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Original Article

Saving The Radial Head: A Prospective Interventional Study of Functional Outcome

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ABSTRACT

Background: Radial head fractures are common elbow injuries that significantly affect joint stability and upper limb function. Preservation of the radial head has become increasingly important to maintain elbow biomechanics and prevent long-term complications associated with excision.
Aim: To evaluate the functional outcome of radial head preservation in patients with Mason type II, III, and IV fractures.
Materials and Methods: This prospective interventional study was conducted from January 2021 to December 2024 and included 31 patients after applying inclusion and exclusion criteria. All patients underwent surgical management aimed at preserving the radial head using fixation techniques such as Kirschner wires, interfragmentary screws, or mini-fragment plates. Functional outcomes were assessed using DASH and MEPI scores, and pain was evaluated using VAS at 3, 6, 12, and 24 weeks.
Results: The majority of patients were young males, with slip and fall being the most common mechanism of injury. Mason type II fractures predominated. DASH scores showed progressive improvement from 32.5 ± 8.4 at 3 weeks to 4.2 ± 5.1 at 24 weeks. MEPI scores improved from 56.8 ± 6.5 to 88.6 ± 7.3 over the same period. VAS scores decreased significantly from 5.4 ± 1.2 to 0.8 ± 0.9. All improvements were statistically significant ($p < 0.001$).
Conclusion: Radial head preservation provides excellent functional outcomes and significant pain reduction. Early surgical intervention combined with structured rehabilitation leads to optimal recovery and restoration of elbow function.

Keywords: *Radial head fracture, Mason classification, radial head preservation, DASH score, MEPI score, elbow function, VAS score.*

INTRODUCTION

Radial head fractures are among the most common injuries involving the elbow joint, accounting for approximately one-third of all elbow fractures in adults and nearly 1.5–4% of all fractures overall [1]. These injuries typically result from a fall on an outstretched hand, leading to axial loading across the radiocapitellar joint. The radial head plays a crucial role in maintaining elbow stability, particularly in resisting valgus stress and axial load transmission, as well as contributing to forearm rotation [2]. Consequently, preservation of the radial head has gained increasing importance in modern orthopaedic practice.

Historically, radial head excision was widely performed for comminuted fractures; however, long-term studies revealed complications such as elbow instability, proximal migration of the radius, wrist pain, and degenerative changes [3]. These adverse outcomes shifted the treatment paradigm toward preservation strategies, including open reduction and internal fixation (ORIF) and radial head arthroplasty, depending on fracture type and associated injuries [4]. The Mason classification, later modified by Hotchkiss, remains the most commonly used system to guide management decisions, categorizing fractures based on displacement and comminution [5].

The concept of "saving the radial head" is rooted in the understanding that even a partially intact radial head contributes significantly to elbow biomechanics. Preservation techniques aim to restore joint congruity, maintain stability, and allow

early mobilization, thereby improving functional outcomes [6]. Advances in surgical techniques, implant design, and imaging modalities have further enhanced the feasibility of radial head preservation, even in complex fracture patterns [7]. Functional outcome assessment in such injuries is commonly performed using validated scoring systems such as the Disabilities of the Arm, Shoulder and Hand (DASH) score and the Mayo Elbow Performance Index (MEPI). These tools provide a comprehensive evaluation of pain, range of motion, stability, and daily functional capacity [8]. In addition, pain assessment using the Visual Analog Scale (VAS) offers valuable insight into patient recovery and satisfaction over time [9].

Despite evolving management strategies, there remains ongoing debate regarding the optimal treatment approach for different fracture types, particularly in cases with associated ligamentous or osseous injuries. Moreover, variability in functional outcomes reported across studies highlights the need for further prospective evaluation [10].

This study aims to evaluate the functional outcome of radial head preservation in patients with radial head fractures. Objectives include assessing improvement in DASH and MEPI scores, pain reduction using VAS, and analyzing the influence of fracture type and associated injuries on overall clinical and functional recovery outcomes.

MATERIALS AND METHODS

Study Design and Setting

- This was a prospective interventional study conducted at a tertiary care institution.
- The study was carried out over a period of January 2021 to December 2024.
- Ethical approval was obtained from the Institutional Ethics Committee (Letter No. ETH/025/CHEC/ dated 1st January 2021).
- Written informed consent was obtained from all participants prior to enrollment.
- The study was specifically designed to evaluate functional and radiological outcomes of radial head preservation using open reduction and internal fixation (ORIF) in patients with displaced radial head fractures.

