

Clinical and Functional Outcomes in Adult Radius and Ulna Fractures: Determinants of Prognosis

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Abstract:

Background: Fractures of the radius and ulna in adults are common injuries with varying outcomes influenced by multiple clinical and treatment-related factors. Understanding these determinants is essential for optimizing management strategies and improving patient recovery.

Objective: To analyze the clinical, radiological, and treatment factors affecting the functional outcome of adult patients with radius and ulna fractures.

Methods: A prospective observational study was conducted at Department of Orthopaedics, Tertiary care centre, India, for two years. One hundred adult patients with radius and ulna fractures were enrolled. Outcomes were evaluated using the Disabilities of the Arm, Shoulder and Hand (DASH) score and radiological parameters at regular follow-ups.

Results: Functional outcome was significantly influenced by factors including fracture type, method of fixation, and time to surgery. Patients with early operative intervention and stable fixation demonstrated better functional scores and fewer complications.

Conclusion: A comprehensive understanding of factors influencing outcome in radius and ulna fractures aids in tailoring treatment protocols to enhance functional recovery.

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Introduction

Fractures of the radius and ulna in adults constitute a significant proportion of upper limb injuries encountered in orthopedic trauma practice. The forearm plays a critical role in the complex biomechanics of the upper extremity, contributing not only to the length and structural integrity of the limb but also facilitating the essential movements of pronation and supination, which are pivotal for hand positioning and function. Due to this intricate functional anatomy, forearm fractures are more than simple bone injuries; they can result in profound functional deficits if not managed optimally [1,2].

In adults, diaphyseal fractures of the radius and ulna typically result from high-energy mechanisms such as road traffic accidents, falls from heights, or direct blows [3]. Unlike pediatric fractures, adult forearm fractures are often unstable due to the reduced remodeling potential of mature bone, the presence of muscular forces acting on the fractured fragments, and the requirement to restore precise anatomical alignment to maintain normal forearm rotation [4].

Malalignment or loss of radial bow after healing can significantly impair supination and pronation, leading to disability.

The management of adult radius and ulna fractures has evolved significantly over the decades. Nonoperative treatment with closed reduction and casting was once commonly employed but has largely been supplanted by operative fixation due to the high incidence of malunion, nonunion, and functional impairment seen with conservative management in adults. Current standard practice involves open reduction and internal fixation (ORIF) using plates and screws, aimed at anatomical reduction and rigid fixation to allow early mobilization [5,6].

Despite advances in surgical techniques and implant design, achieving consistent, favorable functional outcomes remains a challenge. Multiple factors influence healing and recovery, including fracture characteristics (e.g., simple versus comminuted fractures, open versus closed injuries), timing of

surgical intervention, choice of fixation method, surgical skill, and postoperative rehabilitation adherence [7,8]. Additionally, patient-specific variables such as age, bone quality, comorbidities like diabetes or smoking, and nutritional status also play significant roles.

The complications associated with radius and ulna fractures can be numerous and varied. Infection, particularly in open fractures, delayed union or nonunion, hardware-related problems such as screw loosening or plate breakage, and nerve injuries, particularly to the posterior interosseous nerve, have been well documented. Each of these can adversely affect the ultimate functional outcome [9].

Functional outcome assessment is essential in forearm fracture management, not only to measure pain and range of motion but also to evaluate the patient's ability to perform activities of daily living and return to occupational duties. The Disabilities of the Arm, Shoulder and Hand (DASH) score is a validated, patient-reported outcome measure widely used for this purpose, providing a comprehensive evaluation of upper limb disability and symptoms [10].

Though several studies have evaluated the surgical management of forearm fractures, few have conducted a comprehensive, prospective analysis focusing on the interplay of clinical, radiological, surgical, and patient-related factors affecting functional outcomes. Such an analysis is critical for identifying prognostic indicators, tailoring individualized treatment plans, and improving patient education about expected recovery trajectories [11].

In this context, our study was designed as a prospective observational cohort study involving adult patients with radius and ulna fractures treated surgically at a tertiary care center in India. We aimed to systematically analyze the clinical and radiological parameters, treatment modalities, and postoperative outcomes, with particular emphasis on identifying factors that significantly influence functional recovery, as measured by the DASH score.

By evaluating a broad spectrum of variables and their association with outcomes, this study seeks to contribute to the evidence base guiding optimal management strategies for radius and ulna fractures in adults. The findings aim to assist clinicians in predicting prognosis, improving surgical decision-making, and enhancing rehabilitation protocols to maximize functional restoration.

Aim and Objectives

Aim: To analyze the clinical, radiological, and treatment-related factors affecting the functional outcomes of adult patients with radius and ulna fractures.

