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Original Research Article

A Retrospective Observational Study to Evaluate the Functional Outcome of Type III and IV Radial Head Fractures Treated by Radial Head Prosthesis

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Abstract

Aim: The aim of the present study was to evaluate the functional outcome of type III and IV radial head fractures treated by radial head prosthesis.

Material & methods: A retrospective study included 70 patients of type III and IV radial head and neck fractures according to Mason's classification. They were admitted and treated in the Department of Orthopaedics with radial head prosthesis over the duration of 2 years.

Results: Out of 70 cases, 45 cases were <40 years and 25 cases were >40years. The mean age was 39.3 years. Maximum age was 54 years, minimum age was 30 years. Majority were females as compared to males. Mechanism of injury most of the cases i.e 68.58% were due to history of fall and remaining were due to RTA. 54 cases (77.14%) were right side dominant and 16 cases (22.86%) were left side dominant. In our case study group, out of 70 cases, 56 cases (80%) were under Modified Mason's classification type Ill and 14 cases (20%) were under Modified Mason's classification type IV. Out of 70 cases, 55 cases (78.57%) were not associated with any ligamentous injury, 7 cases of LUCL and 8 cases of MCL injury was noted. Mean flexion at 2nd week post-op was 79.31 degrees which improved to 118.32 degrees at 6 post-op weeks. The mean extension deficit at 2nd post-op week (24 degrees) improved to (10 degrees) at end of 6th post-op week. The mean pronation at end of 2nd post op week was 20 degrees which improved to a mean of 63.17 degrees at end of 6th post op week. The mean supination at end of 2nd post-op week was 37 degrees and it improved to a mean of 70.32 degrees at end of 6th week post-op. The P value of flexion, extension, pronation and supination was found to be very significant. 49 cases (70%) had MEPI score (Mayo Elbow Performance Index) >90 which indicates excellent result, 14 cases (20%) had MEPI score 75-89 which is good result and 7 cases (10%) had MEPI score 60-74 which indicates fair result.

Conclusion: Radial Head Prosthesis is a viable option in communited and irreparable radial head fractures. Proper preoperative planning, good Intraoperative technique and rigorous postoperative rehabilitation gives predictable results.

Keywords: Radial head fracture, radial head arthroplasty, radial head replacement, fracture of elbow, modified mason's classification, elbow dislocation, Mayo elbow performance index

Introduction

Fractures of the radial head and neck account for 1.7%–5.4% of all fractures and 33% of all elbow fractures. [1-4] These fractures are often the result from falling on outstretched arms. [5,6] The radial head contributes to motion of the elbow such as flexion, extension, pronation, and supination. [7] It also functions biomechanically as a secondary stabilizer to valgus stress about the elbow and in the longitudinal stability of the forearm. [8] In general, the treatment of radial head fractures is based on the type of fracture. The most commonly used classification of radial head fracture was proposed by Mason. [9] Modified Mason Type I and II fractures are treated nonoperatively or by open reduction and internal fixation (ORIF). [10]

Radial head fractures make up approximately 3% of all fractures and they are the most common type of elbow fracture in adults. [9,11] These fractures usually result from a fall on an outstretched arm with the forearm pronated; they range from simple fractures to those associated with complex elbow instability. [12] Normally, most radial head fractures without associated fractures or ligament injuries are inherently stable, even when displaced more than 2 mm. [11]

Many authors have described serious complications in case of resection of the radial head such as proximal migration of radius and longitudinal instability, humeroulnar osteoarthritis [13-15], decrease in grip strength, cubitus valgus, and ulnar neuropathy. [16,17] Therefore, radial head arthroplasty has obtained a large consensus in orthopaedic surgeons as primary option of treatment in fractures Mason types III and IV. It allows an anatomical reconstruction and it maintains stability and physiologic kinematics of the elbow if associated with ligament reconstruction. However, oversizing or overstuffing of radial head prosthesis, malpositioning, and aseptic mobilization may lead to a high rate of complications and failure of this surgical procedure. Recent reviews of literature [16,18] on elbow arthroplasties have reported satisfactory results in radial head replacement studies due to improvement of biomaterials and operative techniques.

Formerly, radial head resection was a typical procedure treating unreconstructable radial head fractures. [19] However, it is avoided nowadays, because the radius can migrate proximally and cause distal radio-ulnar joint complaints and reduce elbow joint stability. [20] Arthroplasty can be offered in extremely comminuted cases but is rather seen as a salvage procedure in unreconstructable cases. [21] The first treatment of choice is typically ORIF for Mason-Johnston type 3 fractures. Usually, ORIF is performed in situ to preserve the blood supply to all fracture fragments. However, performing ORIF in situ can be challenging and sometimes not possible due to the comminution and small working space. [22,23]
Hence the aim of the study was to evaluate the results of radial head replacement for type III and IV radial head fractures in terms of functional outcome.

