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FUNCTIONAL OUTCOMES OF PATIENTS WITH COMMINUTED RADIAL HEAD FRACTURE UNDERGOING RADIAL HEAD ARTHROPLASTY

Orthopedics

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ABSTRACT

Introduction: Comminuted radial head fractures are often associated with secondary injuries and elbow instability. The aim of this retrospective study was to evaluate how well the modular metallic radial head implant EVOLVE® prosthesis restores functional range of motion (ROM) and stability of the elbow in acute care**. Methodology:** This prospective observational study was conducted in the Department of Orthopaedics at a tertiary level care hospital in North India from April 2021 till March 2022. All consecutive patients above 18 years of age, with comminuted closed radial head fractures were included. All underwent modular metallic head radial head implantation. The Mayo Elbow Performance Score (MEPS) was used to measure functional results. **Results:** We observed that MEPS at one month follow up was 81.54 ± 11.18, which improved significantly at 3rd month follow up to 87.24 ± 12.42 (p value < 0.001). On the next follow up at 6th month, MEPS increased further to 92.14 ± 7.36, p value < 0.001 (table 2). At the final follow up at 6th month, MEPS was graded as excellent for 80%, good for 12%, fair for 4% and poor for 4%. One patient had complex regional pain syndrome and one had joint stiffness. **Conclusions:** Comminuted radial head fractures with elbow instability can be treated well with a modular radial head prosthesis, which restores stability in acute treatment. The modular radial head arthroplasty used in this study showed promising findings in short to midterm results.

KEYWORDS

Radial Head; Fracture; Prosthesis; Arthroplasty; Elbow Instability

INTRODUCTION

The incidence of radial head fractures constitutes about 2% to 5 % of all adult fractures[1] and they are responsible for one third of all elbow injuries. When radial head fractures occur in combination with damage to the collateral ligaments of the elbow, damage to these structures results in gross instability to the elbow joint[2], causing the radial head to become the primary stabilizer. Managing the radial head is important in restoring stability to the elbow joint and enabling early mobilization. In general, injuries to the radial head are treated accordingly: Mason I injuries are treated conservatively; Mason II injuries conservatively or if displaced with open reduction and internal fixation (ORIF)[3]; and Mason III fractures with ORIF or radial head prosthesis. The resection of the radial head has received ever more criticism and is now only recommended for isolated fractures with no ligament injury.[4] In any case, it is important that the joint is functionally stable following surgery and early mobilization is possible to prevent elbow stiffening.

A controversy exists regarding the treatment of Mason III and IV radial head fractures with some authors recommending ORIF and others the radial head prosthesis.[5] Authors have expressed some concern over the use of radial head prostheses because of associated complications such as loss of motion, neuropathy of the ulnar nerve or posterior interosseous nerve, radiolucency, and periprosthetic osteolysis. In addition, there is concern that younger patients will suffer long-term consequences, which have not yet been adequately documented. [6] Nevertheless, the radial head prosthesis has in many ways become increasingly more established as the treatment of choice for comminuted fractures, which often have associated ligament injuries further compromising stability.

METHODOLOGY

Study Design and Sampling

This prospective observational study was conducted in the Department of Orthopaedics at a tertiary level care hospital in North India from April 2021 till March 2022. All consecutive patients above 18 years of age, with comminuted closed radial head fractures. We excluded patients with open fractures, modified Mason type I and II, active infection and those lost to follow-up. The sample size was calculated using following formulae: $N = (Z\alpha/2)\ 2 * (PQ) / E^2$, N = Sample size, $Z\alpha/2$ = Z value at 5% error (1.96), P = taken as 77% (Tarallo et al[6] reported excellent MEPS in 77% of their patients), Q = 1-P, E = allowable error (taken as 20%),l $N = (1.96)2 * (0.77*0.23)/(0.15)^2$, N = 17. So minimum sample required was 17 patients. The purpose and rationale of the study and their role as participants was explained to all the patients. Written informed consent was obtained from all patients prior to enrolling them. Patient enrolment commenced after obtaining approval from the Institutional Ethics Committee.