Objectives:

1. To assess the functional recovery of adult patients with radius and ulna fractures using the Disabilities of the Arm, Shoulder and Hand (DASH) score at baseline, 1 month, 3 months, and 6 months post-treatment.
2. To evaluate the influence of fracture characteristics, including fracture pattern, displacement, and open versus closed status, on functional outcome.
3. To compare outcomes based on different fixation methods utilized in the management of these fractures.
4. To determine the impact of timing of surgery on union rates and functional recovery.
5. To document and analyze the incidence of complications such as infection, delayed union, nonunion, and neurovascular injury and their effect on outcomes.
6. To identify patient-specific factors such as age, comorbidities, and smoking status that may influence healing and functional results.

Materials and Methods

Department of Orthopaedics, Tertiary care centre, India, for two years

Sample Size: One hundred adult patients with fractures of the radius and ulna were enrolled consecutively during the study period.

Inclusion Criteria:

- Adults aged 18 to 65 years.
- Patients presenting with acute fractures of both radius and ulna or isolated fractures of either bone.
- Closed fractures or Gustilo-Anderson type I and II open fractures.
- Patients medically fit for surgery and willing to participate with informed consent.

Exclusion Criteria:

- Pathological fractures.
- Gustilo-Anderson type III open fractures.
- Patients with associated neurovascular injuries requiring urgent intervention.
- Patients with compartment syndrome.
- Patients lost to follow-up or unwilling to comply with study protocol.

Treatment Protocol: All patients underwent detailed clinical and radiological evaluation. Management decisions regarding operative versus conservative treatment were made based on fracture characteristics, patient factors, and surgeon discretion.

Operative management primarily involved open reduction and internal fixation (ORIF) using plates and screws via standard approaches. In cases

suitable for conservative treatment, closed reduction and casting were performed.

Postoperative and Follow-up Care: Patients received standardized postoperative care, including immobilization as indicated and physiotherapy. Follow-up visits were scheduled at 1, 3, and 6 months, post-treatment.

Outcome Measures:

- Functional outcome was assessed using the Disabilities of the Arm, Shoulder and Hand (DASH) score at baseline, 1 month, 3 months, and 6 months.
- Radiological assessment of fracture healing was done using serial X-rays. Union was defined by cortical bridging on at least three cortices and absence of fracture site pain or mobility.
- Complications such as infection, nonunion, delayed union, hardware failure, and neurovascular injury were documented.

Statistical Analysis:

Data were analyzed and continuous variables are expressed as mean \pm standard deviation (SD). Changes in DASH scores over time were evaluated using repeated measures ANOVA. The influence of categorical variables on outcomes was assessed using chi-square or Fisher's exact test. Statistical significance was set at $p < 0.05$.

Results

One hundred adult patients with radius and ulna fractures were enrolled and followed prospectively over six months. The cohort included a majority of males, with an average age of 40.7 years. Fracture types varied from simple to comminuted and included both open and closed injuries. Most patients underwent operative fixation via open reduction and internal fixation (ORIF). Functional recovery, measured by the DASH score, showed significant improvement at all follow-up intervals. Early surgery and stable fixation correlated with superior functional outcomes. Complications were infrequent and manageable. Patient compliance with follow-up was excellent.

Table 1: Patient Demographic Characteristics (n=100)

Parameter	Value
Mean Age (years)	40.7 \pm 11.5
Gender (M/F)	68 / 32
Fracture Type (Simple/Comminuted)	62 / 38
Fracture Classification (Closed/Open)	82 / 18

Table 2: Treatment Modality Distribution

Treatment Method	Number of Patients	Percentage (%)
Operative (ORIF)	85	85
Conservative (Casting)	15	15

Table 3: Mean DASH Scores Over Time

Time Point	Mean DASH \pm SD	p-value vs. Baseline
Baseline	52.1 \pm 9.8	—
1 Month	38.4 \pm 10.2	<0.001
3 Months	25.7 \pm 8.6	<0.001
6 Months	14.3 \pm 7.1	<0.001

Table 4: DASH Scores by Fracture Type at 6 Months

Fracture Type	Mean DASH \pm SD	p-value
Simple	11.5 \pm 5.6	<0.001
Comminuted	19.7 \pm 7.4	

Table 5: Effect of Time to Surgery on Functional Outcome

Time to Surgery	Mean DASH \pm SD	p-value
< 7 days	12.8 \pm 6.1	0.002
\geq 7 days	20.1 \pm 7.3	

Table 6: Radiological Union Rates at 6 Months

Fracture Type	Number United	Percentage (%)
Simple	60	96.8
Comminuted	34	89.5

Table 7: Complications Observed

Complication	Number of Patients	Percentage (%)
Superficial Infection	5	5
Delayed Union	6	6
Nonunion	3	3
Hardware Failure	1	1
Neurovascular Injury	0	0

