



## Management of Mason IV radial head fractures: A tertiary care hospital, experience

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Prevalence rate of radial head fracture account for approximately 4% of reported fractures while 33% of reported elbow fractures worldwide. Radial head fractures affects young population, This study aims to assess the efficacy of radial head replacement in mason type IV radial head fracture, evaluate the clinical outcomes of patients who received this implant with functional scoring scale by MAYO. A total of 30 patients with communized radial head fractures were enrolled, The Mayo Elbow Performance Index (MEPI) is the major handy score for estimating elbow performance We used the Kocher's approach for this procedure. Chi-square test was performed to check the significance P-value of < 0.05 was considered as significant. Mean hospital stay was measured as  $2.3 \pm 0.6$  days with minimum and maximum days of 2 and 4 respectively. After surgery, postoperative hemoglobin values were analyzed in mean with results of  $11.1 \pm 0.6$ , and mean hemoglobin drop was measured as  $0.4 \pm 0.1$ . The mean pain VAS score was reported as  $3.6 \pm 1.0$ . The study participants were categorized within above-mentioned groups as 14(46.6%), 4(13.3%), 8(26.6%), and 4(13.3%) respectively. The importance of time within presentation and surgery has been proved as crucial in other studies too, our study participants had only 4 patients with a waiting time of 48 hours with poor elbow performance and failure of surgery Mason type IV fractures or also known as fracture-dislocations, multiple complications were reported including instability and stiffness as a major component of revision.

**Keywords:** Radial head fracture, Mason IV

### INTRODUCTION

Prevalence rate of radial head fracture account for approximately 4% of reported fractures while 33% of reported elbow fractures worldwide (Gruszka D, 2019-Koyer FM, 2013-Laumonerie P, 2019) Common presenting complaints are pain at the affected side, stiffness, and swelling of the elbow. Presentation of such symptoms incline orthopedics to consider this fracture as simple and uncomplicated, deceived diagnosis and treatment results in dysfunction.(Pogliacomini F, 2015) Radial head fractures are challenging to manage especially when associated with dislocation of the elbow, which is prevalent in 10% of radial head fractures, this complication often results in poor outcomes for patients and enhances the challenge to attending health care providers (Quinzi DA, 2021) established the classification of predictive tool used for decades as a gold standard, (Dillon MT, 2010) while another study incorporated four forms of radial head fractures, (Johnson JA, 2005) defined Type I and II as marginal fractures with minimal

displacement, no mechanical block & displacement respectively, Type III defined as comminuted fracture while type IV was associated with elbow dislocation. Mason types I and II administration has been commonly acknowledged as non-operative treatment (Type I) or with screws (Type II). (Swensen SJ, 2019) Intricate, uneven fractures of the radial head, such as Mason type III and IV, are a unique surgical task due to the connotation with additional injuries nearby the elbow and forearm and are frequently linked with instability. However, Type III & IV management has been controversial, a few researchers advocated the reconstruction of the native radial head while some insisted on ORIF. These procedures are demanding and bear the risk of complications. (Lanzerath F, 2021) Comminuted fractures are considered unmanageable and surgical treatments are associated with multiple ligament injuries compromising elbow stability. While the key objective of invasive management is to restore elbow mobility and preserve physiological elbow kinematics, the medial collateral ligament is only

responsible to keep the stability of the elbow in order, its preservation is necessary to avoid chronic instability. Researchers stated proximal migration of radius and longitudinal instability, decline grip strength, and ulnar neuropathy. (Aslam A, 2021- Gao X, 2019) Radial head replacement is known as acute management of unrepairable radial head fractures, multiple prostheses have been developed in the past decade, diverse in geometry, the material used to manufacture, and methods of fixation. Loosening of the radial head is associated with pain in the arm, bone loss, and expansion of the radial neck. (Lee ys, 2018) The radial head acts as an additive of the elbow in valgus and spin. In the occurrence of other lacerations, commonly associated with fractures of the radial head, auxiliary arthroplasty can subsidize significantly to the stability. Auxiliary prostheses might be used in continuing situations, counting nonunion, osteoarthritis, and when symptoms ascend subsequent preceding resection of the head. Failure of replacement leading to revision surgery is stated in numerous studies, but the precise mechanism of failure and the results of reoperation are presently unidentified. (Bergmann M, 2020 – Mazhar FN, 2018) Radial head fractures affects young population with a mean age at the time of injury of 43 years, these active patients depend on the physiological function of the elbow for everyday activities. The intricacy of these osteoligamentous injuries can clarify the ongoing inability after radial head fractures. A revision rate of up to 15% has been testified at 2 years subsequently to surgery of radial head fractures, lack of conclusive evidence about the most communal cause of adjustment subsequently radial head fractures and related rescue measures. (Avisar E, 2021- Vannabouathong C, 2019) This study aims to assess the efficacy of radial head replacement in mason type IV radial head fracture, evaluate the clinical outcomes of patients who received this implant with functional scoring scale by MAYO, reasons of failure and/or redo surgeries within an acute setting department of tertiary care hospital, Karachi Pakistan.

