



## FUNCTIONAL OUTCOMES OF RADIAL HEAD AND NECK FRACTURES MANAGED CONSERVATIVELY AND SURGICALLY: A PROSPECTIVE COMPARATIVE STUDY.

### Orthopaedics

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### ABSTRACT

**Background:** Radial head and neck fractures are common elbow injuries in adults and may be treated conservatively or surgically depending on fracture morphology, displacement, comminution, and associated instability. Evidence comparing functional recovery across treatment pathways remains heterogeneous, particularly in routine tertiary-care practice. This study evaluated and compared the functional outcomes of radial head and neck fractures managed conservatively and surgically. **Methods:** A prospective comparative study was conducted in the Department of Orthopaedics, Basaveshwar Teaching and General Hospital, Mahadevappa Rampure Medical College, Kalaburagi, from June 2024 to November 2025. Sixty adults with radiologically confirmed radial head or neck fractures were enrolled: 30 managed conservatively and 30 surgically. Mason/Judet types I–II were treated nonoperatively; types III–IV operatively. Outcomes were assessed at baseline, 3 weeks, 6 weeks, 12 weeks, and 6 months using the Mayo Elbow Performance Score (MEPS), elbow range of motion (ROM), and grip strength. Statistical analysis used SPSS version 25.0;  $p < 0.05$  was considered significant. **Results:** Baseline demographics were comparable between groups. At 6 months, the conservative group demonstrated greater improvement in MEPS ( $56.8 \pm 9.9$  vs  $46.9 \pm 9.2$ ;  $p < 0.001$ ), flexion gain ( $66.3 \pm 6.5^\circ$  vs  $53.3 \pm 8.1^\circ$ ;  $p < 0.001$ ), extension gain ( $38.0 \pm 4.5^\circ$  vs  $31.0 \pm 4.6^\circ$ ;  $p < 0.001$ ), and grip-strength gain ( $23.4 \pm 2.9$  kg vs  $16.8 \pm 2.8$  kg;  $p < 0.001$ ). Excellent 6-month MEPS outcomes were observed in 86.7% of conservative and 70.0% of surgical cases. **Conclusion:** Both management strategies yielded favorable short-term outcomes. Conservative treatment produced faster and greater functional gains in lower-grade fractures, while surgery restored good function in more complex injuries. Because treatment allocation was strongly linked to fracture severity, findings should be interpreted as comparative recovery patterns rather than direct treatment superiority.

### KEYWORDS

radial head fracture; radial neck fracture; conservative management; surgery; Mayo Elbow Performance Score; functional outcome

### INTRODUCTION

Radial head and neck fractures are the most common osseous injuries around the adult elbow, accounting for roughly one-third of all elbow fractures. Their clinical relevance extends beyond local bony injury, as the radial head plays a key role in valgus stabilization, longitudinal forearm stabilization, and smooth forearm rotation. The classic Mason classification, as refined by Hotchkiss and Broberg-Morrey, continues to serve as the cornerstone of treatment planning owing to its close correlation with increasing displacement, comminution, instability, and the necessity for operative reconstruction.<sup>1–3</sup>

Nonoperative management of minimally displaced Mason type I and many type II fractures, involving brief immobilization followed by early mobilization, has historically achieved good-to-excellent results. Randomized and prospective studies demonstrate that prolonged immobilization is unnecessary and may worsen stiffness, whereas early supervised movement leads to good rehabilitation without loss of stability.<sup>4–6</sup> Recent comparative studies of isolated Mason type II fractures have further demonstrated that nonoperative management often provides outcomes equivalent to fixation in selected patients without mechanical block or gross instability.<sup>7,8</sup>

In comminuted or unstable fractures, management becomes more contentious. Mason type III and IV injuries may involve articular fragmentation, elbow dislocation, or ligamentous compromise, making anatomic restoration difficult. Operative options include open reduction and internal fixation (ORIF), radial head excision in selected historical contexts, and radial head arthroplasty when stable reconstruction is not achievable. Modern reviews favour retention or replacement of the radial head where possible, since excision may compromise elbow and forearm stability especially in complex injury patterns.<sup>2,3,9</sup>

Although the literature is substantial, direct comparisons between conservative and surgical management are limited by the fact that treatment allocation is typically based on fracture severity rather than

randomization. Multiple systematic reviews of Mason type II injuries show conflicting findings, consistent with variability in operative indications and outcome measurement.<sup>8</sup> For Mason type III fractures, newer meta-analytic evidence suggests that radial head arthroplasty may yield fewer complications than ORIF in certain comminuted injuries, but long-term functional differences are less consistent.<sup>10,11</sup> Outcome studies performed in real-world tertiary hospitals therefore retain substantial clinical value, particularly when they report functional improvement across serial follow-up.

