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Radial head arthroplasty in mason type 3 and 4 radial head fractures: Functional efficacy and complications

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Abstract
Background: Radial head arthroplasty (RHA) is a best alternative to radial head excision in Mason III and IV fractures. The purpose of this study was to assess the outcomes of RHAs in terms of the range of movement and elbow stability using the Mayo elbow performance score (MEPS).
Methods: A prospective and interventional study included 25 patients were performed RHAs. During follow up, patients were clinically and radiologically assessed and complications.
Results: 92%of patients presented with excellent to good outcomes at 24 weeks (mean MEPS was 92.17±11).
Conclusion: RHA is successfully performed in comminuted radial head fractures because of injury to lateral collateral complex and comminution.

Keywords: Radial head arthroplasty, comminuted radial head fractures, Mason type 3 & 4 radial head fractures

Introduction
The elbow joint, a hinge joint that is complex and intrinsically stable, consists of 3 different joints: radio-capitellar, humero-ulnar and proximal radio-ulnar joint. The stability of bony components of the lbow joint is further strengthened by capsule and ligaments [1]. The humero-ulnar joint is a ginglymus (hinge) joint which is allowing flexion and extension movement. The proximal radio-ulnar and radio-capitellar joints are pivot joints (trochoid) responsible for rotational movements [2]. The trochlea of the lower humerus is a pulley shaped structure that is medially more larger, and it articulates with the olecranon notch of the ulna. The capitellum articulates with the head of the radius bone laterally. The rim of the radial head is articulate with a point of the trocleo-capitellar groove between the trochlea and capitellum. Both the capitellum and olecranon notch are lined with hyaline cartilage [3]. In respect of the humeral shaft, these joint surfaces are directed at 40° anterior, in 4-8° of valgus angulation and in 5° internal rotation. The carrying angle is made between the longitudinal axis of the humerus and ulna in a fully extended elbow. In females, the normal carrying angle is 13° to 16°, while in male, it is 11° to 14°. The normal range of motion (ROM) is from a full extension of 0° to 140° of flexion. A few degrees of hyperextension may be normal. The normal supination and pronation are both of approximately 80 degree. In different individuals, these values may vary. For normal activities of the daily living full range of motion is not necessary.
Incidence of radial head fractures constitutes 2% to 5 % of total body fractures in an adult [2] and one third of all elbow fractures [4]. The average age of presentation is 40 years and over 90% having isolated radial head fractures i.e. not associated with other injuries of the elbow [5]. The mechanism of injury is falling on an outstretched arm with the pronated forearm. The fracture may be non-displaced, simple or complex with elbow instability. Biomechanical evidence shows that a forward fall onto an outstretched arm and prone forearm leads to indirect transfer of load onto the radial head and compressed over the capitellum. Radial head or neck fractures are occurs by an indirect transfer of load within 0 to 80° angle at the elbow joint. Isolated radial head fractures are generally non-displaced or minimally displaced, while displaced and comminuted fractures of the radial head are commonly occurs with injuries to the collateral ligaments and may have associated fractures of the capitellum, coronoid or

proximal ulna.

3% to 14% of radialare head fractures associated with elbow dislocation and can occur after a fall on the extended arm [6]. Severe elbow instability and many post-traumatic complications are associated with this terrible triad injury [7]. One of the most important classification systems is the Mason classification [8], according to which

- type I- include the chip or marginal fracture without displacement;
- type II- minimally displaced;
- type III- displaced and comminuted
- And IV- type was added by Johnston as radial head fractures associated with elbow dislocation.

The Mason's classification of radial head fractures did not include associated injuries and/or it did not aid in planning management. Most of the radial head fractures are non-displaced. These fractures typically have a better outcome with conservative treatment. Collateral ligament damage with radial head fractures results in gross instability to the elbow joint. Conservative management of Mason type I fracture includes a POP slab and sling for support, and active mobilization as soon as possible. The prognosis of Mason typeIfractures is good, however, in a few studies, some cases have been reported with persistent complaints with non-surgical treatment.

