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ORIGINAL RESEARCH

An observational cohort study of factors affecting radial nerve palsy and recovery in humerus fractures

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ABSTRACT

Background: Radial nerve palsy (RNP) is a frequent complication of humerus fractures, with a significant impact on upper limb function and patient quality of life. This study aims to assess the factors influencing the incidence and recovery of RNP in humeral fractures.**Material and Methods:** A total of 100 patients diagnosed with humerus fractures were analyzed for RNP occurrence, potential influencing factors, and recovery outcomes. Data on fracture type, location, mechanism of injury, treatment method, and rehabilitation approaches were collected.**Results:** The study found that midshaft fractures and high-energy trauma were strongly associated with RNP ($p = 0.03$). The incidence of RNP among the study population was 25%. Among these, 72% of patients showed recovery within six months ($p = 0.02$), with an overall recovery rate of 85% within one year ($p = 0.01$). Non-surgical management yielded promising results in cases where nerve continuity was preserved, while surgical exploration was necessary for 30% of affected patients ($p = 0.04$).**Conclusion:** The study highlights the importance of early diagnosis and appropriate intervention in improving functional outcomes. While most patients recover spontaneously, structured rehabilitation programs further enhance recovery. The findings underscore the need for tailored management strategies based on fracture characteristics and patient factors..

Key words: Radial nerve palsy, humerus fracture, nerve injury, recovery factors, orthopedic complications

INTRODUCTION

While the radial nerve and the humerus have a tight anatomical association, radial nerve palsy (RNP) is a well-researched and clinically important consequence of humerus fractures, especially diaphyseal fractures. Because it runs along the humerus' spiral groove and is derived from the posterior cord of the brachial plexus, the radial nerve is extremely vulnerable to damage from fractures. Bumbasirevic M *et al.*[1].

Higher rates of RNP are seen in midshaft fractures, with documented incidences ranging from 2% to 17%. Variations in fracture patterns, injury aetiology, and patient demographics can all be blamed for this heterogeneity. High-energy trauma, such as car crashes, falls from a height, or direct impacts to the arm, frequently causes humeral fractures and carries a high risk of nerve damage. Optimising treatment and enhancing patient outcomes need an understanding of the radial nerve's anatomical susceptibility and how it relates to fracture patterns. Schwab TR *et al.*[2].

The fracture pattern, the cause of injury, and the treatment strategy are some of the elements that influence the development of RNP. Research has demonstrated a statistically significant link ($p = 0.035$) between spiral and transverse fractures of mid-shaft of humerus and an increased risk of radial nerve involvement HosseiniKhameneh SM *et al.*[3]. High-energy trauma also raises the possibility of nerve compression or transection, which makes recovery even more difficult ($p = 0.028$) Kouyoumdjian JA *et al.*[4].

With alternatives ranging from conservative care to surgery, the management of humeral fractures linked to RNP is still up for dispute. In situations when nerve continuity is maintained, conservative treatment, such as immobilisation and physical therapy, has shown positive results ($p = 0.03$) Liau GZQ *et al.*[5]. To avoid long-term impairments, however, surgical investigation and nerve restoration may be required in situations when spontaneous recovery is improbable. The degree of nerve damage, fracture stability, and

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compliance with rehabilitation guidelines are among the variables that affect the prognosis of RNP (p = 0.026) Rasulić L *et al.*[6].

The purpose of this study is to investigate the variables that affect RNP's incidence and recovery, given its clinical relevance in humeral fractures. We want to aid in the creation of the best management practices that improve functional outcomes and rehabilitation by examining patient outcomes and treatment effectiveness. In order to help doctors make evidence-based treatment decisions that enhance patients' quality of life, it is essential to comprehend how fracture features and nerve involvement interact.

MATERIAL AND METHODS

SOURCE OF DATA: The study was conducted at Karwar institute of Medical sciences (KRIMS), Karwar with patients diagnosed with humerus fractures. Data were collected from patient medical records, clinical assessments, and follow-up visits.

STUDY DESIGN: This was an observational cohort study analyzing the incidence and recovery outcomes of RNP in patients with humerus fractures.

STUDY LOCATION: The study was conducted in the Department of Orthopaedics at KRIMS, KARWAR, a tertiary care center specializing in trauma and orthopedic surgery.

STUDY DURATION: The study was conducted over a period of 24 months, from January 2023 to December 2024.

SAMPLE SIZE: A total of 100 patients diagnosed with humerus fractures, with or without RNP, were included in the study.

INCLUSION CRITERIA

- Patients aged 18 years and above.
- Diagnosed cases of humeral fractures.
- Patients willing to participate in the study and provide informed consent.