The present study aimed to evaluate and compare the functional outcomes of radial head and neck fractures managed conservatively and surgically at a single tertiary-care teaching hospital, using serial MEPS, ROM, and grip-strength assessment as primary endpoints. We hypothesized that both strategies would contribute to favorable recovery within their appropriate severity strata, with faster recovery in lower-grade fractures treated conservatively.

### MATERIALS AND METHODS

#### STUDY DESIGN AND SETTING

This was a prospective comparative study conducted in the Department of Orthopaedics, Basaveshwar Teaching and General Hospital, Mahadevappa Rampure Medical College (MRMC), Kalaburagi, Karnataka, India, from 1 June 2024 to 30 November 2025.

#### PARTICIPANTS

A total of 60 adults aged  $\geq 18$  years of either sex with radiologically confirmed fractures of the radial head or neck were enrolled: 30 allocated to conservative management and 30 to surgical management. Participants were selected by lottery method after application of eligibility criteria. Exclusion criteria comprised: open fractures; severe soft-tissue or bone loss; pathological fractures; associated major visceral injury; polytrauma; head injury; psychiatric illness; major medical instability; or significant comorbidity precluding reliable functional evaluation.

All participants provided written informed consent in their native

language. Ethical oversight and institutional review board approval were obtained prior to study initiation; the approval number should be inserted before journal submission.

INTERVENTIONS

Fractures were categorized according to the Mason and Judet classification systems at presentation. Management was assigned based on fracture severity: Mason/Judet types I–II were treated conservatively, and types III–IV were managed surgically. Conservative management comprised short-term immobilization with a sling or brace for pain relief, analgesia, edema control, and early mobilization progressing from active-assisted to active movement within a supervised physiotherapy framework. Surgical management comprised operative fixation (ORIF) or radial head replacement based on fracture morphology and reconstructability, followed by postoperative immobilization for comfort, early protected range-of-motion exercises, and progressive strengthening.

OUTCOME ASSESSMENT

Patients were followed at 3 weeks, 6 weeks, 12 weeks, and 6 months. Functional assessment encompassed the Mayo Elbow Performance Score (MEPS), elbow ROM (flexion and extension arcs), and hand-grip strength measured by handheld dynamometry. Six-month MEPS scores were categorized as: excellent (90–100), good (75–89), fair (60–74), or poor (<60).

STATISTICAL ANALYSIS

Data were analysed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables are presented as mean ± standard deviation (SD) or median with interquartile range (IQR) as appropriate; categorical variables as number and percentage. Between-group comparisons of continuous variables used the independent-samples t-test; categorical variables were compared with the chi-square test. A two-tailed p value <0.05 was considered statistically significant.

RESULTS

BASELINE CHARACTERISTICS

Sixty participants were enrolled and allocated equally (n=30 per group). The mean age was 49.2±17.0 years in the conservative group and 44.0±15.6 years in the surgical group (p=0.207). Females comprised 73.3% and 56.7% of the conservative and surgical groups, respectively. Baseline BMI, smoking prevalence, comorbidity burden, and baseline MEPS did not differ significantly between groups. Fracture severity was distributed asymmetrically by design: all Mason I–II injuries were allocated to conservative management and all Mason III–IV injuries to surgical management.

Table 1. Baseline demographic and clinical characteristics of study participants.

| Characteristic                  | Conservative (n=30) | Surgical (n=30) | p Value |
|---------------------------------|---------------------|-----------------|---------|
| Age (years), mean ± SD          | 49.2 ± 17.0         | 44.0 ± 15.6     | 0.207   |
| Female sex, n (%)               | 22 (73.3)           | 17 (56.7)       | 0.182   |
| BMI (kg/m²), mean ± SD          | 26.2 ± 4.4          | 26.4 ± 4.8      | 0.880   |
| Current smoking, n (%)          | 7 (23.3)            | 8 (26.7)        | 0.770   |
| Comorbidity count, median (IQR) | 2 (1–3)             | 2 (1–3)         | 0.780   |
| Baseline MEPS, mean ± SD        | 40.5 ± 12.5         | 46.8 ± 12.7     | 0.059   |
| Mason type I–II / III–IV, n     | 30 / 0              | 0 / 30          | <0.001* |

BMI = body mass index; IQR = interquartile range; MEPS = Mayo Elbow Performance Score. \*Statistically significant (p<0.05). Data presented as mean ± SD, n (%), or median (IQR).