Surgical management of displaced fractures, as well as of those associated with complex elbow instability, historically has included radial head excision, open reduction and internal fixation (ORIF), and radial head arthroplasty (RHA). It has been suggested that fractures displaced greater than 2 mm and involving greater than 30% of the articular surface (Type 2 fracture in the modified Mason classification) might be best treated with surgery [9]; however, this remains unproven. Comminuted radial head fractures can lead to instability of the elbow. ORIF in Mason type III fractures with 3 or more fracture fragments was more likely to have unsatisfactory results as compared to 2 part fractures [10]. Routine internal fixation of fractures having more than three fragments can result in implant failure, non-union, and loss of rotational movement of the forearm. When ORIF is not possible, then must go for radial head excision alone or follow by radial head replacement. In cases of isolated comminuted radial head fractures, resectioning the radial head may lead to satisfactory results. As the ligament injuries are commonly associated with radial head fractures, elbow instability in the coronal plane and forearm instability may become apparent after excision of the radial head. Radial head prosthesis stabilizes the lateral column and ensures elbow stability in the vertical and coronal plane [11]. Therefore metallic radial head prosthesis (RHP) uses if a stable internal fixation of the comminuted radial head cannot be achieved. The radial head replacement was introduced as a better alternative to simple radial head resection. Since then, better in the knowledge of elbow biomechanics has allowed advancement in the shape of the radial head prosthesis and its materials. In this study, we have analyzed the functional outcome after treatment of comminuted fracture of the radial head with radial head prostheses in terms of pain, range of motion, stability and daily functions with the help of the Mayo elbow performance score and its complications.

Methodology

This study was a prospective, hospital based and Interventional the study. DThe duration of the study was from June 2018 to may 2021. All patients with comminuted fracture of the radial head admitted to our centre fulfilling the inclusion criteria during the study period were included in the study with the aim of a minimum sample size of 25 patients.

In this study, skeletally mature patients belonging to the age group 18 to 65 years of both sexes having comminuted radial head fractures amenable for radial head arthroplasty and Mason type III & type IV fractures. However Exclusion Criteria are:-

- Patients with chronic illness or immune-compromised patients.
- Vascular compromised (of affected limb) patients.
- Patients are suffering from neuropathy of the affected limb.
- Age above 65 years and less than 14 years.
- Other associated fractures or previous surgery of/around the elbow.
- Mason type I and type II

All patients gave written informed consent. All the patients presenting with comminuted fractures of the radial head were assessed and classified according to Mason classification. All patients with fractures of the radial head fulfilling the inclusion criteria were included in the study. The injured limb was evaluated completely, including assessment of skin condition, swelling and distal neurovascular status. All routine preoperative investigations were performed. Standard good quality AP and lateral x-ray of the fractured part of the limb was taken. Pre-Operatively above elbow POP slab with arm pouch was applied and limb was kept elevated till tissue edema reduces and skin condition becomes good enough to post the patient for surgery. Patients presented with associated elbow dislocation were first managed by closed reduction under anaesthesia and then assessed for neurovascular involvement before surgery.

During the surgical procedure, patient was in the supine position and the affected arm was positioned over the chest with pronation. The limb was exsanguinated by applying a tourniquet after elevating it for 3-5 minutes. A lateral (Kocher) approach was used. Incision started over the lateral humeral epicondyle and continued distally and obliquely to a point over the posterior border of the ulna. The subcutaneous tissue was incised in line with the incision and flaps were raised to expose the fascia over the muscles. Kocher's interval was identified between anconeus and extensor carpi ulnaris. The superior origin of anconeus detached from the lateral epicondyle of the humerus to expose the joint capsule & anconeus and extensor carpi ulnaris muscle was separated using retractors. The capsule of elbow joint cut longitudinally to expose the underlying structure. All radial head and neck fragments were resected carefully. Annular ligament preserved for repair. Radial neck trimmed to fit the prosthesis. The medullary canal opened with an awl to fit the prosthesis stem (figure 1& 2). The prosthesis of appropriate diameThe annular size was inserted and size and stability was as the woundd.