Operative detail

Patients were put in a supine posture with the afflicted extremity in abduction after acquiring surgical fitness and submitting regular laboratory procedures. The Kaplan technique was utilised to find the extensor carpi radialis longus anteriorly, between the extensor digitorum communis and the extensor carpi radialis longus. The annular ligament was preserved so that it may be sutured at the conclusion of the surgery if necessary. If the radial collateral ligament (especially its ulnar section) was not injured at the time of the trauma, special care was taken to save it. The radial head was then reached via either a lateral arthrotomy or an olecranon fracture. During the arthrotomy, the capitellar cartilage was examined. Despite the fact that the state of the capitellar cartilage has no influence on the therapeutic circumstances, it is one of the criteria that regulate the long-term prognosis. The MCL, LCL, and interosseous ligament were tested for competence after the radial head was removed. The resected radial head was put on the table, and an acceptable prosthetic size was chosen.

A prosthesis with the suitable diameter and height was tested. A reamer was then used to prepare the radius's proximal medullary canal for the implant. The final actual stem was placed after demonstrating adequate contact between capitulum and trial prosthesis and a good fit in the radial medullary canal. The final prosthesis was then secured. Finally, a bipolar radial articular surface prosthesis with a good fit was implanted.

Nonabsorbable sutures were used to repair the annular ligament. The joint's stability was assessed, and dressing was applied. The arm pouch was worn throughout the day in between exercises. A physiotherapist introduced immediate passive motion in all patients, and continuous passive motion (CPM) without limitation of movement out of the cast began on day 2 postoperatively. After one week, the cast was removed and full range of motion was restored. At 6 weeks postoperatively,

patient was allowed to lift weight. For three weeks, indomethacine (75 mg/day) was administered to prevent heterotopic ossification.

Data Collection and Data Analysis

A pre-designed semi-structured research proforma was used to gather data. The patients' demographic information, such as age and gender, was recorded. Clinical information such as the method and side of damage were recorded. Patients were asked if they had any major medical or surgical history. A thorough physical examination was performed to look for any connected injuries. Every follow-up appointment included a radiographic evaluation both before and after surgery. Antero-posterior, lateral, and Greenspan radial head images of the elbow were obtained. If a wrist injury was suspected, bilateral posterior-anterior wrist stress images were performed. Outcome assessments were done as follows:

1. Each follow-up included a radiological examination. Bridging bone on anteroposterior and lateral radiographs was used to define fracture union at the coronoid process.
2. The Mayo Elbow Performance Score (MEPS)[7], which comprises dimensions of pain, mobility, stability, and function, was used to measure functional results. An overall score of >90 indicates an exceptional outcome, 75 to 89 indicates a good outcome, 60 to 74 indicates a fair outcome, and 60 indicates a bad outcome. Pre-operative (baseline) and post-operative (months 1, 3, and 6) functional results were evaluated.
3. Follow-up x-rays and clinical examination revealed complications such as capitellar osteopenia, degenerative alterations, and heterotopic ossifications. According to Popovic et al., radiographic indicators of radial head prosthesis loosening (radiolucent lines, osteolysis, and proximal radial head resorption) were also assessed.[8]

RESULTS

In the present study, 25 patients were included. Mean age of the patients was 41.23 ± 8.2 years, ranging from 21 to 55 years. In the present study, 44% of the patients were females. Right side was involved in 52% of the patients. Road traffic accident was the mode of injury in 56% of the patients and rest 44% had a fall as the mode of injury. We observed that 44% of the patients were operated with in 6 days from the day of trauma. We found that 16% had LCL injury, 12% had MCL injury, 12% had elbow dislocation with LCL and MCL injury and 8% had an olecranon fracture (table 1). We observed that MEPS at one month follow up was 81.54 ± 11.18, which improved significantly at 3rd month follow up to 87.24 ± 12.42 (p value < 0.001). On the next follow up at 6th month, MEPS increased further to 92.14 ± 7.36, p value < 0.001 (table 2). At the final follow up at 6th month, MEPS was graded as excellent for 80%, good for 12%, fair for 4% and poor for 4%. One patient had complex regional pain syndrome and one had joint stiffness. No post-operative complications were observed in 92% of the patients (table 3).

DISCUSSION

Radial head fractures occur in about 17–19% of cases of elbow trauma and account for 33% of elbow fractures.[9] For the majority of complex radial head fractures, restoration of radiocapitellar contact is essential and the choice is between radial head fixation and replacement.[10] However, the role of excision cannot be nullified for certain clinical settings.[11] In our cohort, the clinical results of the radial head replacement and osteosynthesis were significantly better than excision. Definitive difference between prosthesis and osteosynthesis could not be deciphered significantly. Chen et al. in a prospective cohort study in 45 patients could demonstrate significantly better clinical results with 91% excellent result in monopolar titanium prosthesis group as compared to patients assigned to the ORIF group with 65.2%. Postoperative complication rate of the radial head replacement group (13.6%) was significantly lower than that of the ORIF group (47.9%; P < 0.01), where ORIF was performed with AO steel plates and K-wires.[12] Although their inclusion criteria matched our study, the operative protocol was different.

