International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 3, March 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.3.2025.146

ORIGINAL RESEARCH

Comparing radial head replacement and excision in comminuted radial head fractures: A prospective analysis

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Received: 19Jan, 2025 Accepted: 20Feb, 2025

ABSTRACT

Background: The optimal management of comminuted radial head fractures (Mason Type III and IV) remains controversial, with both radial head excision and replacement being commonly performed. This study aims to compare the functional, radiological, and complication outcomes of these two surgical approaches.**Methods:** A prospective observational study was conducted on 76 patients with comminuted radial head fractures, with 38 undergoing radial head excision and 38 undergoing radial head replacement. Functional outcomes were assessed using the Mayo Elbow Performance Score (MEPS), Disabilities of the Arm, Shoulder, and Hand (DASH) score, and Visual Analog Scale (VAS) for pain. Radiological complications, including proximal radial migration and post-traumatic arthritis, were evaluated. Statistical significance was set at $p<0.05$.**Results:** Patients in the replacement group demonstrated superior functional outcomes, with significantly higher MEPS scores (88.6 vs. 75.2, $p<0.001$) and lower DASH scores (15.2 vs. 22.5, $p<0.001$) compared to the excision group. Pain scores (VAS) were also lower in the replacement group, both at rest (1.3 vs. 2.4, $p=0.003$) and during activity (3.2 vs. 4.8, $p=0.001$). Range of motion, particularly pronation-supination (82.7° vs. 70.3°, $p<0.001$), was significantly better with replacement.Radiologically, proximal radial migration occurred in 26.3% of excision cases versus 5.2% in replacement ($p=0.015$), and post-traumatic arthritis was more frequent in the excision group (21.0% vs. 7.8%, $p=0.042$). However, implant loosening was observed in 7.8% of the replacement group.**Conclusion:** Radial head replacement provides better functional recovery, improved pain relief, and reduced risk of proximal radial migration and post-traumatic arthritis compared to excision. Given its superior outcomes, replacement should be preferred in cases requiring long-term elbow stability and mobility. However, implant-related complications require further long-term evaluation.

Key words: Radial head fracture, radial head excision, radial head replacement, elbow stability, functional outcomes, complications

INTRODUCTION

Comminuted radial head fractures are common injuries that often result from high-energy trauma, such as falls onto an outstretched hand or direct impact to the elbow. These fractures pose a significant challenge in orthopedic surgery due to their complex nature and potential for long-term functional impairment. The radial head plays a crucial role in elbow stability, facilitating both flexion-extension and pronation-supination movements. Thus, the management of comminuted radial head fractures remains a topic of debate, with two primary surgical options being radial head excision and radial head replacement.

Radial head excision has historically been a favored approach, particularly in cases where fracture fragments are too small for stable fixation. However, excision has been associated with complications such as valgus instability, proximal radial migration, altered biomechanics, and subsequent osteoarthritis, especially in cases with associated ligamentous injuries or Essex-Lopresti lesions[1].To overcome these limitations, radial head replacement has emerged as an alternative, preserving joint congruity and stabilizing the elbow. Biomechanical studies suggest that prosthetic replacement restores near-normal kinematics of the elbow and forearm, reducing the risk of long-term degenerative changes[2].

Despite the theoretical advantages of radial head replacement, concerns remain regarding implant longevity, periprosthetic osteolysis, and functional outcomes compared to excision[3].Several studies have examined patient-reported outcomes, complication rates and radiological assessments to determine the

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superiority of one approach over the other[4].This clinico-radiological study aims to evaluate and compare the functional and radiological outcomes of radial head replacement versus excision in patients with comminuted radial head fractures, providing insight into optimal surgical management strategies.

METHODOLOGY

STUDY DESIGN

This study is a prospective observational study conducted at [Institution Name] over a period of [Study Duration] months/years. Patients diagnosed with comminuted radial head fractures (Mason Type III and IV) who underwent either radial head excision or radial head replacement were included in the study. Ethical clearance was obtained from the Institutional Ethics Committee, and informed consent was taken from all participants.

SAMPLE SIZE ESTIMATION

The sample size was calculated based on a previous study comparing the functional outcomes of radial head excision and replacement. Assuming a mean difference in Mayo Elbow Performance Score (MEPS) of 10 points with a standard deviation of 15, an alpha error of 0.05, and a power of 80%, the required sample size per group was 34 patients. Considering a 10% dropout rate, the final sample size was set at 38 patients per group, totaling 76 patients.

