patients may have wrist function difficulties.

Table 3: Radiographic Outcomes

Outcome Measure	ORIF Group (n=50)	Closed Reduction Group (n=50)	p-value
Radial Inclination (degrees)	22 ± 2	19 ± 3	< 0.01
Radial Height (mm)	11 ± 1	9 ± 2	< 0.01
Volar Tilt (degrees)	11 ± 1.5	8 ± 2.2	< 0.01
Healing Time (weeks)	14 ± 1.8	12 ± 1.5	< 0.05
Bone Union Quality (Malunion %)	4%	12%	-

Comparative Analysis

The statistical analysis showed that ORIF and closed reduction groups differed considerably in several crucial outcomes. ORIF resulted in lower VAS pain levels ($p < 0.01$) and improved DASH functional scores ($p < 0.05$) compared to closed reduction, indicating better functional recovery. However, the ORIF group had improved grip strength and range of motion at 18 months ($p < 0.05$). On radiographs, the ORIF group had significantly better alignment metrics ($p < 0.01$), while the closed reduction group healed faster ($p < 0.05$).

Finally, ORIF and open reduction can treat distal radius fractures. ORIF improves functional recovery, pain reduction, and anatomical alignment in complicated fractures. The findings emphasise the importance of tailoring treatment to the fracture and patient needs for optimal clinical and radiological results.

Discussion

The study confirms prior findings that closed reduction is better than ORIF for distal radius fractures. DASH ratings, grip strength, and range of motion improved in the ORIF group, while the Visual Analogue Scale (VAS) showed less discomfort. Previous study has shown that ORIF enhances stability and allows early mobilisation, which improves long-term functional outcomes.

Even though they achieved satisfactory results, the closed reduction group had worse pain relief and range of motion. This is likely because non-surgical fracture treatment lacks alignment and stability. Radiographs show that ORIF improves anatomical restoration in alignment measures such radial inclination, height, and volar tilt. [11] and [12] found that ORIF improves bone healing and union quality, with fewer malunions than closed reduction. The closed reduction group may have healed faster because to the less intrusive surgery, but alignment and stability may have suffered.

Implications for Clinical Practice

Our findings suggest that ORIF may improve clinical and radiological outcomes in intra-articular or unstable distal radius fracture patients who need accurate anatomical restoration. Clinically, ORIF may benefit patients who need a faster functional recovery and better wrist function. Closed reduction may be an option for stable, extra-articular fractures if surgery is not possible or too hazardous. Finally, treatment approaches should take into account age, activity level, fracture kind, and recovery possibilities.

Strengths and Limitations

This study's 18-month follow-up and 100-patient sample size are strengths. Since early and later-stage results can be seen, this time range allows a complete assessment of healing and functional recovery. The study's systematic radiographic and clinical assessments ensure a complete understanding of treatment impacts on patient outcomes. However, the study has limitations. The study's single-center design may prevent generalisation to other clinical situations or demographic groupings. Surgeries, patient adherence, and postoperative rehabilitation regimens may vary between centres. The trial design also excluded patients' self-reported quality of life indicators, which could have illuminated treatment's functional and social impacts.

Future Research

Future research should examine outcomes in subgroups like elderly individuals or those with bone health problems, or use multicenter trials to boost generalisability. Clinicians and lawmakers in low-resource settings should benefit from open reduction versus ORIF cost-effectiveness study. Using quality-of-life surveys and long-term follow-up data could improve our understanding of patient satisfaction and functional results. Finally, exploring new fixation methods and using advanced imaging to track recovery may improve distal radius fracture treatment. ORIF clearly improves clinical and radiological outcomes. The present evidence base and distal radius fracture

methods can be improved. Other recovery factors should be studied in future studies.

Conclusion

ORIF improved clinical and radiological results for distal radius fractures, including pain alleviation, functional recovery, and anatomical alignment, compared to closed reduction. These findings suggest that open reduction and internal fixation (ORIF) is best for difficult or unstable fractures that require precision stabilisation. For stable fractures or those who cannot undergo open reduction surgery, closed reduction is less invasive. More research across multiple centres with longer follow-up and quality of life assessments is needed to improve therapeutic decision-making and patient outcomes.

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