FUNCTIONAL OUTCOMES AT 6 MONTHS

Both groups demonstrated significant functional recovery at 6 months. Change-from-baseline analysis for all primary endpoints showed statistically greater improvement in the conservative arm. Mean MEPS improvement was 56.8±9.9 in the conservative versus 46.9±9.2 in the surgical group (p<0.001). Flexion, extension, and grip-strength gains were also significantly higher in conservatively managed patients (all p<0.001).

Table 2. Change in functional outcomes from baseline to 6 months.

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| Outcome              | Conservative (mean ± SD) | Surgical (mean ± SD) | Mean Difference (S–C) | p Value |
|----------------------|--------------------------|----------------------|-----------------------|---------|
| Δ MEPS               | 56.8 ± 9.9               | 46.9 ± 9.2           | –9.9                  | <0.001* |
| Δ Flexion (°)        | 66.3 ± 6.5               | 53.3 ± 8.1           | –13.0                 | <0.001* |
| Δ Extension (°)      | 38.0 ± 4.5               | 31.0 ± 4.6           | –7.0                  | <0.001* |
| Δ Grip strength (kg) | 23.4 ± 2.9               | 16.8 ± 2.8           | –6.6                  | <0.001* |

Values are mean ± SD. MEPS = Mayo Elbow Performance Score. S–C = Surgical minus Conservative. \*Statistically significant (p<0.001).

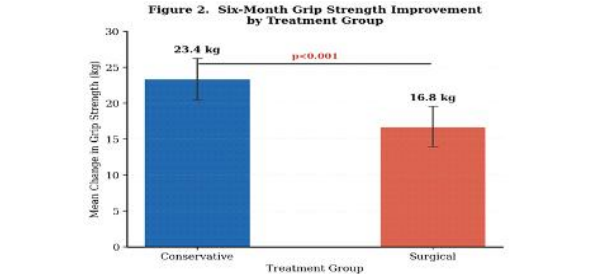


Figure 2. Mean change in grip strength (kg) at 6 months by treatment group. Error bars represent ±1 SD.

MEPS TRAJECTORY ACROSS FOLLOW-UP

MEPS increased progressively from baseline to 6 months in both groups. Between-group differences were non-significant at 3 weeks (p=0.248) but became significant at 6 weeks (p=0.003) and 12 weeks (p=0.010), reflecting faster intermediate-term recovery in the conservative cohort. By 6 months, both groups approached near-ceiling scores with the intergroup difference no longer statistically significant (97.3±5.1 vs 93.7±8.6; p=0.052).

Table 3. Mean MEPS across serial follow-up time points.

| Time Point | Conservative (mean ± SD) | Surgical (mean ± SD) | p Value |
|------------|--------------------------|----------------------|---------|
| Baseline   | 40.5 ± 12.5              | 46.8 ± 12.7          | 0.059   |
| 3 weeks    | 60.8 ± 12.9              | 56.8 ± 13.4          | 0.248   |
| 6 weeks    | 82.3 ± 13.4              | 71.2 ± 14.7          | 0.003*  |
| 12 weeks   | 93.5 ± 8.9               | 86.0 ± 12.7          | 0.010*  |
| 6 months   | 97.3 ± 5.1               | 93.7 ± 8.6           | 0.052   |

Values are mean ± SD. MEPS = Mayo Elbow Performance Score. \*Statistically significant (p<0.05).