Study Population

- Adult patients aged ≥18 years were included.
- Patients diagnosed with Mason type II, III, or IV radial head fractures were enrolled.
- Patients with associated elbow injuries (e.g., ligamentous injuries, elbow dislocation) were included.
- Only reconstructable radial head fractures deemed suitable for fixation (ORIF) were considered for inclusion.

Exclusion Criteria

- Mason type I fractures (non-displaced fractures) were excluded to maintain consistency with the study objective focusing on operative management.
- Patients with previous elbow injury or deformity were excluded.
- Patients with pre-existing elbow arthritis were excluded.
- Patients with bilateral elbow injuries were excluded.

Sample Size and Selection

- Total patients assessed: 54
- Excluded: 18 patients (Mason type I fractures)
- Eligible patients: 36
- Lost to follow-up: 5
- Final sample size: 31 patients

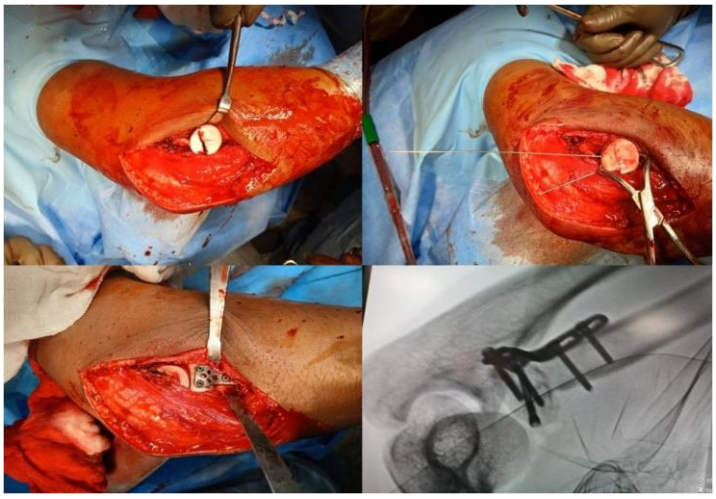

Figure 1: - Intraop photographs of plating radial head

Figure 2 : 6 weeks follow up photographs

Statistical Analysis: We put the data into Microsoft Excel and then used SPSS software version 27.0 (SPSS Inc., Chicago, IL, USA) and GraphPad Prism version 5 to look at it. Mean ± standard deviation was used to show continuous variables, and frequencies and percentages were used to show categorical variables. The unpaired t-test was utilized to examine continuous variables between independent groups, whereas the paired t-test was employed for comparisons within the same group. The Chi-square test or Fisher's exact test was used to look at categorical variables, depending on which one was better. A p-value of less than 0.05 was seen to be statistically important.

RESULT

Table 1. Demographic Profile of Patients (n = 54)

Variable	Category	Number	Percentage (%)	P-value
Age Group (years)	≤20	4	7.40%	**0.041**
	21–30	20	37.00%	
	31–40	18	33.30%	
	41–50	9	16.70%	
	51–60	3	5.60%	
Sex	Male	49	90.70%	**<0.001**
	Female	5	9.30%	

Table 2. Injury Characteristics

Variable	Category	Number	Percentage (%)	P-value
Mode of Injury	Slip & Fall	43	79.60%	**0.002**
	RTA	11	20.40%	
Mason Type	Type I	15	27.80%	**0.036**
	Type II	26	48.10%	
	Type III	8	14.80%	
	Type IV	5	9.30%	

Table 3. Associated Soft Tissue and Bony Injuries

Variable	Yes	No	Percentage (Yes)	P-value
LCL Injury	6	48	11.10%	**0.048**
MCL Injury	3	51	5.60%	
Associated Fractures	10	44	18.50%	

Table 4. Functional Outcome Scores (DASH & MEPI)

Time Interval	DASH Score (Mean ± SD)	MEPI Score (Mean ± SD)	P-value
Preoperative	1.2 ± 2.1	98.6 ± 3.2	
3 weeks	32.5 ± 8.4	56.8 ± 6.5	
6 weeks	23.1 ± 7.2	68.2 ± 7.1	**<0.001**
12 weeks	12.8 ± 6.5	78.5 ± 6.9	
24 weeks	4.2 ± 5.1	88.6 ± 7.3	

Table 5. Pain Assessment (VAS Score)

Time Interval	Mean ± SD	P-value
3 weeks	5.4 ± 1.2	
6 weeks	3.2 ± 1.1	**<0.001**
12 weeks	2.1 ± 0.8	
24 weeks	0.8 ± 0.9	

