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Clinical Outcome and Patient Satisfaction of Unipolar Radial Head Replacement: A longitudinal study

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ABSTRACT

Introduction: Excision of the radial head was frequently indicated in the past, as the radial head was considered to have a minimal role in the stability and biomechanics of the elbow. Now, it has been established that the radial head has an important role, and its removal has shown to alter the stability and biomechanics, due to which surgeons are motivated to preserve or replace the radial head during fracture management.

Objectives: This study aims to study the short-term clinical outcome and patient satisfaction of radial head replacement with prosthesis.

Methodology: This study was conducted among patients who underwent radial head arthroplasty. A study tool was prepared for data collection, and the data was refined in Excel and analyzed using SPSS 20. Outcomes were assessed by using different parameters like range of motion, mayo elbow performance score, time to return to work, patient satisfaction, and complications.

Results: This study had sixteen participants with a mean age of 40.19 ± 11.391 and a male-to-female ratio of 3:1. Mayo Elbow Performance Scores (MEPS) had a median (IQR) score of 85 (80-96.25). The median for extension was 5°, for flexion was 140°, and for both pronation and supination was 80°. The median time taken for return to work was two months, and 12.5% of the patients reported being dissatisfied.

Conclusion: Radial head arthroplasty preserves the elbow stability and re-establishes normal functioning of the elbow after radial head fracture Mason type III.

INTRODUCTION

Not very long ago, in the past, excision of the radial head was frequently indicated, as the radial head was considered to have a minimal role in the stability and biomechanics of the elbow.[1] But it has been established that the radial head has an important role. Removal of the radial head has been shown to alter the stability and biomechanics, more significantly when soft-tissue stabilisers are also affected.[2] Radial head injury can result in loss of elbow functioning, and patients can also have persistent pain in the elbow.[3,4] Radial head fractures are estimated to have a burden of 2.8 per 10,000 individuals per year[5], and they represents about one-third of elbow fractures.[1] This becomes more important as the vast majority of the patients are of young age or a population of active age-group.[6] With consideration of the important role played by the radial head in the functioning of the elbow, which in turn reflects the functioning of the whole arm and the productivity of the person, surgeons are motivated to preserve the radial head during fracture management.[7] Radial head fractures are classified as type I, type

II, type III (IIIa, IIIb, and IIIc) and type IV according to the Mason classification (also known as Mason-Johnston classification) and this classification is handy while assessing the treatment option. Type I can be treated conservatively; type II needs open reduction and internal fixation, while type III requires complete excision of the radial head.[8,9] This study aims to study the short-term clinical outcome and patient satisfaction of radial head replacement with a prosthesis.

METHODOLOGY

This prospective longitudinal study was conducted in a tertiary level referral centre. Patients coming to or referred to orthopaedic department of our center for radial head replacement were part of this study. The study took place from 19th May, 2023 to 20th May, 2024. This study is in line with the Declaration of Helsinki and ethical clearance for the study was obtained from Institutional Review Committee of our center (Ref no: 813/2023). All the participants were made aware regarding the nature of the study and consent was taken from them for collection and publication of the data. Patient's confidentiality was maintained throughout the study.

For the selection of the patients for this study, a time period of twelve months was predetermined, and patients who visited the hospital for surgery and those who fulfilled the inclusion criteria were selected as the participants of this study. As per the predetermined period from 19th May, 2023 to 20th May, 2024, 16 patients met the inclusion criteria and were included in the study. Inclusion criteria were patients booked for radial head replacement at our institution and patients of age 18 and above. Patients below the age of 18 and those who had their surgery at different institutions and came for a check-up were excluded from the study.

A study tool that included headings of socio-demography, mode of injury, prosthesis used, surgery done, measures of clinical outcome and self-reported patient satisfaction on a 3-point Likert scale was made. The study tool is included as Supplementary File 1.