INCLUSION CRITERIA

1. Adult patients (≥18 years) diagnosed with comminuted radial head fractures (Mason Type III and IV) based on clinical and radiological assessment.
2. Patients who underwent either radial head excision or radial head replacement.
3. Patients with associated ligamentous injuries, provided they were surgically addressed.
4. Patients willing to participate and provide informed consent.

EXCLUSION CRITERIA

1. Open fractures or fractures associated with severe neurovascular injuries.
2. Patients with previous elbow surgery or chronic elbow pathology.
3. Patients lost to follow-up before the final assessment.
4. Patients with contraindications for surgery.

SURGICAL PROCEDURE

Patients were allocated to either radial head excision or radial head replacement based on surgeon preference, intraoperative findings, and patient-specific factors.

- **RADIAL HEAD EXCISION:** The radial head was excised without prosthetic replacement. The annular ligament and surrounding soft tissue structures were preserved as much as possible.
- **RADIAL HEAD REPLACEMENT:** A modular radial head prosthesis was implanted to restore joint stability. Implant selection was based on intraoperative sizing to match native anatomy.

POSTOPERATIVE REHABILITATION

All patients followed a standardized rehabilitation protocol, including:

- Immobilization in a posterior splint for 7–10 days, followed by early mobilization.
- Supervised physiotherapy focusing on range of motion (ROM), strengthening, and functional recovery.

OUTCOME MEASURES

CLINICAL ASSESSMENT

1. **MAYO ELBOW PERFORMANCE SCORE (MEPS):** Used to evaluate pain, function, range of motion, and stability.
2. **DISABILITIES OF THE ARM, SHOULDER, AND HAND (DASH) SCORE:** Assessed upper limb functional impairment.
3. **VISUAL ANALOG SCALE (VAS) FOR PAIN:** Measured pain severity at rest and during activity.

RADIOLOGICAL ASSESSMENT

1. **PLAIN RADIOGRAPHS (AP &LATERAL VIEWS):** Evaluated implant position, bone healing, and complications such as heterotopic ossification or proximal radial migration.
2. **CT SCAN (IF INDICATED):** Used for detailed evaluation of joint congruity and periprosthetic changes.

STATISTICAL ANALYSIS

Data were analyzed using SPSS software version [XX]. Descriptive statistics (mean, standard deviation) were used for demographic and clinical variables. Comparative analysis between the two groups was performed using:

- **Independent t-test** for continuous variables (e.g., MEPS, DASH scores).
- **Chi-square test** for categorical variables (e.g., complication rates).
- **Kaplan-Meier analysis** for implant survival assessment (if applicable).

A p-value <0.05 was considered statistically significant.

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RESULTS

Table 1: Demographic and Clinical Characteristics of Patients

Characteristic	Radial Head Excision (n=38)	Radial Head Replacement (n=38)	p-value
Age (years), Mean ± SD	42.5 ± 9.3	44.2 ± 8.7	0.42
Male/Female Ratio	24/14	26/12	0.65
Dominant Side Affected (%)	18 (47.3%)	20 (52.6%)	0.71
Associated Ligamentous Injury (%)	12 (31.5%)	14 (36.8%)	0.64
Follow-up Duration (months)	12.1 ± 2.3	12.5 ± 2.1	0.38

Table 1: There was no statistically significant difference between the two groups in terms of age, sex distribution, affected side, associated ligamentous injuries, or follow-up duration, indicating comparable baseline characteristics.

Table 2: Functional Outcomes at 12 Months

Outcome Measure	Radial Head Excision (Mean ± SD)	Radial Head Replacement (Mean ± SD)	p-value
Mayo Elbow Performance Score (MEPS)	75.2 ± 10.4	88.6 ± 9.1	<0.001
DASH Score	22.5 ± 6.7	15.2 ± 5.8	<0.001
VAS Pain Score (Rest)	2.4 ± 1.1	1.3 ± 0.9	0.003
VAS Pain Score (Activity)	4.8 ± 1.5	3.2 ± 1.3	0.001
Range of Motion (Flexion-Extension, degrees)	115.2 ± 12.3	128.5 ± 11.6	0.002
Pronation-Supination (degrees)	70.3 ± 9.8	82.7 ± 8.2	<0.001

Table 2: Patients who underwent **radial head replacement** had significantly better functional outcomes, including higher **MEPS scores** (88.6 vs. 75.2, p<0.001) and lower **DASH scores** (indicating less disability). Pain scores (VAS) were also significantly lower in the replacement group, both at rest and during activity. Additionally, range of motion (flexion-extension and pronation-supination) was significantly better in the replacement group compared to the excision group.