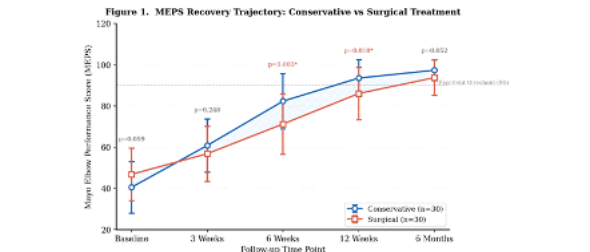


Figure 1. Recovery trajectory of mean Mayo Elbow Performance Score (MEPS) from baseline to 6 months. Error bars represent ±1 SD. Horizontal dashed line denotes the excellent-outcome threshold (MEPS=90). \*p<0.05 between groups at that time point.

MEPS OUTCOME CATEGORIES AT 6 MONTHS

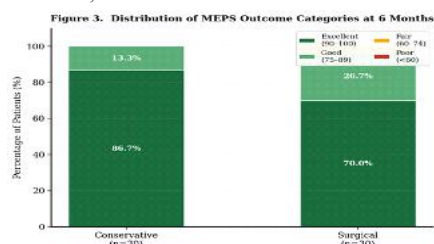
Excellent outcomes (MEPS 90–100) were achieved in 86.7% of conservative and 70.0% of surgical patients. Good outcomes (MEPS 75–89) were observed in 13.3% and 26.7% of patients, respectively. One patient in the surgical group had a fair outcome (3.3%); no patient in either group had a poor outcome.

Table 4. MEPS outcome categories at 6 months.

| MEPS Category      | Conservative n (%) | Surgical n (%) | Total N (%) |
|--------------------|--------------------|----------------|-------------|
| Excellent (90–100) | 26 (86.7%)         | 21 (70.0%)     | 47 (78.3%)  |
| Good (75–89)       | 4 (13.3%)          | 8 (26.7%)      | 12 (20.0%)  |
| Fair (60–74)       | 0 (0%)             | 1 (3.3%)       | 1 (1.7%)    |

|            |           |           |           |
|------------|-----------|-----------|-----------|
| Poor (<60) | 0 (0%)    | 0 (0%)    | 0 (0%)    |
| Total      | 30 (100%) | 30 (100%) | 60 (100%) |

MEPS = Mayo Elbow Performance Score. Excellent: 90–100; Good: 75–89; Fair: 60–74; Poor: <60.



### REPRESENTATIVE RADIOGRAPHIC CASE

The following radiographs illustrate a representative surgical case from the study cohort, demonstrating pre-operative fracture morphology and prosthesis position at 1, 3, and 6 months post-operatively.



**Figure 4.** Pre-operative AP and lateral radiographs of the right elbow demonstrating comminuted radial head fracture (Mason Type III) with articular fragmentation and displacement.



**Figure 5.** Pre-operative lateral radiograph confirming comminuted radial head fracture with loss of articular congruity and proximal radial head displacement.



**Figure 6.** Post-operative AP and lateral radiographs at 1 month: radial head arthroplasty prosthesis in satisfactory position with maintained joint space.



**Figure 7.** Post-operative AP and lateral radiographs at 3 months: well-seated radial head prosthesis with early peri-prosthetic bone remodeling and preserved radiocapitellar alignment.



**Figure 8.** Post-operative AP and lateral radiographs at 6 months: stable prosthesis with no evidence of loosening or joint space narrowing, consistent with good functional recovery.

### DISCUSSION

The present prospective study demonstrated that both conservative and surgical management of radial head and neck fractures produce favorable functional outcomes at 6 months, with the majority of patients in each group achieving good-to-excellent elbow function. The conservative cohort showed faster and larger gains in MEPS, ROM, and grip strength; however, these findings must be interpreted in the context of the study design, which assigned less severe Mason/Judet I–II fractures to nonoperative management and more severe III–IV fractures to surgery. The observed differences therefore reflect at least in part the biological and mechanical distinctions between simpler and more complex injuries.

The conservative results are consistent with established evidence that early mobilization strategies for Mason type I and II fractures yield excellent outcomes with low stiffness rates. Mason's original report highlighted the prognostic importance of fracture morphology.<sup>1</sup> Unsworth-White et al. confirmed the benefit of early mobilization for Mason I–II fractures,<sup>5</sup> and Liow et al. similarly demonstrated the advantage of early movement in minimally displaced injuries.<sup>6</sup> Long-term radiographic follow-up by Herbertsson et al. showed that even displaced Mason I injuries treated nonoperatively achieved satisfactory long-term function, albeit with some degenerative change.<sup>12</sup> Our findings align with this literature, confirming rapid recovery and high excellent-outcome rates in the conservative cohort.