Annular ligament was repaired with non-absorbable sutures. Woun was applied after the operation at 90 degrees of flexion eration a high above elbow POP slab at 90 degrees of flexion was applied. Patients were advised to keep the limb elevated and move their fingers and shoulder joint. Appropriate injectable antibiotics were given along with analgesics and anti-inflammatory medicines. Good quality AP and lateral radiographs of the operated part of the limb were taken (figure

3 & 4). The wound was inspected after 3 days postoperatively. Flexion and extension exercises were started within pain limits and within a safe range of motion, keeping in mind the associated osseous and soft tissue injuries. Forearm pronation and supination exercises were done actively while keeping the elbow at 90° of flexion. Later, patients were discharged with the forearm in an arm pouch advised for wrist and finger movements. Patientsare advised not to lift heavy weight or exert the affected upper limb.

Patients were further follow-up at 4, 8, 12, and The outcomes. The outcome of the operated limb was assessed during follow-up, and standard anteroposterior and lateral x-ray were taken. Patients were instructed to carry out physiotherapy in the form of active flexion-extension and pronation-supination movements. Outcome Assessment At the end of 6 months follow-up ,the clinical evaluation was performed using the Mayo elbow performance score (MEPS) (Table-1). The assessment was included as a record of the patient's pain level, range of movement at the elbow, elbow stability, and functional level. Each patient's affected range of movement was compared with the normal side.

Results-

A total of 25 patients were included in the study. Of the cases all fulfilled the inclusion criteria. Maximum numbers of patients were between 40-50 years (56%), followed by less than 40 years (32%). The mean age of patierangedging from 18 to 54 years. More than half of the patients were males (60%). Only Mason type III and type IV fractures were included in the study as per inclusion criteria. Out of the 25 patients studied, According to The Modified Masons classification, sixteen (64%) patients were of type III and nine (36%) patients of type IV. MaA maximumumber of patients had a right-sided fracture (60%). Nine patients (36%) were having associated ipsilateral elbow dislocation.

Mayo elbow performance score

1. Pain intensity- In this study, out of 25 patients, twenty (80%) patients were pain-free and five (20%) patients had mild pain. No patients had moderate or severe pain.
2. Range of motion- Nineteen (76%) patients were having an arc of motion >100 degrees, six (24%) were having an arc of motion between 50 to 100 degrees and no patients with the arc of motion less than 50 degrees.
3. Stability- In our study twenty oof ne (84%) patients were having stable elbow and four (16%) patients had moderate instability. No patients had gross instability.
4. Daily functions- In our study 19 (76%) patients was atheir ble to comb hair, all twenty-five (100%) patients can eat, all 25 (100%) patients can perform hygiene, twenty (80%) patients can put on a shirt and all twenty-five (100%) patients can put on shoes.

Mayo elbow performance score (mean±SD) at 24 weeks follow up depicted in table-2. However total mean MEPS at 24 weeks was 92.17. In our stu , the final functional outcome was assessed The result was graded as excellent, good, fair, ir and poor. The functional outcome was excellent to good in 92% of patients and fair in 8% of patients (Figure 5).

In our study, out of twenty-five patients, one (4%) patient had posterior interosseous nerve (PIN) palsy, five (20%) patients developed elbow stiffness, two (8%) patients had heterotopic calcification and one (4%) patient had pa ost-op infection. Seventeen patients had no complications.

Discussion

Comminuted fractures of the radial head are most often unreconstructible. Radial head resection is a good option if there is none associated injuries affecting the elbow joint stability [12]. Careful clinical and radiological assessment should be done to diagnose the associated injuries to interosseous membrane, and radio-ulnar instability in comminuted radial head fracture. After radial head excision, weakness and instability of the elbow, late cubitus valgus, secondary subluxation or dislocation of the elbow joint and proximal migration of the radius were the main factors which would impair the elbow functions and also cause persistent pain of elbow and wrist [13]. The radial head is an important secondary stabilizer to valgus stress. Because of the high incidence of injury to the lateral collateral ligament complex, radial head replacement arthroplasty is most often used in the treatment of comminuted fractures of radial head. Speed (1941) first proposed prosthetic replacement of the radial head [14]. After that in 1970s, Silastic (silicone) implants were introduced. It acted as a spacer only without giving any biomechanical advantage in weight transmission. Good results were reported initially; however, longer-term follow-up data indicated problems with failure of the prosthesis and silicone synovitis [15]. Because of the problems associated with silicone radial head replacements the metal prostheses were introduced which are stiffer. Various metal prostheses such as vitallium, stainless steel, and most recently titanium are being used. The metal prostheses have been reported to be durable and help to maintain valgus stability of the elbow after radial head replacement. The purpose of this study was to evaluate the efficacy of radial head arthroplasty in the comminuted radial head fractures and comparing the results with those in literature. In this study mean age of patients was 43 years ranging from 23 to 54 years. More than half of the patients were from 40-50 years of age (56%). It was comparable with mean age of 45 years in study by Ashwood *et al*. [16] and age of 46.4 years in study by Smets *et al*. [17]. Thus we can emphasize the fact that the radial head fractures are common among young and adult individuals.