Material & Methods

A retrospective study included 70 patients of type III and IV radial head and neck fractures according to Mason's classification. They were admitted and treated in the Department of Orthopaedics, Lord Buddha Koshi Medical College and Hospital, Saharsa , Bihar, India with radial head prosthesis over the duration of 2 years.

Inclusion Criteria

- Severely comminuted fractures of the head and neck of radius i.e type III and type IV,
- Skeletally mature patients,
- patients giving consent for the surgery were included in the study.

Exclusion Criteria

- Type I and type II fracture patterns that can be managed conservatively or by simple internal fixation, open fractures, other fractures around the elbow, presence of any infection,
- Children with fracture of radial head and neck were excluded from the study.

Methodology

A well informed and written consent was taken from patient and relative in their local language. Pre-operatively patients were evaluated on admission, a detailed history including the mechanism of injury and complaints of the patients were noted, along with a thorough clinical examination. Radiographs of affected limb and contralateral normal limb in anteroposterior and lateral view were taken. For primary treatment immobilization was given in the form of above elbow slab. All routine investigations were done and preoperative anaesthesia fitness was taken. Patient was posted for radial head replacement with radial head prosthesis. Templates were available to facilitate preoperative implant selection based on radiographs of the injured and normal contralateral elbow. Prophylactic antibiotics were given intravenously pre operatively 30 minutes before skin incision to cover the common bacteria associated with postoperative surgical infections. Under general or regional anaesthesia, the patient was positioned in the supine position. A sandbag was placed under the ipsilateral shoulder to assist in positioning of the elbow across the chest. The operative arm was placed over a padded bolster with a sterile tourniquet in place. After routine preparation and draping, Kocher approach was marked. Skin incision was placed. A full-thickness fascio-cutaneous flap was elevated. This exposure provided access to the radial head, capitellum, and lateral collateral ligament. The medial flap if needed was elevated to expose the coronoid and medial collateral ligament. The fascial interval between the anconeus and extensor carpi ulnaris was identified and developed**.**

Excision of the fragments of the radial head was facilitated with the use of an image intensifier and a pituitary rongeur. Generous joint irrigation was performed to remove all loose intraarticular debris. Varus, Valgus and axial stress tests were done to check LCL, MCL and interosseous ligament, to confirm need for radial head replacement. A modular radial head implant system was used. Measurement was taken after excision of radial

head. Appropriate size press fit modular radial head prosthesis was inserted.

After radial head replacement the elbow was placed through an arc of extension while carefully evaluating for elbow stability in pronation and supination. Closed suction drain was used for 24 hours. Haemostasis was achieved and wound was closed in layers. If the elbow was stable it was splinted in full extension with anterior plaster slabs, avoiding pressure over the olecranon and wound. If there was some residual instability it was splinted in 900 flexion and supination. Postoperatively patients were given antibiotics and anti-inflammatory medicines for 3 days post op as per our institutional policy. The elbow was started with active flexion and extension exercises throughout a full arc of motion 3 days after surgery. A collar and cuff were worn during the day between exercises. A static progressive extension splint was used at night. Patient assessments was done of the basis of range of motion (ROM) at 2- and 6-weeks post op, stability and functionality was assessed according to the Mayo Elbow Performance Score (MEPS) at the final follow up.

Statistical Analysis

Statistical Data analysis was done using the SPSS (Statistical Package for the Social Science) Version 17 for windows. A p-value of 0.05 was accepted as the level of statistical significance.

Results

Table 1: Patient details

Age in years	**N**	**%**
<40	45	64.28
>40	25	35.72
Gender		
Male	21	30
Female	49	70
Mode of injury		
RTA	22	31.42
Fall	48	68.58
Dominant side		
Right	54	77.14
Left	16	22.86

Out of 70 cases, 45 cases were <40 years and 25 cases were >40years. The mean age was 39.3 years. Maximum age was 54 years, minimum age was 30 years. Majority were females as compared to males. Mechanism of injury most of the cases i.e 68.58% were due to history of fall and remaining were due to RTA. 54 cases (77.14%) were right side dominant and 16 cases (22.86%) were left side dominant.

Table 2: Mason's classification and associated injury

Mason's classification	**N**	**%**
Type III	56	80
Type IV	14	20
Associated injury		
LUCL	7	10
MCL	8	11.43
None	55	78.57

In our case study group, out of 70 cases, 56 cases (80%) were under Modified Mason's classification type Ill and 14 cases (20%) were under Modified Mason's classification type IV. Out of 70 cases, 55 cases (78.57%) were not associated with any ligamentous injury, 7 cases of LUCL and 8 cases of MCL injury was noted.