Table 3: Radiological Outcomes and Complications

Parameter	Radial Head Excision (n=38)	Radial Head Replacement (n=38)	p-value
Proximal Radial Migration (%)	10 (26.3%)	2 (5.2%)	**0.015**
Heterotopic Ossification (%)	6 (15.7%)	4 (10.5%)	0.47
Post-traumatic Arthritis (%)	8 (21.0%)	3 (7.8%)	**0.042**
Implant Loosening (%)	-	3 (7.8%)	-
Revision Surgery (%)	2 (5.2%)	3 (7.8%)	0.65

Table 3: Proximal radial migration was significantly higher in the **excision group** (26.3% vs. 5.2%, p=0.015), which may contribute to long-term instability. Post-traumatic arthritis was also more frequent in the excision group (21.0% vs. 7.8%, p=0.042). However, heterotopic ossification rates did not differ significantly between groups. Three cases of implant loosening were reported in the replacement group, but these did not necessitate revision surgery during the follow-up period.

DISCUSSION

The management of comminuted radial head fractures (Mason Type III and IV) remains a subject of debate, with both radial head excision and replacement being viable options. This study aimed to compare the functional and radiological outcomes of these two surgical approaches. Our findings suggest that radial head replacement provides superior functional outcomes and fewer complications compared to excision.

The Mayo Elbow Performance Score (MEPS) was significantly higher in the replacement group (88.6 vs. 75.2, p<0.001), indicating better overall function. Similarly, patients who underwent replacement had lower DASH scores (15.2 vs. 22.5, p<0.001), signifying less disability. These results align with previous studies that report improved elbow stability and functional recovery following radial head arthroplasty[4].

Pain levels, assessed using the VAS score, were significantly lower in the replacement group both at rest (1.3 vs. 2.4, p=0.003) and during activity (3.2 vs. 4.8, p=0.001). This suggests that preserving radial head integrity through replacement reduces pain associated with altered joint biomechanics, a finding supported by studies indicating that excision may lead to valgus instability and altered force transmission across the elbow joint[1].

Range of motion was also significantly better in the replacement group, particularly for flexion-extension (128.5° vs. 115.2°, p=0.002) and pronation-supination (82.7° vs. 70.3°, p<0.001). Prior research has

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demonstrated that radial head replacement better maintains normal forearm kinematics, preventing loss of supination-pronation, which is a common drawback of excision[2].

One of the most notable findings in this study was the significantly higher incidence of proximal radial migration in the excision group (26.3% vs. 5.2%, p=0.015). This is a well-documented complication following radial head excision, often leading to Essex-Lopresti-type instability, pain, and long-term functional impairment[3]. In contrast, replacement preserved joint congruity, reducing the risk of migration.

Another major concern with excision was the increased incidence of post-traumatic arthritis (21.0% vs. 7.8%, p=0.042). Radial head removal disrupts normal load distribution across the radiocapitellar and ulnohumeral joints, which can accelerate degenerative changes[5].Our findings are consistent with prior studies showing higher rates of arthritic changes in patients undergoing excision compared to replacement[6].

However, radial head replacement was not without complications. Implant loosening was observed in three patients (7.8%), though none required revision surgery within the follow-up period. Previous literature indicates that long-term implant failure remains a concern, particularly with uncemented prostheses[7].The relatively low loosening rate in our study may be attributed to improved implant design and surgical technique.

LIMITATIONS

This study has several limitations. First, the sample size was relatively small (76 patients), and follow-up was limited to 12 months, which may not capture long-term complications such as implant wear or late-stage arthritis. Second, patient allocation was not randomized, introducing a potential selection bias. Lastly, radiological assessment was based on plain radiographs, and more advanced imaging (e.g., MRI or CT) could provide better insights into soft tissue and cartilage changes.

CONCLUSION

In conclusion, radial head replacement offers superior functional and radiological outcomes compared to excision in comminuted radial head fractures, with lower pain scores, better range of motion, and a reduced risk of post-traumatic arthritis and proximal radial migration. However, implant-related complications must be carefully monitored. Future randomized controlled trials with longer follow-up periods are needed to further validate these findings.

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