In the present study majority that is 60% of the patients were males with male to female ratio of 1.5:1 suggesting male preponderance. However, Papovic *et al*. [18] reported male preponderance with male to female ratio of 1.2:1. Higher male to female ratio can be explained by the more involvement of day to day activities compared to females. In our study total 25 patients were studied, out of them fourteen (56%) patients sustained fractures due to road traffic accidents; eleven (44%%) patients were injured due to accidental fall. Thus it can be said that road traffic accidents and accidental fall are the common cause of radial head fractures. In our study total 25 patients were studied, out of them 16 (64%) patients had type III fracture and 9 (36%) patients had type IV fracture according to modified Mason classification. In study by Smets *et al*. [17] 10 (66.67%) patients were Mason type III fractures and 5 (33.33%) patients were having associated elbow dislocation. In our study out of 25 patients, 15 (60%) patients had right sided injury while 10 (40%) had left sided injury. In the study by Smets *et al*. [17], 10(66.7%) patients had right sided fracture while 5(33.3%) were having left sided injury. In the study by Chen A C Y *et al*. [19], 17(53.1%) patients had right sided fracture while 15(46.9%) had left sided fracture. Thus it can be said that dominant arm is involved at most of the times. In our study of 25 patients functional outcome was evaluated on the basis of Mayo Elbow Performance Score (MEPS). The

mean MEPS were 92.17±11.67. Out of 25 patients, 17 (68%) had excellent result, 6 (24%) had good and 2 (8%) had fair results and it is comparable to various studies as Chen A C Y *et al*. [19].

In our study out of 25 patients, one (4%) patient developed wound infection postoperatively which was managed by oral antibiotics and resolved uneventfully in 4 weeks. Moro *et al*. [20] in their study of 25 patients, reported wound infection in one (4%) patient. Thus we can say that the results of our study are more or less comparable with other studies in literature. In our study total 25 patients were studied, out of them one (4%) patients had transient posterior interosseous nerve palsy. Moro *et al*. [20] in their study of 25 patients, reported posterior interosseous nerve palsy in one (4%) case. In study by Smets *et al*. [17] out of 15 patients, one (6.67%) had posterior interosseous nerve palsy. Thus we can say that the results of our study are more or less comparable with other studies in literature. In our study total 2 (8%) patients developed heterotopic calcification. They were being treated by oral NSAIDS and at the time of review these patients had decreased range of motion on affected side. Three (9.38%) out of 32 patients developed heterotopic ossification in study by Chen *et al*. [19]. In our study five (20%) had elbow stiffness. Among these seven patients, 2 are those having heterotopic calcification. These patients were managed by regular physiotherapy and CPM. Thus we can say that the results of our study are more or less comparable with other studies in literature. Thus at the end we can conclude that radial head arthroplasty achieves excellent functional outcome in treatment of comminuted radial head fractures with less complications.

Conclusion

This study was conducted among 25 patients of comminuted radial head fractures for which radial head replacement done and functional outcome was evaluated with excellent functional outcome in most of the patients. The results are comparable to other studies with respect to mechanism of injuries, side involved and Mason classification of radial head fractures. Radial head arthroplasty consistently leads to improved functional outcomes, as is evident from the reviewed literature. However, the consistent low quality of evidence and poor reporting standards reduce any confidence in the findings. This study was not without limitations. Even though it is prospective study, the sample size was small (n=25) and patients were followed up for shorter duration only. Hence, large sample size randomized controlled trials with longer duration of follow up are required to accurately assess the efficacy of radial head arthroplasty for the management of comminuted radial head fractures. Thus we can conclude that Radial head arthroplasty can be used successfully with most of excellent results for treatment of Comminuted fractures of radial head (The Mason type III and IV radial head fractures).