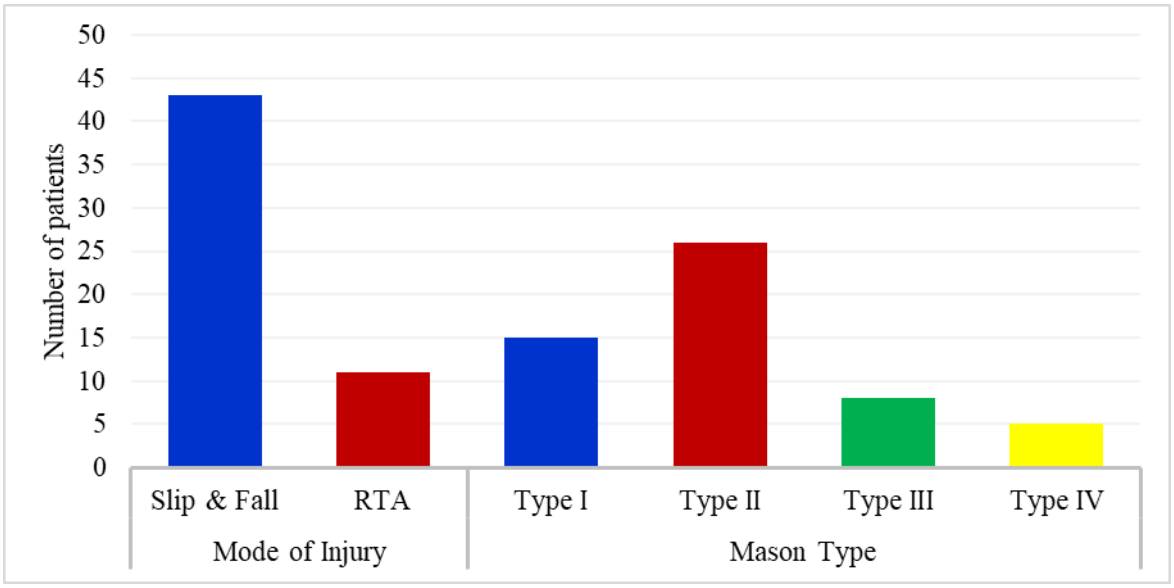

Figure: 1. Injury Characteristics

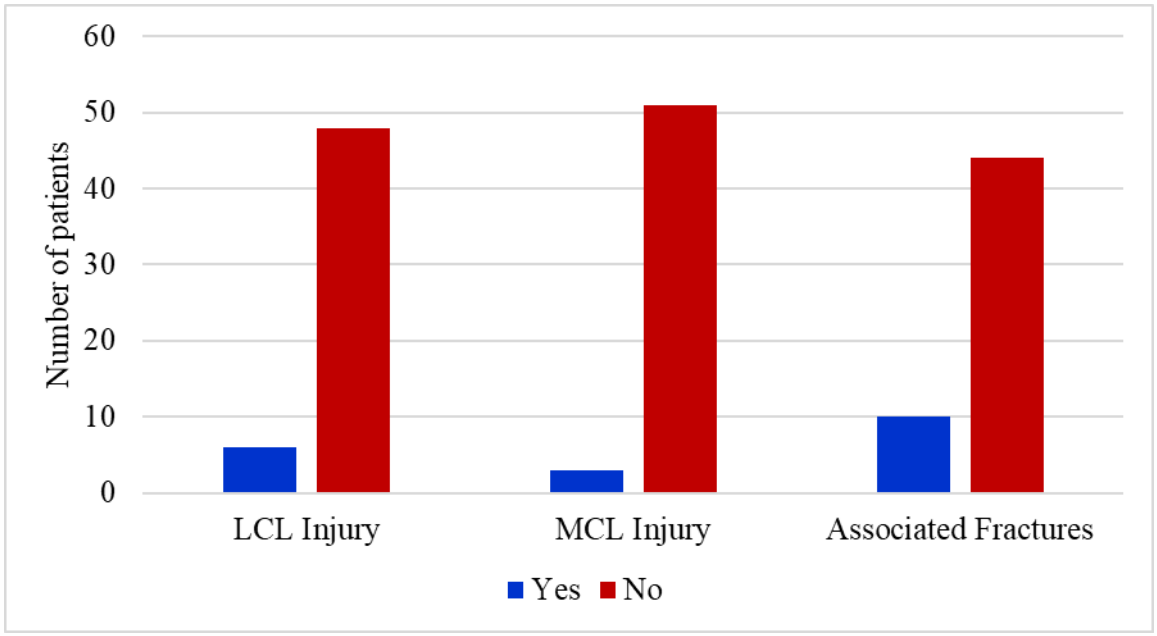

Figure: 2. Associated Soft Tissue and Bony Injuries

Table 1. Demographic Profile

The present study included a total of 54 patients. The majority of patients belonged to the younger age groups, with 21–30 years accounting for 20 patients (37.0%), followed by 31–40 years with 18 patients (33.3%). Patients aged 41–50 years constituted 9 cases (16.7%), while ≤20 years and 51–60 years groups comprised 4 (7.4%) and 3 (5.6%) patients,

respectively. The age distribution showed statistical significance (p = 0.041), indicating a higher prevalence among young adults.