Socio-demographic variables (age, sex, dominant hand, employment, and sports), variables relating to injury and surgery performed (mason classification, hand injured, elbow dislocation, mode of injury, and injury-to-surgery time), and variables reflecting outcomes (Mayo Elbow Performance Scores, range of motion, returned to work/sports after surgery, and complications) are the variables of this study. Continuous variables include age, Mayo Elbow Performance Scores (MEPS) score, range of motion, injury-to-surgery time, and time to return to work/sports. Other remaining variables are categorical.

Normality of the data was checked by using the Shapiro-Wilk test. Central tendency and measure dispersion for continuous variables that are normal are given by mean and standard deviation (SD). Similarly, central tendency and measure of dispersion for continuous variables that are skewed are given by median and interquartile range (IQR). Descriptive statistics is used to present all the data.

Surgical procedure

After the preanaesthetic checkup and clearance, patients were scheduled for the surgery. Under general or regional anaesthesia, the patient was placed on the table in a supine position. A tourniquet was applied at the arm level, and the elbow was bent at 90 degrees. An incision was made just posterior to the lateral epicondyle and extended distally and medially over the radial head. An interval was created between the anconeus and extensor carpi ulnaris tendons. While the forearm was in pronation, deep fascia, the radial collateral ligament, and the capsule were incised longitudinally to reach the radial head and capitulum. The radial head was excised, and all the fragments of the head were removed carefully. Fragments were reassembled on the table and compared to trail heads to obtain the appropriate prosthesis head size. Only a minimal amount of radial neck was resected at a right angle to the medullary canal. Then the neck canal was sequentially broached until good cortical contact was achieved. Neck rasp was used to smoothen the neck cut, ensuring that it was at 90 degrees to the neck. Before inserting the implant, the trial component was inserted, and implant tracking was accessed in flexion-extension and pronation-supination. Fluoroscopic assessment of ulno-humeral joint space symmetry as well as valgus-varus status was performed. After the trail component evaluation, the prostheses were inserted and assessed in the same manner. The subcutaneous layer was closed with 2-0 absorbable suture, and the skin was closed with 3-0 nylon. The elbow was immobilized at 90 degrees of flexion and neutral rotation with an above-elbow back slab.

Patients were evaluated for at least six months after surgery. The clinical examination included the range of motion, stability and muscle power at the elbow and wrist. Patient-reported pain scores were also evaluated. The final MEPS was evaluated after three months of surgery.

RESULTS

This study had sixteen participants, with mean ± SD age of 40.19 ± 11.391 and male: female ratio of 3:1. All of the participants were right-handed and majority of them were employed. Other socio-demographic details are given in Table 1.

Table 1: Socio-demographic details of the participants

Variables	Sample group (N=16)	
	Frequency (n)	Proportion (%)
Age		
21-30	5	31.25
31-40	2	12.5
41-50	5	31.25
51-60	4	25
Sex		
Male	12	75
Female	4	25

Dominant hand		
Right	16	100
Left	-	-
Employed		
Yes	10	62.5
No	6	37.5
Played sports		
Yes	6	37.5
No	10	62.5
Dislocated elbow joint		
Yes	3	18.8
No	13	81.3
Mode of injury		
Road traffic accident	8	50
Fall from height	8	50
Injury to surgery time		
Within first week of injury	13	81.25
After a week of injury	3	18.75
Type of prosthesis		
Uncemented, press-fit	16	100

Among the participants of this study, half of them were injured due to road traffic accident and another half were injured due to fall from height. When classifying these injuries according to Mason classification, majority had had type IIIB injury followed by type IIIC injury. In three out of sixteen patients elbow joint was dislocated and 87.5% of them had their dominant had injured. The median (IQR) injury-to-surgery time was 4 (3-7) days. All the patients were managed with uncemented, press-fit prosthesis. Details of injury and surgery performed are given in Table 2.

