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## Short term comparative study of fixation versus replacement in the treatment of mason type iii radial head fractures

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### Abstract

**Background:** Radial head fractures accounts for one third of elbow fractures. The treatment of comminuted, unstable fractures which often have a worst prognosis is still controversial. The objective of this study was to compare replacement of the radial head by metal prostheses with open reduction and internal fixation (ORIF) for the treatment of Mason type 3 radial head fractures.

**Materials and Methods:** A prospective randomised controlled trial was employed to investigate 30 patients with Mason type 3 radial head fractures, from June 2016 to June 2018. The patients were randomized to two groups: the ORIF group and the radial head replacement group. Over the next two years, follow-up assessments recorded. The overall functional outcome was rated using Broberg and Morrey's rating system.

**Result:** The outcome was considered to be satisfactory if the result was good or excellent and unsatisfactory if it was fair or poor. The outcome was satisfactory in 86.6% of patients in the replacement group and in 66.7% of patients in the ORIF group.

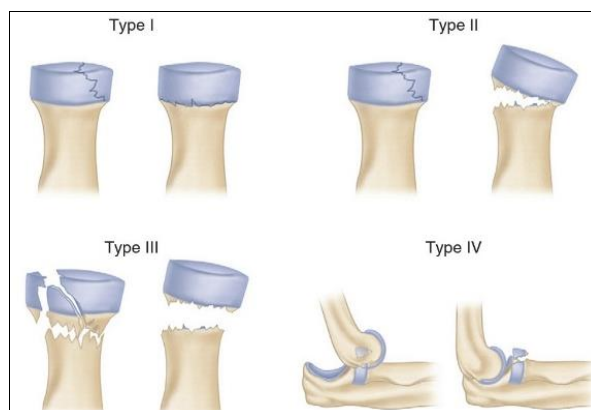
**Conclusion:** Compared with open reduction and internal fixation, radial head replacement with a metal prostheses resulted in favorable joint function for type 3 Mason fractures.

**Keywords:** Radial head, comminuted, internal fixation, replacement, mason type III

### Introduction

Fractures of the radial head accounts for one third of elbow fractures. Radial head fractures most commonly occur as the result of fall on the outstretched hand with partially flexed and pronated elbow.

The radial head plays a vital role in maintaining elbow stability. The ulnohumeral articulation and the medial and lateral collateral ligaments are the three primary static stabilizers of elbow. Secondary stabilizers include radial head, joint capsule and the common flexor and extensor origins. The muscles crossing the elbow function as dynamic stabilizers. If coronoid process or medial collateral ligaments (MCL) are injured, radial head becomes a critical stabilizer.



**Fig 1:** Mason's classification

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Mason type I fracture, because of nondisplacement, should be managed without surgery. Displaced radial head fractures (Mason type II), are often treated operatively, good results can be achieved with open reduction and internal fixation (ORIF). Management of radial head fracture of Mason type III remains controversial among clinicians.

The surgical options for complex fractures include ORIF, excision, and replacement of the head. Excision of the radial head for fracture has a high complication rate. Excision of radial head may lead to loss of strength, valgus instability, & proximal migration of radius leads to wrist pain. ORIF and radial head prosthesis replacement have been used in the treatment of radial head fractures of Mason type III in recent years. The management of this issue remains a matter of controversy. This study was conducted to compare ORIF with radial head prosthesis replacement in the treatment of Mason type III-+ radial head fracture.

### Materials and Methods

In this study 30 patients with Mason type 3 radial head fractures who were admitted in Tirunelveli medical college from June 2016 to June 2018 were included. All the patients were randomly divided into the replacement group and ORIF group. The replacement group consisted of 15 patients, nine men and six women, who received treatment of the fracture with radial head prosthesis replacement. The ORIF group consisted of 15 patients, ten men and five women, who received treatment of the fracture with ORIF. The average age was 46 years in the replacement group and 39 years in the ORIF group. In the replacement group, patients received bipolar titanium radial head prosthesis. The ORIF group was treated using radial head locking plate (11 patients), mini T plate with lag screw (4 patients). The average follow up period was 2 years. Functional outcome at 2 years was evaluated using Broberg and Morrey's rating system.

### Surgical Techniques

All cases done in regional block under tourniquet control. KOCHER's approach used commonly for isolated radial head fracture & for associated proximal ulna fracture BOYD'S approach is used.

For replacement - the annular ligament was incised transversely, radial head sectioned at the junction of radial head and neck using an oscillating saw.