In terms of sex distribution, there was a marked predominance of males, with 49 patients (90.7%), compared to 5 females (9.3%). This difference was statistically highly significant (p < 0.001), suggesting that males are more frequently affected in this cohort.

Table 2. Injury Characteristics
Regarding the mode of injury, the majority of cases were due to accidental slip and fall, observed in 43 patients (79.6%), whereas road traffic accidents (RTA) accounted for 11 patients (20.4%). This difference was statistically significant (p = 0.002), indicating that low-energy trauma was the predominant mechanism of injury.

Analysis of fracture type using Mason classification revealed that Type II fractures were the most common, seen in 26 patients (48.1%), followed by Type I fractures in 15 patients (27.8%). Type III and Type IV fractures were less frequent, observed in 8 (14.8%) and 5 (9.3%) patients, respectively. The distribution of fracture types was statistically significant (p = 0.036).

Table 3. Associated Injuries
Evaluation of associated soft tissue and bony injuries showed that lateral collateral ligament (LCL) injury was present in 6 patients (11.1%), while medial collateral ligament (MCL) injury was noted in 3 patients (5.6%). Additionally, associated fractures were identified in 10 patients (18.5%).

The occurrence of associated fractures was relatively higher compared to ligament injuries and reached statistical significance (p = 0.048), suggesting that concomitant bony injuries are an important consideration in these cases.

Table 4. Functional Outcome (DASH & MEPI)
Functional assessment using DASH and MEPI scores demonstrated significant improvement over the follow-up period. The mean DASH score increased from a preoperative value of 1.2 ± 2.1 to 32.5 ± 8.4 at 3 weeks, reflecting early postoperative disability, but subsequently showed progressive improvement with 23.1 ± 7.2 at 6 weeks, 12.8 ± 6.5 at 12 weeks, and 4.2 ± 5.1 at 24 weeks.

Conversely, the mean MEPI score decreased from a preoperative value of 98.6 ± 3.2 to 56.8 ± 6.5 at 3 weeks, indicating early postoperative impairment, but gradually improved to 68.2 ± 7.1 at 6 weeks, 78.5 ± 6.9 at 12 weeks, and 88.6 ± 7.3 at 24 weeks, approaching near-normal functional levels.

These changes in both DASH and MEPI scores were statistically highly significant (p < 0.001), indicating substantial functional recovery over time.

Table 5. Pain Assessment (VAS Score)
Pain assessment using the Visual Analog Scale (VAS) revealed a progressive decline in pain intensity over the follow-up period. The mean VAS score was 5.4 ± 1.2 at 3 weeks, which reduced to 3.2 ± 1.1 at 6 weeks, 2.1 ± 0.8 at 12 weeks, and further to 0.8 ± 0.9 at 24 weeks.

This steady reduction in pain scores was statistically highly significant (p < 0.001), demonstrating effective pain control and clinical improvement with the intervention.

DISCUSSION

In the present prospective interventional study evaluating radial head preservation using open reduction and internal fixation (ORIF) in Mason type II–IV fractures, the demographic profile demonstrated that the majority of patients belonged to the 21–40 years age group (70.3%), with a statistically significant distribution (p = 0.041). This observation is consistent with previous studies which report that radial head fractures predominantly occur in young, active individuals due to higher exposure to trauma [11,12]. The predominance of this age group is clinically relevant, as preservation of the radial head is particularly important in younger patients to maintain long-term elbow stability and function.

A marked male predominance (90.7%) observed in this study (p < 0.001) aligns with existing literature, reflecting increased exposure to high-energy activities and occupational hazards among males [13,14]. The most common mechanism of injury was accidental slip and fall (79.6%) (p = 0.002), consistent with the classical mechanism of axial loading across the radiocapitellar joint described in earlier studies [15,16].

Importantly, in accordance with the study design, only Mason type II, III, and IV fractures were included, with Mason type II fractures (48.1%) being the most prevalent (p = 0.036). These fractures are often amenable to fixation and represent ideal candidates for radial head preservation. Previous studies have similarly highlighted that Type II fractures constitute a substantial proportion of surgically managed cases and generally demonstrate favorable outcomes with ORIF [17,18].