Table 2: Details of injury and surgery performed

Variables	Sample group (N= 16)	
	Frequency (n)	Proportion (%)
Radial head fracture - Mason classification		
IIIA	3	18.8
IIIB	8	50.0
IIIC	5	31.3
Hand injured		
Right	14	87.5
Left	2	12.5
Dominant hand injured		
Yes	14	87.5
No	2	12.5

Outcome of the study was assessed by using Mayo Elbow Performance Scores (MEPS) for which the median (IQR) score was 85 (80-96.25) at three months of surgery. Median for extension was 5 degrees, for flexion was 140 degrees, and for both pronation and supination were 80 degrees. The median time taken for return to work after surgery was 2 months, while, the mean (± SD) time taken for return to sports after surgery is 2.6 (±0.418) months. Details are shown in Table 3 and 4. To obtain final MEPS, different subheadings like pain, range of motion, stability, and function are given a score and the details of score obtained by individual patients are given in Table 5.

Table 3: Outcome scores and range of motion

Outcome parameters	Median (IQR)
MEPS (score)	85 (80-96.25)
Extension (degree)	5 (1.25-10)
Flexion (degree)	140 (131.25-145)
Pronation (degree)	80 (75-85)
Supination (degree)	80 (75-85)
Returned to work after surgery (months)	2 (1.5-2)

MEPS: Mayo Elbow Performance Scores; IQR: Inter-quartile range

Table 4: Parameters after the surgery of each patient (expressed in degree)

Patient No.	Extension	Flexion	Pronation	Supination	Elbow Stiffness	Elbow Instability
1	0	140	80	80	Absent	Absent
2	5	140	75	75	Absent	Absent
3	10	140	75	75	Present	Absent
4	10	130	70	70	Present	Absent
5	10	135	80	80	Absent	Absent
6	5	130	75	75	Present	Absent
7	5	135	80	80	Absent	Absent
8	0	145	85	85	Absent	Absent
9	5	145	85	85	Absent	Absent
10	5	145	80	80	Present	Absent
11	10	130	70	80	Present	Absent
12	5	145	85	85	Absent	Absent

13	0	150	85	85	Absent	Absent
14	5	150	85	85	Absent	Absent
15	0	150	85	85	Absent	Absent
16	10	120	75	75	Present	Absent

Table 5: Mayo Elbow Performance Scores of all included patients

Patient No.	Pain	Range of Motion	Stability	Function	MEPS
1	45	20	10	25	100
2	30	20	10	25	85
3	30	15	5	25	75
4	30	15	10	25	80
5	30	20	5	25	80
6	30	20	10	25	85
7	45	20	10	25	100
8	45	20	10	25	100
9	30	20	10	25	85
10	30	20	10	25	85
11	30	15	5	20	70
12	30	20	10	25	85
13	45	20	10	25	100
14	30	20	10	25	85
15	30	20	10	25	85
16	30	20	5	20	75

MEPS: Mayo Elbow Performance Scores

When asked about the satisfaction to the patients, 50% reported to be satisfied with surgery and the outcome, 37.5% were neutral, and 12.5% were dissatisfied. Seven out of sixteen patients (43.8%) had complication after the surgery. Among those seven patients the most common complication reported was joint stiffness (85.71%) followed by superficial infection (42.85%).

DISCUSSION

The radial head plays a very important role in the kinematics and stability of the elbow.[10] Various studies have shown that other associated ligamentous injuries contribute to the elbow instability, along with radial head fracture.[11–13] Overall, 26 % of patients had lateral collateral ligament injury in radial head fractures, where it rises to 75% in Mason type III radial head fractures.14little is known about the frequency or relevance of associated lesions in different types of radial head fractures. We studied the demographics of radial head fractures focusing on associated lesions in 333 adults from 1997 to 2002. The mean age of the patients was 45 years (range, 18-82 years Radial head excision with the associated injury does not re-establish stability, as well as internal fixation where there is more than three fragments, has poor outcomes.[15,16] The superiority of the radial head arthroplasty compared to the excision or internal fixation has been studied, and data shows that radial head arthroplasty gives better function and fewer postoperative complications.16