The excised fragments are reassembled on the back table to confirm that all fragments are removed correct from the elbow and to measure the diameter and thickness of the radial head prosthesis. The optimal implant diameter is typically the minor diameter of the elliptical native radial head, most commonly 2 mm smaller than the maximum diameter. When it comes in between sizes, smaller prosthesis is usually chosen both in diameter as well as thickness. The proximal medullary canal of the radius was then prepared with burs or rasps to accept the implant. After the use of a trial prosthesis has demonstrated satisfactory contact between the capitulum and the prosthesis, and a good fit in the radial medullary canal is found, the final prosthesis is inserted. The definitive prosthesis is cemented. Then annular ligament was repaired.

For ORIF - after exposing the radial head, fragment reduced under direct vision. In 3 out of 15 cases, the shattered fragmented bones were reconstructed externally (on table reconstruction). After the reconstruction of the radial head they were fixed with either 2.7 mm radial head locking plate or lag screw and 2 mm mini T plate. The plates were placed in the safe zone of the radial head. Safe zone is the area of radial head that does not articulate with ulna.

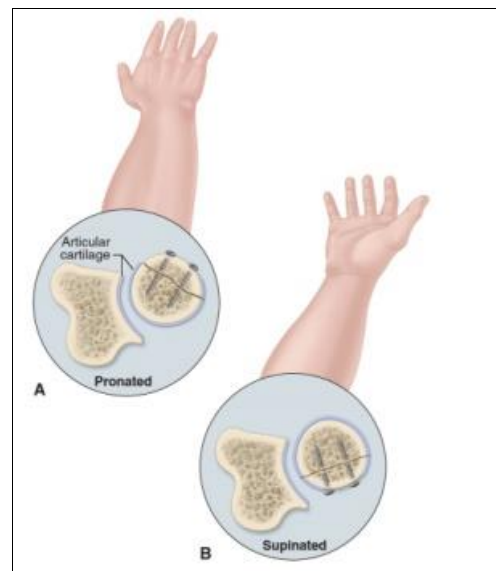


Fig 2: "safe zone"

The non-articulating portion of the safe zone consistently encompasses a 90 degrees angle localized by palpation of the radial styloid and Lister's tubercle. Annular ligament repaired. Associated injuries repaired.

### Rehabilitation Protocol

Patient immobilised in above elbow slab until suture was removed. Then active and passive range of motion exercises of elbow was started. Varus / Valgus forces across the elbow and axial loading of extremity allowed after 3 months postop.

### Follow Up

Patients were reviewed on 6<sup>th</sup> week, 12<sup>th</sup> week and thereafter every 3 months. They were assessed both clinically and radiologically. The parameters evaluated radiologically are fracture union, loss of reduction, implant location, osteoarthritic changes, loosening of implant and periprosthetic osteolysis. The clinical outcome was determined by using the Broberg and Morrey's rating system.

Broberg and Morrey rating system	
Variable	No. of points
Motion (total for each plane) (degrees)	
Flexion (0.2 x arc)	27
Pronation (0.1 x arc)	6
Supination (0.1 x arc)	7
Strength	
Normal	20
Mild loss (appreciable but not limiting; strength 80% that of contralateral side)	13
Moderate loss (limits some activity; strength 50% that of contralateral side)	5
Severe loss (limits everyday tasks, disabling)	0
Stability	
Normal	5
Mild loss (perceived by patient, no limitation)	4
Moderate loss (limits some activity)	2
Severe loss (limits everyday tasks)	0
Pain	
None	35
Mild (with activity, no medication)	28
Moderate (with or after activity)	15
Severe (at rest, constant medication, disabling)	0

Umile Giuseppe Longo, et al. Rating systems for evaluation of the elbow. British Medical Bulletin 2008

Excellent 95-100 points;  
Good 80-94 points; Fair 60-79 points;  
Poor <60 points:

**Results**

Out of 15 patients who received radial head replacement, 8 showed excellent, 5 showed good, and 2 patient showed fair functional outcome according to Broberg and Morrey’s rating system. One patient developed elbow stiffness probably due to delayed presentation after injury and poor participation in the post op rehabilitation. One patient who had associated olecranon fracture developed heterotopic ossification. There were no post-operative nerve injury, infection noted.

In fixation group out of 15 patients, 4 patients showed excellent, 6 showed good scores and 3 showed fair scores and 2 had poor scores. In our study, after fixation movements in the flexion and extension plane were excellent and restriction of movements occurred in rotational plane especially in pronation. The causes for movement restriction in our study were the wrong placement of the implant out of the safe zone, loss of fracture reduction, heterotopic ossification. One patient had PIN palsy and infection occurred in one patient which was managed initially with antibiotics and once the infection removal of implant after fracture union.