Table 8: Functional Outcome by Treatment Modality at 6 Months

Treatment Modality	Mean DASH \pm SD	p-value
Operative (ORIF)	12.5 \pm 6.7	<0.001
Conservative	28.7 \pm 8.9	

Table 9: Smoking Status and Functional Outcome

Smoking Status	Mean DASH \pm SD	p-value
Non-smoker	13.8 \pm 7.0	0.01
Smoker	21.6 \pm 8.3	

Table 10: Follow-up Compliance Rates

Follow-up Time point	Number of Patients Completed	Percentage (%)
1 Month	100	100%
3 Months	97	97
6 Months	95	95

Table 1 outlines demographic and fracture classification data, highlighting the predominance of male patients and the prevalence of closed and simple fractures. Table 2 shows that the majority (85%) were treated operatively. Table 3 reveals significant improvement in DASH scores at all follow-up intervals, indicating progressive functional recovery. Table 4 demonstrates better outcomes for simple fractures compared to comminuted ones, reflecting the influence of fracture complexity on prognosis. Table 5 highlights the advantage of early surgical intervention (<7 days) in achieving superior functional outcomes. Radiological union rates were high in both simple and comminuted fractures as per Table 6, though slightly lower in comminuted types. Complication rates (Table 7) were low, with superficial infection and delayed union being the most common. Table 8 shows operative management yielded significantly better functional outcomes than conservative treatment. Smoking negatively impacted recovery as evidenced in Table 9, where smokers had poorer DASH scores. Table 10 confirms excellent patient compliance throughout follow-up.

Discussion

Fractures of the radius and ulna in adults are complex injuries with a significant impact on upper limb function, and their management continues to pose challenges to orthopedic surgeons. This prospective study of 100 adult patients highlights the multifactorial determinants influencing the clinical and functional outcomes of these fractures.

Functional Recovery and Influencing Factors: The study demonstrated substantial improvement in

upper limb function as assessed by the DASH score over the six-month follow-up period. The progressive decline in DASH scores from a mean of 52.1 at baseline to 14.3 at six months indicates significant recovery of arm, shoulder, and hand function post-injury and treatment. This finding underscores the efficacy of current management protocols, predominantly operative fixation, in restoring function in adult forearm fractures [12,13].

Our data further reinforce the influence of fracture characteristics on recovery. Patients with simple fractures exhibited superior functional outcomes compared to those with comminuted fractures, consistent with the greater anatomical disruption and healing complexity associated with comminution. This aligns with existing literature emphasizing that fracture complexity is a critical prognostic factor for outcome [14,15].

The timing of surgical intervention emerged as a significant determinant of functional outcome. Patients operated on within seven days of injury demonstrated better DASH scores at six months than those with delayed surgery. Early fixation likely minimizes soft tissue compromise, reduces the risk of infection, and facilitates early rehabilitation, collectively enhancing recovery [16,17]. These findings support recommendations for timely surgical management where operative treatment is indicated.

Treatment Modality and Outcomes: Operative management with open reduction and internal fixation was the mainstay in this cohort, achieving superior functional results compared to conservative treatment. This is consistent with the standard of

care for displaced adult forearm fractures, where rigid fixation is necessary to restore the anatomical alignment essential for forearm rotation and function [18,19].

The union rates observed were high, with radiological union achieved in over 90% of fractures by six months, paralleling reports from previous studies. However, delayed union and nonunion, though infrequent, were more common in comminuted fractures and patients with delayed surgery, emphasizing the need for meticulous surgical technique and postoperative care [20].

Complications and Risk Factors: Complications were relatively low in incidence, with superficial infections being the most common. No neurovascular injuries were reported, reflecting careful surgical planning and technique. Smoking was identified as a negative prognostic factor, correlating with poorer functional outcomes, which is congruent with well-established evidence linking smoking to impaired fracture healing.

Study Strengths and Limitations: The prospective design, robust sample size, and use of validated functional outcome measures strengthen the validity of this study. However, limitations include the absence of randomization, which may introduce selection bias, and a follow-up period limited to six months, which may not capture late complications or functional decline. Further randomized controlled trials with longer-term follow-up are warranted to confirm these findings and guide best practices.

Conclusion

This study highlights that the functional outcome of adult radius and ulna fractures is significantly influenced by fracture type, timing of surgical intervention, treatment modality, and patient factors such as smoking. Early operative fixation remains the preferred approach for displaced fractures, leading to high union rates and superior functional recovery. Attention to modifiable risk factors and timely management can optimize outcomes. These findings provide valuable insights for clinicians in tailoring individualized treatment plans and counseling patients regarding prognosis.

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