## MATERIALS AND METHODS

### Study Participants:

From January 2020 to December 2021, a total of 30 patients with communized radial head fractures were reported in the emergency department of orthopedic surgery, Dow university hospital, Karachi. Fractures were classified according to the Mason classification system modified by Johnston, and only Mason type IV fractures were included. These patients were enrolled in the study after signing informed consent and understanding the study design and follow-up details.

### Questionnaire:

A pre-structured questionnaire was used to get all the required information from study participants, this

questionnaire had three parts, part I had demographic details including age, sex, site of the fracture, date of presentation, and presence of any additional injury. Part II had pre-operative and intra-operative details including pre-operative hemoglobin level, date of surgery, duration of surgery, and intra-operative complications, while part III had post-operative details including post-operative pain VAS score, complications, hospital stay, reported success or failure of surgery and, post-operative hemoglobin levels.

### Mayo Elbow Performance Score (MEPS):

The Mayo Elbow Performance Index (MEPI) or score (MEPS) is the major handy score for estimating elbow performance, including elbow stiffness, with an assortment of movement (ROM, flexion-extension) being the most common obstacle for patients. The Mayo score has been endorsed by several studies and proved to be one of the best scores to determine elbow physiological functions.<sup>17</sup> this score is categorized within four major functions of elbow performance including Pain, Motion, Stability, and function. Each function has specific points, for example, the pain has 45 points, the motion has 20, stability has 10 and the function has 25 points as a perfect performance, the points distribution depends upon the degree of pain, motion in Arc degree, stability points and day to day functioning. Upon completion the sum of points indicates elbow performance, the results are categorized into four items, Excellent performance with >90 points, good performance with 89-75 points, fair performance with 74-60 points, and poor performance with <60 points in total. (Geurts EJ, 2019)

### Surgery:

We used the Kochers approach for this procedure. Intraoperative bone fragments were removed, radial head replaced, and stability checked. Soft tissue repaired/reconstructed as per need and wound closed in layers. Under the cover of good analgesia or when the patient was pain-free, an aggressive rehabilitation protocol was followed.

### Post-operative follow up:

Upon discharge, patients were asked to visit a health care facility every 30 days for 4 months. Patients were asked for their generalized day-to-day activities and problems related to the affected arm, any pain, or other clinical symptoms if reported. Re-do surgery after failure was performed.

### Radiographic assessments:

Radiographic assessments were performed upon presentation to confirm the diagnosis, after the procedure to evaluate the success of the surgery, and upon follow-up. X-ray was used as a radiological technique.

**Data Management:**

Statistical package of social science version 22 was used for data entry and statistical analysis, for independent variables frequencies and percentages were analyzed. Mean  $\pm$  standard deviation was used to report descriptive data such as age, hemoglobin values, hospital stay in days, and duration of surgery in minutes. Chi-square test was performed to check the significance of the of study variables with post-operative days. P-value of  $< 0.05$  was considered as significant.