References

1. Morrey BF, An KN. Articular and ligamentous contributions to the stability of the elbow joint. The American journal of sports medicine. 1983 Sep;11(5):315-9.
2. Green DP. Operative hand surgery. InOperative hand surgery. 1988, pp. 3200-3200.
3. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. Injury. 2006 Aug 1;37(8):691-7.
4. Johnson JA, Beingessner DM, Gordon KD, Dunning CE, Stacpoole RA, King GJ. Kinematics and stability of the fractured and implant-reconstructed radial head. Journal of shoulder and elbow surgery. 2005 Jan 1;14(1):S195-201.
5. Ikeda M, Sugiyama K, Kang C, Takagaki T, Oka Y. Comminuted fractures of the radial head: comparison of resection and internal fixation. JBJS. 2005 Jan 1;87(1):76-84.
6. Van Riet RP, Morrey BF, O'Driscoll SW, Van Glabbeek F. Associated injuries complicating radial head fractures: a demographic study. Clinical Orthopaedics and Related Research®. 2005 Dec 1;441:351-5.
7. Somford MP, Wiegerinck JI, Hoornenborg D, van den Bekerom MP, Eygendaal D. Eponyms in elbow fracture surgery. Journal of shoulder and elbow surgery. 2015 Mar 1;24(3):369-75.
8. Mason ML. Some observations on fractures of the head of the radius with a review of one hundred cases. British Journal of Surgery. 1954 Sep;42(172):123-32.
9. Broberg MA, Morrey BF. Results of treatment of fracture-dislocations of the elbow. Clinical orthopaedics and related research. 1987 Mar 1(216):109-19.
10. Ring D, Quintero J, Jupiter JB. Open reduction and internal fixation of fractures of the radial head. JBJS. 2002 Oct 1;84(10):1811-5.
11. Beingessner DM, Dunning CE, Gordon KD, Johnson JA, King GJ. The effect of radial head excision and arthroplasty on elbow kinematics and stability. JBJS. 2004 Aug 1;86(8):1730-9.
12. Sowa DT, Hotchkiss RN, Weiland AJ. Symptomatic proximal translation of the radius following radial head resection. Clinical orthopaedics and related research. 1995 Aug 1(317):106-13.
13. Rokkjaer M. Fractures of the head and neck of the radius treated by excision.
14. Swanson AB, Jaeger SH, La Rochelle DA. Comminuted fractures of the radial head. The role of silicone-implant replacement arthroplasty. The Journal of bone and joint surgery. American volume. 1981 Sep 1;63(7):1039-49.
15. Stoffelen DV, Holdsworth BJ. Excision or Silastic replacement for comminuted radial head fractures. A long-term follow-up. Acta orthopaedica belgica. 1994 Jan 1;60(4):402-7.
16. Bain GI, Ashwood N, Baird R, Unni R. Management of Mason type-III radial head fractures with a titanium prosthesis, ligament repair, and early mobilization. JBJS. 2005 Mar 1;87(1_suppl_1):136-47.
17. Smets S, Govaers K, Jansen N, Van Riet R, Schaap M, Van Glabbeek F. The floating radial head prosthesis for comminuted radial head fractures: a multicentric study. Acta orthopaedica belgica. 2000 Oct 1;66(4):353-8.
18. Popovic N, Gillet P, Rodriguez A, Lemaire R. Fracture of the radial head with associated elbow dislocation: results of treatment using a floating radial head prosthesis. Journal of orthopaedic trauma. 2000 Mar 1;14(3):171-7.
19. Chen AC, Chou YC, Weng CJ, Cheng CY. Long-term outcomes of modular metal prosthesis replacement in patients with irreparable radial head fractures. Journal of orthopaedic surgery and research. 2018 Dec;13(1):1-7.
20. Moro JK, Werier J, MacDermid JC, Patterson SD, King GJ. Arthroplasty with a metal radial head for unreconstructible fractures of the radial head. JBJS. 2001 Aug 1;83(8):1201-11.