Reconstruction of coronoid fractures was not mentioned, as this in our protocol emphasizes the importance of anterior pillar restoration. Thus, it is a probable explanation for getting equivocal results and low complication rates in the two groups, in our study. Another contrasting study in the literature by Ruan et al. compared 14 patients with bipolar prosthesis with 8 patients of osteosynthesis of radial head and found 92.2% excellent as compared to 12% in the latter at 14-month follow-up.[13] Our results differ as we emphasized on collateral reconstruction, coronoid fixation and no k-wire on radial head and standardized operative protocols.

Our surgical protocol is supported by Doorenberg et al. in assessing the role of radial head arthroplasty in acute traumatic instability of elbow in 27 patients with modular metal spacer prosthesis.[14] In their recommendations, results were satisfactory with minimal complications when an intentionally loosely placed modular metal radial head prosthesis was applied to restore stability in conjunction with repair of other fractures and reattachment of the lateral collateral ligament to the epicondyle. While a prosthesis that is too large can cause problems, lucencies around the stem of the intentionally loose prosthesis and most changes in the capitellum do not appear to cause problems; however, seven patients had secondary procedures with the removal of prosthesis in two, in their cohort.

Our series illustrates the clear-cut advantage of surgical protocol in the form of no revision or loosening of cemented titanium radial head prosthesis which is monopolar and nonmodular. Duckworth et al., in a retrospective study, identified silastic prosthesis and younger age as two independent risk factors for high rates of revision and loosening within 1 year of index procedure, up to 28%. They advised that younger patients should be counselled regarding the increased risk of requiring further surgery after radial head replacement. However, as their study was retrospective, they were not able to document concomitant soft tissue or other bony injuries.[11]

CONCLUSION

Radial head fracture is a commonly occurring in complex elbow fracture–dislocations. In view of dealing with ligamentous and other bony injuries like coronoid/olecranon fractures, radial head osteosynthesis has preferable outcomes in terms of patient-related outcomes as compared to arthroplasty, although it is not statistically significant. Radial head excision though has acceptable outcomes but there is a statistically significant restriction of movements especially flexion–extension. Rate of complications either major or minor, need for a secondary surgical procedure or a staged treatment are potential drawbacks of management of such injuries. Realistic goals of acceptable range of movements have to be explained beforehand to the patients with complex elbow fracture–dislocations.

Table 1. Baseline characteristics of the patients included in the study

Age groups (years)	Number	Percentage
25 to 35	8	32.00%
36 to 45	5	20.00%
46 to 55	12	48.00%
Gender		
Male	14	56.00%
Female	11	44.00%
Side of injury		
Right	13	52.00%
Left	12	48.00%
Mode of injury		
Road traffic accident	14	56.00%
Fall	11	44.00%
Time of surgery from day of trauma		
≤ 6 days	11	44.00%
> 6 days	14	56.00%
Associated injury		
Lateral Collateral Ligament injury	4	16.00%
Medial Collateral Ligament injury	3	12.00%
Elbow dislocation and LCL injury and MLC injury	3	12.00%
Olecranon fracture	2	8.00%
No associated injury	13	52.00%
Mason fracture type		
Type III	19	76.00%
Type IV	6	24.00%
Total	25	100.00%

Table 2. Change in MEPS at subsequent follow ups

	Post-operative months of follow up		
	At 1st month	At 3rd month	At 6th month
	Mean (± SD)	Mean (± SD)	Mean (± SD)

MEPS	81.54 (± 11.18)	87.24 (± 12.42)	92.14 (± 7.36)
P value between 1st and 3rd month <0.001, 3rd and 6th months <0.001 both were statistically significant.			

Table 3. Clinical outcome at final follow up

MEPS	Number	Percentage
Excellent (>95)	20	80.00%
Good (75 to 94)	3	12.00%
Fair (60 to 74)	1	4.00%
Poor (<60)	1	4.00%
Complications		
Complex regional pain syndrome	1	4.00%
Joint stiffness	1	4.00%
No complications	23	92.00%
Total	25	100.00%

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