**Table 1:** Borberg and Morrey elbow scores at 2 year follow up

	Replacement	ORIF
Mean elbow score	92.6	82.3
No of patients (%)		
Excellent	8 (53.3%)	4(26.7%)
Good	5 (33.3%)	6(40%)
Fair	2 (13.3%)	3(20%)
Poor	0	2(13.3%)
Total	15(100%)	15(100%)

The outcome was considered to be satisfactory if the result was good or excellent and unsatisfactory if it was fair or poor. The outcome was satisfactory in 86.6% of patients in the replacement group and in 66.7% of patients in the ORIF group.

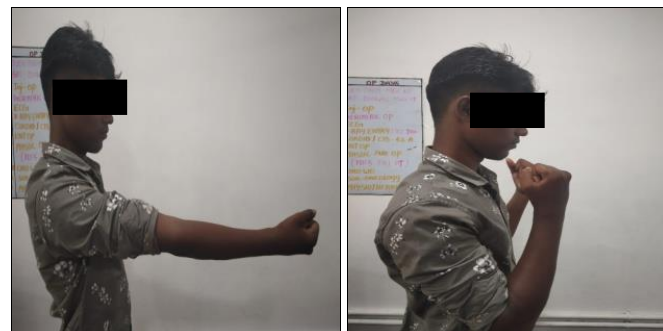
**Table 2:** Post surgical complications at any follow up

Complication type	Replacement N =15	ORIF N=15
Infection	0	1(6.7%)
PIN palsy	0	1(6.7%)
Loss of reduction	0	1(6.7%)
Heterotopic ossification	1(6.7%)	1(6.7%)
Elbow stiffness	1(6.7%)	3(20%)
Total	2(13.3%)	7(46.7%)

**Pre op x ray**



**2 years follow up**



**Case 1:** 20 year old patient after RTA sustained Right elbow monteggia fracture variant. Radial head fixed with pre contoured locking plate. Follow-up after 2 years - flexion in elbow 0°- 130°; pronation/supination 75°-0°-85°. The patient had functional score of 90 points.

**Pre op image**



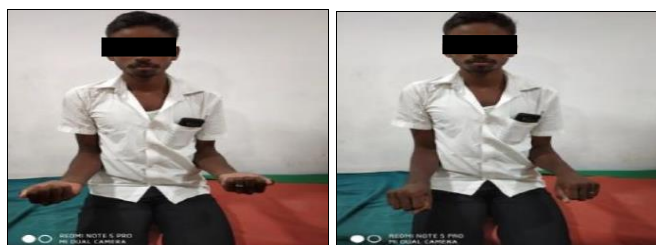
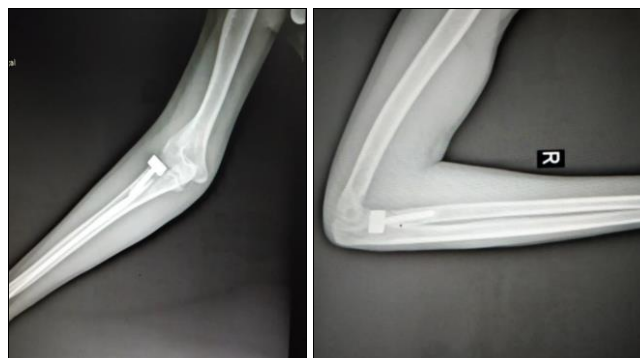
**2 year follow up**







**Follow up**



**Case 2:** 24 year old male patient after fall on outstretched hand sustained Right elbow mason type 3 radial fracture. Fracture was fixed with Herbert screw and 2.0 mm mini T plate. Follow-up after 2 years - flexion in elbow 0°- 135°; pronation/supination 80°-0°-90°. The patient had functional score of 95 points.

**Case 3:** 24 year old male patient after fall on outstretched hand sustained Right elbow mason type 3 radial fracture. Radial head replacement done. Follow-up after 2years ; flexion in elbow 0°- 140°; pronation/supination 90°-0°-90°. The patient had functional score of 96 points.

**Pre op image**



**Post op image**



**Discussion**

Radial head fractures occur in about 17–19% of cases of elbow trauma and account for 33% of elbow fractures. Mason type I fractures can be managed without surgery and Mason type II fractures can be managed with open reduction and internal fixation with excellent results achieved. Most clinicians have personally experienced dissatisfaction with the treatment of radial head fractures of Mason type III, which has many surgical options, and this has resulted in controversy.