**Ethical consideration:**

Institutional review board approved the study after through consideration, with approval IRB number of IRB/Ortho/07/19

**RESULTS**

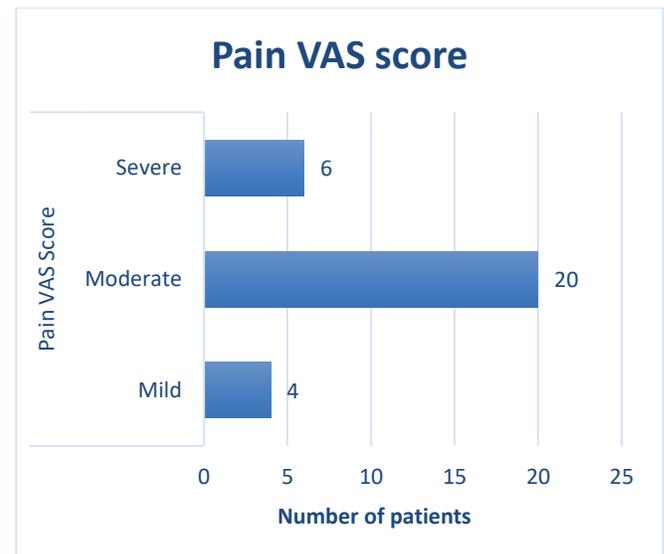
A total of 30 patients was included in the study with a mean age of  $40.9 \pm 6.3$  years, upon presentation, the hemoglobin level was measured, and mean hemoglobin was  $11.6 \pm 0.7$ . The patients underwent surgery, duration of surgery was measured in minutes, and mean duration was reported as  $42 \pm 8.4$  mins with a minimum duration of 30 minutes and maximum of 60 minutes. Mean hospital stay was measured as  $2.3 \pm 0.6$  days with minimum and maximum days of 2 and 4 respectively. After surgery, postoperative hemoglobin values were analyzed in mean with results of  $11.1 \pm 0.6$ , and mean hemoglobin drop was measured as  $0.4 \pm 0.1$ . The mean pain VAS score was reported as  $3.6 \pm 1.0$ . The duration between presentations with injury to surgery was calculated in mean, the result indicated  $2.1 \pm 1.0$  days with a minimum 1-day breach and maximum 4 days gap. (Table I) Within 30 radial head fractures, 22 (73.3%) were on the right side while 8 (26.7%) were on the left side, failure of radial head replacement was noted in 4 (13.3%) of patients, and the reason was an infection.

**Table I: Descriptive analysis of study participants**

Descriptive analysis			
Variables	min	max	mean $\pm$ St. deviation
Age (years)	30	51	$40.9 \pm 6.3$
Pre OP HB	10.8	12.8	$11.6 \pm 0.7$
Post OP HB	10.3	12.3	$11.1 \pm 0.6$
HB Drop	0.3	1	$0.4 \pm 0.1$
Duration of Surgery	30	60	$42 \pm 8.4$
Pain VAS score	2	6	$3.6 \pm 1.0$
Hospital Stay	2	4	$2.3 \pm 0.6$

Presentation to surgery time (days)	1	4	$2.1 \pm 1.0$
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Upon analyzing the categorical distribution of pain VAS score, 4 (13.3%) participants reported mild pain, 20 (66.6%) reported moderate pain score while only 6(20%) reported severe pain after surgery. (Fig I)

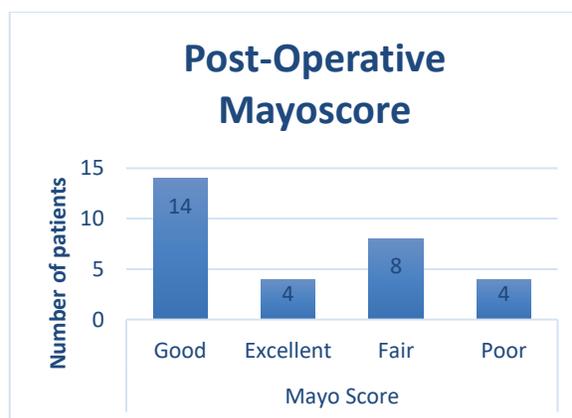
**Figure I: Post-operative pain VAS score of study participants.**