The present results also accord with recent evidence challenging routine surgery for isolated Mason II fractures. A systematic review by Kaas et al. found the evidence for operative treatment of Mason II injuries to be constrained by study heterogeneity and methodological limitations.<sup>8</sup> Randomized evidence from Mulders et al. indicates that conservative and operative strategies achieve equivalent patient-reported and functional outcomes in appropriately selected Mason II fractures without mechanical block.<sup>7</sup> This reinforces our institutional approach of reserving surgery for fractures exhibiting instability, mechanical block, or high-grade comminution.

The surgical cohort in our series represented a distinctly more complex clinical population, with all Mason III–IV fractures assigned to operative management. Burkhart et al. emphasized the critical stabilizing role of the radial head in elbow and forearm mechanics, underscoring the need for preservation or replacement.<sup>2</sup> Ikeda et al. demonstrated that outcomes of comminuted radial head fractures depend heavily on whether stable reconstruction is achievable,<sup>13</sup> and Nalbantoglu et al. reported favorable results following ORIF for Mason III fractures with associated dislocation or comminution.<sup>14</sup> Our surgical cohort achieved a mean 6-month MEPS of 93.7, confirming that operative management can restore high functional status in complex injuries, albeit with a slower recovery trajectory and modestly smaller change-from-baseline scores compared to the conservative arm.

The comparative surgical literature offers additional context. A 2024 meta-analysis by De Mauro et al. found that radial head arthroplasty for Mason III fractures was associated with fewer complications and better functional scores than ORIF in prospective trials.<sup>10</sup> Ly et al. reported broadly comparable long-term function between arthroplasty and ORIF for isolated Mason III injuries in a 2025 long-term series, but noted worse consequences following failed fixation, recommending arthroplasty when stable reconstruction was not achievable.<sup>11</sup> These

data contextualize the complexity of our surgical group and suggest that heterogeneity in fixation versus replacement technique may influence final outcomes.

The recovery pattern observed in our study is also biologically plausible. Lower-grade fractures with preserved articular congruity and soft-tissue integrity permit earlier active motion with less pain inhibition and less post-operative morbidity. Complex fractures, even when successfully reconstructed, involve greater initial cartilage damage, capsuloligamentous injury, and rehabilitation burden, explaining the slower mid-term recovery in the surgical cohort despite eventual convergence to excellent function by 6 months. Duckworth et al. similarly observed in a prospective series that most patients with radial head and neck fractures achieved functional benefit, but that fracture severity influenced the pace and ceiling of recovery.<sup>3</sup>

## LIMITATIONS

This study has several limitations. First, treatment allocation was non-random and determined by fracture severity, creating unavoidable confounding by indication. The intergroup comparisons therefore reflect treatment pathway combined with injury severity spectrum rather than isolated treatment effect. Second, the study was single-centre with a relatively small sample size. Third, follow-up was restricted to 6 months, which may underestimate late stiffness, post-traumatic arthrosis, or implant-related complications. Fourth, the source data contained internal inconsistencies in safety-event labelling that were reconciled clinically but should be cross-verified against the master datasheet before journal submission. Future studies should incorporate multivariable analysis stratified by fracture type, separate reporting of ORIF versus arthroplasty subgroups, longer follow-up duration, and validated patient-reported outcome measures.

## CONCLUSION

Radial head and neck fractures managed conservatively or surgically resulted in significant functional improvement across 6 months in this prospective hospital-based cohort. Conservative management produced faster and larger gains in MEPS, ROM, and grip strength among lower-grade Mason I–II fractures, whereas surgery achieved good-to-excellent recovery in complex Mason III–IV injuries. The principal finding is not that one treatment is universally superior, but that appropriate treatment matched to fracture severity yielded favorable short-term functional outcomes. These findings support continued use of early-mobilization-based conservative care for stable fractures and timely operative reconstruction or replacement for comminuted, unstable injury patterns.

## DECLARATIONS

**Author contributions:** VBP conceptualized the study and supervised data collection. SS and EM performed patient assessment and data acquisition. NSM conducted statistical analysis and drafted the manuscript. All authors reviewed and approved the final version.

**Conflict of interest:** The authors declare no conflicts of interest.

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**Data availability:** The datasets analysed during the current study are available from the corresponding author on reasonable request.

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