The early treatments of unstable and comminuted radial head fractures included excision of the radial head. However, in the follow-up, we found that excision led to a high complication rate. Several significant complications were symptoms at the wrist, degenerative arthritis and so on. With the development of the understanding of biomechanics, the role of the radial head in the elbow, mainly force transmission and elbow stability maintenance, are attracting greater attention. Experiments have demonstrated that after radial head excision, elbow extension decreased by 30%.

When the collateral ulnar ligaments were injured, the integrity of brachioradial articulation was an important factor for elbow stability maintenance. Ring *et al.* reported that four patients out of 11 who underwent terrible triad fractures and radial head excision presented with articulation instability. Josefsson *et al.* reported that out of 19 patients with elbow fractures and dislocation who undertaken radial head excision, three

presented with redislocation and out of 15 patients followed-up 11 had post-traumatic arthritis.

Increasing popularity of the novel technique—internal fixation—for the treatment of mini fractures and growing importance attached to the radial head result in the tendency to preserve comminuted radial heads by internal fixation. Recent researches have demonstrated that after internal fixation operations, unstable, dislocated and comminuted radial head fractures tended to develop internal fixation failures, nonunions and forearm rotation impairment.

Ring *et al.* reported the effects of internal fixation for complex radial head fractures. Of 26 patients with Mason III type radial head fractures, ten required revision for fixation failure, healing failure and chronic, persistent pain. In the remaining 16 patients, five reported unsatisfactory results. Heim *et al.* [21] demonstrated that fractures in six out of 11 patients with ORIF for comminuted radial head fractures failed to heal. Cai *et al.* [22] reported that results of the follow-up of nine patients with Mason type III radial head fractures, who underwent open reduction and mini-steel plate interfixed operations, achieved only 22% satisfaction rate.

In our study, out of 15 patients in the ORIF group, 10 patients showed satisfactory results, in which most of them had only 3 radial head fracture fragments and had adequate fragment size to hold screws. Most of them were young & actively participated in the post op rehabilitation. Most of the unsatisfactory results occurred in severely comminuted fractures. The problems in severely comminuted fractures are difficult reduction (often requiring on table reconstruction), fixation failure due to secondary fragment displacement, non union. In our study, we performed on table reconstruction for 3 patients because of comminution. In our study 2 loss of reduction occurred in one patient and no non union noted. Heterotopic ossification noted in 1 patient. The total satisfaction rate was 66.7%. We believe that for severely comminuted radial head fractures (> 3 radial head fragments), the failure rate of internal fixation is relatively high, which should be taken into account. Therefore, for comminuted and unstable radial head fractures, radial head replacement with prostheses is an appropriate option to best reconstruct stable structures of the elbow and avoid weakness, pain and instability afterwards.

Harrington *et al.* reported that of 20 cases with titanium radial head replacement and an average 12 (range, 6–9) years' follow-up, 16 cases reported excellent or good results with no prostheses-related complications. They believed metal radial head replacement was able to restore stability of the elbow and prevent proximal displacement of the radius, thus reducing extension of the elbow and complications of the ulnoradial joint. Grewe *et al.* Believed that standard-designed prostheses for comminuted radial head fractures were safe and effective with satisfactory results and least function impairments.

In our study 15 cases were involved with two years' follow-up. According to Broberg and Morrey scores, 86.6% presented with excellent or good results. Radial head prosthesis replacement should be restricted to its indications, mainly the unstable and comminuted radial head fractures, including Mason type III radial head fractures associated with collateral ulnar ligaments injury or Essex-Lopresti injury, ulnar coronoid process fractures, proximal ulnar fractures or ulnar anconeal process fractures. For those relatively stable, comminuted radial head fractures devoid of associated fractures and ligament injury, i.e.  $\leq 3$  bone fragments, radial heads should be preserved. Because prostheses have problems

of loosening, wearing on long term. Researches by Pomianowski *et al.* [25] revealed that no prosthesis could fully restore the articular stability. The factors which contribute to successful outcomes for replacement include correct implant size and positioning. Failure of which lead to lengthening and overstuffing or shortening and instability.

Compared to ORIF, replacement had the advantage of less trauma to soft tissues, short operative time, less blood loss and early return of activities.

### Conclusion

We conclude that cement stem and bipolar radial head prosthesis replacement is better than ORIF in treatment of Mason type III radial head fracture.

ORIF is indicated in young patient who had  $\leq 3$  radial head fracture fragments.

Prosthesis replacement can better restore the stability, flexion and extension of the elbow, and the rotational motion of the forearm.

However, longer-term follow-up will be required in order to come to more definitive conclusions regarding the use of the bipolar radial head prosthesis.

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