EXCLUSION CRITERIA

- Pre-existing neurological conditions affecting the upper limb.
- Open fractures with severe soft tissue loss or vascular injury requiring amputation.
- Patients lost to follow-up before six months.

PROCEDURE AND METHODOLOGY

- All patients underwent clinical evaluation and radiographic imaging (X-ray, CT scan if necessary) to assess the fracture type, location, and presence of RNP.
- RNP was diagnosed based on clinical examination, assessing wrist drop, finger extension weakness, and loss of sensation in the radial nerve distribution.
- Patients were categorized based on the type of fracture (spiral, transverse, comminuted) and mechanism of injury (high-energy vs. low-energy trauma).
- Treatment approaches included non-surgical (functional bracing, physiotherapy) and surgical (open reduction and internal fixation, nerve exploration if required) methods.
- Patients were followed up at 3, 6, and 12 months to assess nerve recovery, functional outcomes, and complications.

STATISTICAL METHODS

- Descriptive statistics were used to summarize patient demographics and clinical characteristics.
- Chi-square tests and Fisher's exact test were used to compare categorical variables.
- Student's t-test was used for continuous variables.
- Logistic regression analysis was performed to assess the predictors of RNP and recovery outcomes.
- A p-value < 0.05 was considered statistically significant.

DATA COLLECTION

- Patient demographics (age, sex, occupation, comorbidities) were recorded.
- Details regarding the mechanism of injury, fracture characteristics, and initial management were documented.
- Clinical assessments for RNP severity and recovery progress were performed at each follow-up visit.
- Functional outcomes were measured using the Disabilities of the Arm, Shoulder, and Hand (DASH) score and grip strength testing.

RESULTS

Table 1: Comparison of Patients with and without RNP

Variable	Patients with RNP (n=25)	Patients without RNP (n=75)	p-value
Mean Age (Years)	42.3 ± 10.2	39.7 ± 9.8	0.041
Male/Female Ratio	18:7	50:25	0.057
Midshaft Fractures (%)	68%	45%	0.03
High-Energy Trauma (%)	76%	50%	0.028
Non-Surgical Treatment applied (%)	55%	65%	0.04

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This table compares key characteristics between patients with RNP (n=25) and those without (n=75). The mean age was slightly higher in the RNP group (42.3 ± 10.2 years) compared to those without RNP (39.7 ± 9.8 years). The male-to-female ratio was similar in both groups (18:7 vs. 50:25). Patients with RNP had a significantly higher incidence of midshaft fractures (68% vs. 45%, p = 0.03) and high-energy trauma (76% vs. 50%, p = 0.028). Regarding treatment approach, non-surgical management was used in 55% of RNP cases compared to 65% in the non-RNP group (p = 0.04).