The presence of associated injuries, particularly concomitant fractures (18.5%), was statistically significant ($p = 0.048$), whereas ligamentous injuries (LCL 11.1%, MCL 5.6%) were less frequent. This is consistent with reports emphasizing that associated osseous injuries significantly influence elbow stability and necessitate preservation of the radial head [19,20]. In such scenarios, ORIF plays a crucial role in restoring the structural integrity of the radiocapitellar articulation and preventing valgus instability.

Functional outcomes in the present study demonstrated a statistically significant improvement in DASH, MEPI, and VAS scores over time ($p < 0.001$), indicating the effectiveness of ORIF in restoring elbow function. The progressive reduction in DASH scores and improvement in MEPI scores reflect substantial recovery in daily functional activities, including lifting, gripping, and forearm rotation. The improvement in MEPI scores to a mean of 88.6 at 24 weeks suggests good to excellent functional outcomes, comparable to previously published studies evaluating ORIF in radial head fractures [13,14].

Pain reduction, as assessed by VAS, showed a significant decline from 5.4 ± 1.2 at 3 weeks to 0.8 ± 0.9 at 24 weeks ($p < 0.001$), indicating effective postoperative recovery and rehabilitation. Similar trends have been reported in earlier studies, reinforcing the role of stable fixation and early mobilization in reducing postoperative pain and improving patient satisfaction [12,18].

From a radiological perspective, fracture union was achieved in the majority of cases within the expected time frame, with minimal complications. Although detailed radiological parameters were not the primary focus, no significant incidence of avascular necrosis, secondary displacement, or implant failure was observed during follow-up. Additionally, no clinically significant heterotopic ossification or degenerative changes were noted. These findings are in agreement with previous ORIF studies, which report high union rates and low complication rates when stable fixation and appropriate surgical techniques are employed [17,18].

When compared to alternative treatment modalities, ORIF offers distinct advantages in reconstructable fractures. Radial head excision has historically been associated with complications such as proximal radial migration, wrist pain, and valgus instability, while radial head arthroplasty, although useful in irreparable fractures, carries risks of implant-related complications including loosening, overstuffing, and capitellar wear. Comparative studies suggest that ORIF provides superior functional outcomes in Mason type II and selected type III fractures when anatomical reduction is achievable [12,18]. Therefore, radial head preservation using ORIF remains the preferred treatment in reconstructable fractures, particularly in younger patients.

The clinical significance of the observed functional improvement lies in the restoration of a near-normal range of motion and return to activities of daily living. Most patients in the present study regained functional elbow motion arcs and were able to resume routine activities within the follow-up period, highlighting the effectiveness of ORIF combined with structured rehabilitation protocols.

Despite these encouraging results, certain limitations must be acknowledged. The study had a relatively small sample size and was conducted at a single center, which may limit generalizability. The follow-up duration was relatively short, precluding long-term assessment of degenerative changes or implant-related complications. Additionally, the absence of a comparative group limits the ability to directly compare treatment modalities.

Overall, the findings of this study support the growing body of evidence favoring radial head preservation using ORIF in Mason type II–IV fractures. The results underscore the importance of anatomical reduction, stable fixation, and early mobilization in achieving optimal functional outcomes, particularly in patients with reconstructable fractures and associated injuries.

CONCLUSION

The present prospective interventional study demonstrates that radial head preservation using ORIF in Mason type II–IV fractures results in significant improvement in functional outcomes, as evidenced by progressive reduction in DASH scores, improvement in MEPI scores, and marked pain reduction on VAS. These findings indicate effective restoration of elbow function, stability, and patient quality of life.Radial head preservation plays a critical role in maintaining elbow biomechanics, particularly in resisting valgus stress and axial load transmission, thereby preventing long-term complications such as instability and degenerative changes. The results of this study are consistent with existing literature, which supports ORIF as the preferred treatment modality in reconstructable radial head fractures, especially in young and active individuals.Based on the findings, ORIF is recommended as the treatment of choice in Mason type II and selected type III/IV fractures where anatomical reconstruction is feasible. It allows preservation of native anatomy, facilitates early mobilization, and yields favorable functional outcomes with minimal complications.However, the study is limited by a relatively small sample size, short follow-up duration, and lack of a comparative treatment group. Future research with larger, multicentric cohorts and long-term follow-up is required to further validate these findings and to compare ORIF with alternative modalities such as radial head arthroplasty.In conclusion, “saving the radial head” through ORIF remains a cornerstone in the management of reconstructable radial head fractures, offering optimal functional recovery while preserving elbow stability and biomechanics.

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