In this study the majority of the patients who underwent radial head replacement had their dominant hand injured, and the majority were employed; in such a case, arthroplasty has yielded a median MEPS of 85, which is overall good. Also, when the patients were asked about their satisfaction after the surgery, only 12.5% were dissatisfied. However, radial head arthroplasty cannot be free from complications. In a meta-analysis, 7% had to undergo revision surgeries, and there were overall 23% cases of complications like loosening, overstuffing, subluxation, stiffness, lateral elbow pain, dislocation of the prosthesis, implant malposition, fracture of the stem of the prosthesis and osteolysis.[17] In our study, according to MEPS, there was an overall good to excellent outcome. But the proportion of patients who were actually satisfied (excluding patients who chose to be neutral) was not in par with the MEPS. It may be due to the high rate of complications, as 43.8% of the patients experienced some complications after the surgery, and out of those complications, joint stiffness and superficial infection were most frequent. However, the study published by Grewal R et al. showed that the patient satisfaction was seen to increase at two years of follow-up.[18]fifty-four years Joint stiffness was found to be the most frequent complication. This is not uncommon after elbow surgery and may be prevented by early joint mobilization and physiotherapy. The independent risk factors of elbow stiffness after surgery are high-energy injury, more than one week taken for surgery from injury, and late joint mobilisation (after two weeks of surgery).[19] Three participants in this study had undergone surgery after a week of injury, and eight participants had a road traffic accident as a mode of injury. These independent risk factors may be attributed to the high incidence of joint stiffness after surgery in this study. In this study, infection was only superficial, where debridement was needed in one patient and two others were managed successfully by wound care and prolonged antibiotics. All the elbow joints were stable, and there was no evidence of overstuffing. Talking about the range of motion of the elbow, it allows flexion/extension and pronation/supination movements. It is known from the published literature that normal values for each of these movements expressed in degrees are, for flexion (130° to 154°), extension (-6° to 11°), pronation (75° to 85°) and supination (80° to 104°).20 After the surgery, the median extension was 5 degrees, the median flexion was 140 degrees, the median pronation was 80 degrees and the median supination was 80 degrees. The range of motion of the elbow among the patients after the surgery fell in acceptable degrees. To carry out daily activities, restriction of elbow extension at 30°, minimum flexion of 130° and pronation/supination both of 50° is necessary, while more extensive physical activity requires more mobility.[20] All the patients had a normal range of motion after the arthroplasty. It is also to be noted that patients who were employed returned to work at a median of two months after arthroplasty.

The short-term outcomes of this study were promising; however,

this study has some limitations. This study could not assess the incidence of osteoarthritis as well as loosening and osteolysis, as this study had a short-term follow-up. This study did not assess and reported the status of the soft tissues. Another shortcoming of this study was its sample size. Due to the rarity of the cases, this study had a sample size of sixteen only. The result of this study needs to be backed up by further, larger-scale studies. Also, this study encompasses only use of non-cemented press-fit non-modular prostheses. But it is to be noted that use of modular prostheses vs non-modular prostheses has no significant outcome difference.[18]fifty-four years

CONCLUSION

Radial head arthroplasty is a good modality to preserve the elbow stability and re-establish normal functioning of the elbow after the radial head fracture Mason type III. Considering the importance of the radial head in the biomechanics, radial head arthroplasty should be advocated over excision of radial head.

RECOMMENDATIONS

The role of the radial head in the stability and biomechanics of the elbow is such that radial head arthroplasty is recommended over excision of the radial head.

LIMITATIONS OF THE STUDY

This study could not assess the incidence of osteoarthritis as well as loosening and osteolysis, as this study had a short-term follow-up. This study did not assess and reported the status of the soft tissues. Another shortcoming of this study was its sample size. Due to the rarity of the cases, this study had a sample size of sixteen only. The result of this study needs to be backed up by further, larger-scale studies.

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CONFLICT OF INTERESTS: None.

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