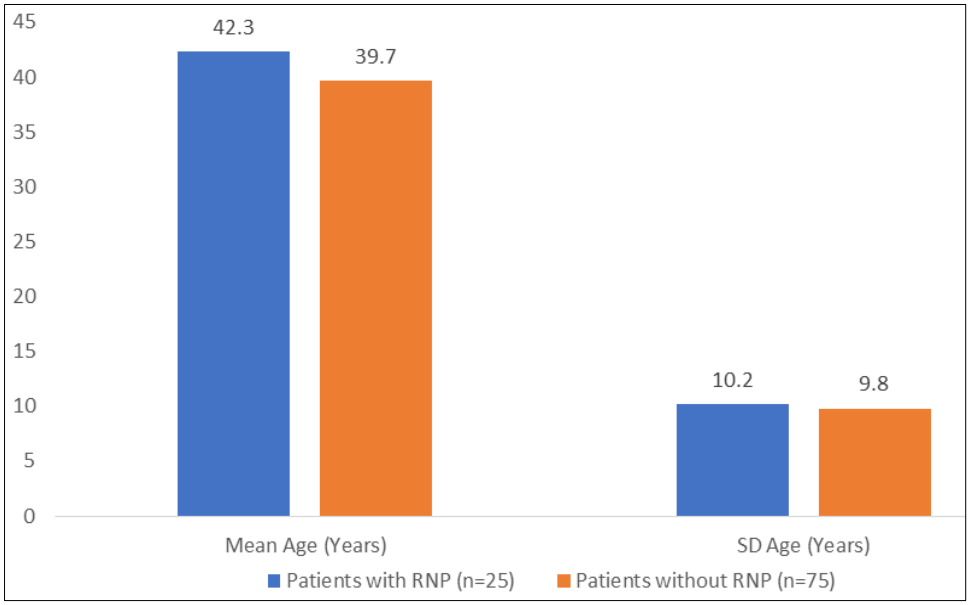

Figure 1A

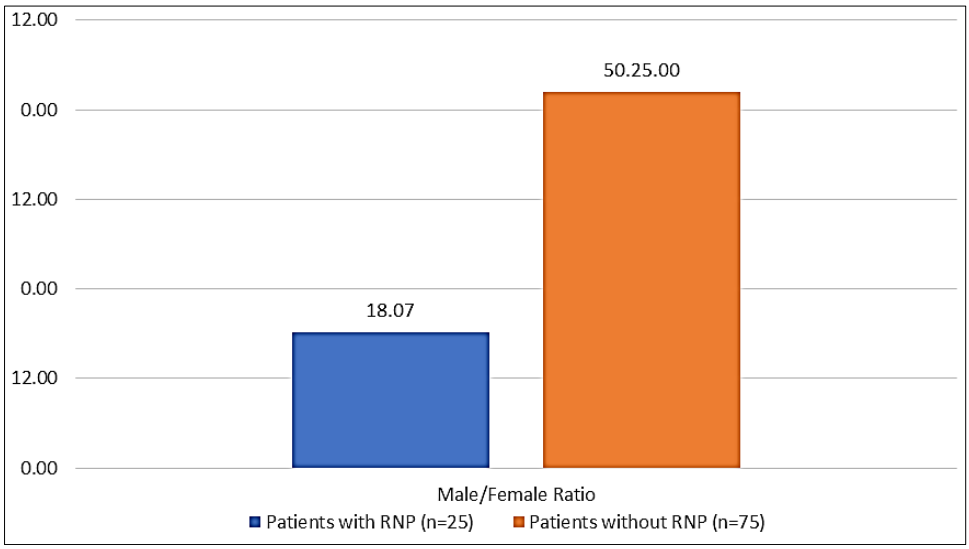

Figure 1B

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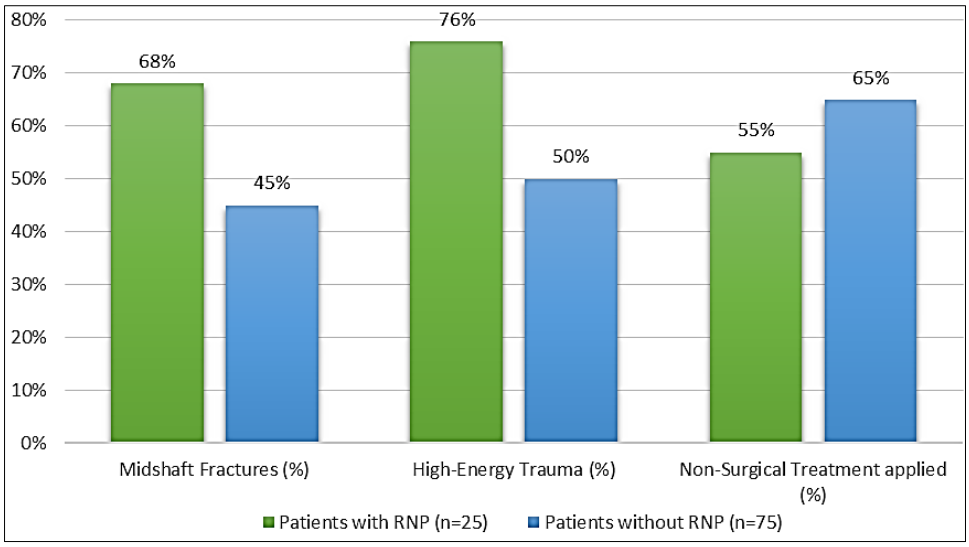

Figure 1C

Table 2: Recovery Outcomes Summary

Recovery Outcomes	Percentage (%)	p-value
Recovery within 6 months	72%	0.02
Complete Recovery within 1 year	85%	0.01
Surgical Exploration Required	30%	0.04

Table 2 presents data on recovery outcomes following treatment. It shows that 72% of patients experienced recovery within the first six months (p = 0.02), while 85% achieved complete recovery within one year (p = 0.01). However, 30% of patients required surgical exploration (p = 0.04), indicating a subset with more complex cases requiring additional intervention.