Table 3: Post-operative flexion, extension, pronation and supination at 2nd and 6th post op week in study group

Parameters	**Flexion**		**P Value**
	2nd week	**6th week**	
ROM (Degrees)	79.31±23.67	118.32±14.96	<0.0001
Extension			
ROM (Degrees)	24±10.64	10±11.44	<0.005
	Pronation		
ROM (Degrees)	22±4.46	63.17±8.52	<0.0001
	Supination		
ROM (Degrees)	37±8.32	70.32±7.33	<0.0001

Mean flexion at 2nd week post-op was 79.31 degrees which improved to 118.32 degrees at 6 post-op weeks. The mean extension deficit at 2nd post-op week (24 degrees) improved to (10 degrees) at end of 6th post-op week. The mean pronation at end of 2nd post op week was 20 degrees which improved to a mean of 63.17 degrees at end of 6th post op week. The mean supination at end of 2nd post-op week was 37 degrees and it improved to a mean of 70.32 degrees at end of 6th week post-op. The P value of flexion, extension, pronation and supination was found to be very significant.

Table 4: MEPI wise distribution

MEPI	N	%
<60 (Poor)	0	0
60-74 (Fair)	7	10
75-89 (Good)	14	20
>90 (Excellent)	49	70

49 cases (70%) had MEPI score (Mayo Elbow Performance Index) >90 which indicates excellent result, 14 cases (20%) had MEPI score 75-89 which is good result and 7 cases (10%) had MEPI score 60-74 which indicates fair result.

Discussion

Radial head fractures make up approximately 3% of all fractures and they are the most common type of elbow fracture in adults. [9,11] These fractures usually result from a fall on an outstretched arm with the forearm pronated; they range from simple fractures to those associated with complex elbow instability. [26] Normally, most radial head fractures without associated fractures or ligament injuries are inherently stable, even when displaced more than 2 mm. [27]

Out of 70 cases, 45 cases were <40 years and 25 cases were >40years. The mean age was 39.3 years. Maximum age was 54 years, minimum age was 30 years which corresponds to Hung-Yang Chien et al [28] who retrospectively examined 13 patients with radial head fractures. In his study the mean age at presentation was 38.6 years. Majority were females as compared to males. According to the study done by Vidisha Kulkarni et al [29] out of 30 patients, 18 cases (60%) were male and 12 cases (40%) were female. Mechanism of injury most of the cases i.e 68.58% were due to history of fall and remaining were due to RTA. 54 cases (77.14%) were right side dominant and 16 cases (22.86%) were left side dominant. Rahul Kadam et al [30] noted mode of injury in 8 of them was a fall on an outstretched hand, 6 of them had a RTA and 4 had history of assault. 38 cases (76%) were right side dominant and 12 cases (24%) were left side dominant. Vidisha Kulkarni et al [29] reported 16 cases (53.33%) of right sided fracture and 14 (46.67%) of left sided. Surgical treatment for comminuted and unrepairable fractures of the radial head may be challenging. These types of fractures are often associated with multiple ligamentous injuries amounting to elbow instability. Radial head resection has been proposed as good option for surgical treatment, while in the last decades, the development of technology and design in radial head prosthesis has increased efficacy in prosthetic replacement.

The radial head is a secondary valgus stabilizer of the joint and it is involved in transmission of axial force load through the elbow during flexion. [31] It is also a varus and external rotatory constrainer. [32] Comminuted radial head fractures Mason type III and type IV are commonly associated with other injures of the elbow as capitellum and coronoid fractures and/or ligaments disruption, both medial and lateral ligaments and interosseus membrane. [27,28] In our case study group, out of 70 cases, 56 cases (80%) were under Modified Mason's classification type Ill and 14 cases (20%) were under Modified Mason's classification type IV. Out of 70 cases, 55 cases (78.57%) were not associated with any ligamentous injury, 7 cases of LUCL and 8 cases of MCL injury was noted. Mean flexion at 2nd week post-op was 79.31 degrees which improved to 118.32 degrees at 6 post-op weeks. The mean extension deficit at 2nd post-op week (24 degrees) improved to (10 degrees) at end of 6th post-op week. The mean pronation at end of 2nd post op week was 20 degrees which improved to a mean of 63.17 degrees at end of 6th post op week. The mean supination at end of 2nd post-op week was 37 degrees and it improved to a mean of 70.32 degrees at end of 6th week post-op. The P value of flexion, extension, pronation and supination was found to be very significant.

49 cases (70%) had MEPI score (Mayo Elbow Performance Index) >90 which indicates excellent result, 14 cases (20%) had MEPI score 75-89 which is good result and 7 cases (10%) had MEPI score 60-74 which indicates fair result. According to Vididsha Kulkarni et al [29] in their study, 20 cases (66.67%) had excellent results, 8 cases (26.66%) had good results, 1 case (3.33%) had fair results, and 1 case (3.33%) had poor result. Rahul kadam et al [30] shows excellent result in 13 (72%) of the patients good results for 3 (17%) and fair result in 2 (11%). Eight cases (80%) out of 10 cases had no complications, 1 case (10%) had infection and 1 case (10%) elbow stiffness.

Conclusion

Radial head prosthesis gives excellent functional outcomes in Modified Mason's type III and IV radial head fractures with lower complication rate and early mobilisation. The key to successful management of radial head for type III and IV is in planning the surgery beforehand. A long term follow up with more number of cases is required to assess further effectiveness of radial head prosthesis in radial head and neck fractures.

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