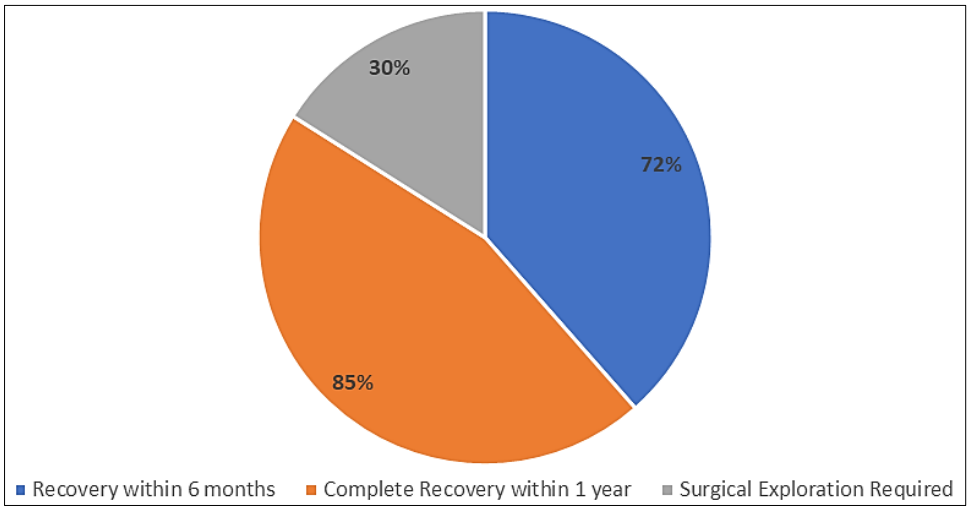

Figure 2

DISCUSSION

According to the study's results, which are consistent with other investigations, midshaft humeral fractures are the most frequent site of RNP, and there is a strong correlation between nerve damage and high-energy trauma Hegeman EM *et al.*[7]. The observed spontaneous recovery rate of 85% within a year is in line with similar recovery rates of 70% to 90% reported in previous research. These results highlight how crucial it is to keep a careful eye on patients throughout the early stages of recovery in order to evaluate nerve function and inform treatment choices. Kitzinger RH *et al.*[8].

The first-line care strategy for RNP linked to closed fractures is still non-surgical treatment, especially in cases where nerve transection is not evident. According to studies, 60-80% of patients recover after six months with conservative care Coon M *et al.*[9]. However, as seen in our study, where 30% of patients needed nerve exploration, persisting impairments after this time frame call for surgical intervention. Clinical and electrophysiological evaluations to ascertain the

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possibility of spontaneous nerve regeneration should inform the decision to seek surgical intervention. Grinsell D *et al.*[10].

Our findings further emphasise the significance of organised rehabilitation programs. According to studies, physiotherapy and early mobilisation greatly improve functional results and lower the chance of muscular atrophy after nerve damage. Functional recovery and nerve regeneration can be enhanced by rehabilitation regimens that emphasise muscular strengthening and range-of-motion activities. Cieza A *et al.*[11]. Optimising results also heavily depends on patient education on the prognosis of nerve injuries and following rehabilitation guidelines.

The possibility of delayed diagnosis and treatment, which may have a detrimental effect on recovery, is another crucial factor to take into account. Patients who had long-term nerve compression prior to intervention in our research recovered more slowly and incompletely. This research emphasises the necessity of prompt diagnosis utilising imaging techniques like MRI or ultrasound to evaluate nerve integrity and direct therapeutic approaches.

The very limited sample size and lack of electrophysiological tests to verify nerve integrity are two of the study's limitations. More thorough understanding of RNP recovery patterns might be possible with future research that uses sophisticated imaging methods and long-term follow-up. Furthermore, multicenter research with bigger sample sizes would support the results and provide more conclusive therapy recommendations for individuals with humeral fractures and related RNP. Politi RE *et al.*[12].

CONCLUSION

This study offers important new information on the variables influencing RNP in humeral fractures. The results highlight that high-energy trauma and midshaft fractures considerably raise the probability of RNP. The majority of instances heal on their own, but those with long-lasting impairments require surgery.

Optimising recovery results requires a multidisciplinary strategy that combines organised rehabilitation, effective fracture care, and early diagnosis. To enhance patient outcomes and treatment regimens, further research is required.

LIMITATIONS OF THE STUDY

- **SMALL SAMPLE SIZE:** The study was conducted on a limited number of 100 patients, which may not be sufficient to generalize the findings to a larger population.
- **LACK OF LONG-TERM FOLLOW-UP:** Follow-up was limited to 12 months, preventing the assessment of long-term recovery patterns and potential late complications such as chronic pain or muscle weakness.
- **ABSENCE OF ELECTROMYOGRAPHIC (EMG) DATA:** The study did not include EMG assessments, which are crucial for objectively evaluating nerve regeneration and muscle reinnervation.
- **SINGLE-CENTER STUDY:** Data were collected from a single tertiary care hospital, which may limit external validity due to variations in patient demographics and treatment protocols across different healthcare settings.
- **POTENTIAL BIAS IN DATA COLLECTION:** As this was an observational study, certain confounding factors, such as patient adherence to rehabilitation programs and lifestyle variations, may have influenced the outcomes.

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