Time-lapse between presentation with injury to diagnosis and radial head replacement was analyzed to assess the effect on treatment, upon analyzing the data the revision of procedure was reported in all patients, 23 (76.7%) patients underwent radial head replacement surgery within 2 days of presentation, 4(13.3%) had 3 days between presentation and surgery while only 3(10%) had 4 days of a wait before surgery. The failure of surgery and revision of procedure was required in 2 (6.6%) patients who underwent surgery after 3 days of presentation while 2 (6.6%) who waited for 4 days before surgery, the p-value was reported as significant and 0.02. Duration of surgery was insignificant with no specific pattern, 35 mins were recorded in 2(6.6%) patients who underwent surgery after 4 days of presentation while the same group indicated prolonged surgery duration too. Complications were reported in delayed surgery patients only, with a significant p-value of 0.01. Mayo elbow performance score was measured as poor in the delayed group, indicating a positive impact of presentation to surgery duration upon the success of the procedure. (Table II)

**Table II: Association of time from injury to surgery with the success of procedure.**

Presentation to surgery duration (days)						
Variables		Surgery after 1 day	Surgery after 2 days	Surgery after 3 days	Surgery after 4 days	P-Value
Revision Procedure	of Yes	0	0	2	2	0.02
	No	10	10	4	2	
Duration Surgery	of 30	2	2	0	0	0.08
	35	4	0	0	2	
	40	2	2	4	0	
	45	0	0	2	0	
	50	2	6	0	0	
	60	0	0	0	2	
Failure Surgery	of Yes	0	0	2	2	0.03
	No	10	10	4	2	
Pain Score	VAS Mild	4	0	0	0	0.02
	Moderate	4	6	6	4	
	Severe	2	4	0	0	
Complications	Infection	0	0	2	2	0.01
	None	10	10	4	2	
Hospital Stay (Days)	2 days	8	8	5	2	0.15
	3 days	1	2	1	0	
	4 days	1	0	0	2	
Mayo Score	Excellent	2	2	0	0	0.08
	Good	4	4	4	2	
	Fair	4	4	0	0	
	Poor	0	0	2	2	

Mayo elbow performance score frequency was measured in pre-validated categories of excellent performances ranging score >90, good performance with a score of 89 - 75, Fair performance with a score of 74-60, and poor performance with a score of <60. The study participants were categorized within above-mentioned groups as 14(46.6%), 4(13.3%), 8(26.6%), and 4(13.3%) respectively. (Figure II)



**Fig II: Post-operative mayo elbow performance scoring.**



**Mayo elbow performance score visuals of operated participants.**



**Radiological presentation of pre-operative and post-operative elbow adjustment**

**DISCUSSION**

Management of radial head fractures has been evolved in the past decade, increase in reported cases and delayed diagnosis are added problems of radial head fracture, as most of the time the RHF is accompanied with other elbow injuries, restoration of mobility, strength and function of arm is first priority. Mason type I or fractures with no motion resistance can be managed with primary vigorous motion deprived of fracture shift. Mason type II

injuries along with motion blockage and scarcer rubbles may be preserved with ORIF as it has excellent results. Mason type II fractures presented with > 3 fragments and substantial comminution indicated deprived results with ORIF, and radial head replacement is ideal. (Brinkman JM, 2005 – Marsh JP, 2016) The management of mason III and IV radial head fractures are surgical implantation of replacement, an actual possibility for dealing with elbow injuries, with the retrieval of practical elbow assortment of motion and minimal complication rate. The existing literature supports the use of metallic, smooth implants, as the reported complications of press-fit are anatomical implants and reoperations. Bipolar implants are known for their excellent lasting results. (Giannaka M, 2021) The main concern of health care providers for radial head fracture patients is to restore joint stability and movement of an arm, ORIF is not feasible in Mason type III & IV fractures as it may cause resistance to mobility and stability of elbow joint after treatment where fracture is escorted with other bone injuries, which leaves radial head replacement as the only procedure of choice. The aim of our study is to assess the efficacy of radial head replacement after MASON type IV radial head fracture, the allocation of study participants in our study was similar to most of the studies conducted to evaluate the efficacy of radial head replacement, although a few studies had smaller sample size, our study had increased number of included patients as no lost to follow up was reported. (Morrey BF , 2000 - Sershon RA , 2018) Age of study participants was reportedly lower as compared to another study where the maximum age was 74 years,( Cristofaro CD, 2019) the age plays an important role in healing mechanism and pain coping attitude of patients, our study participants were comparatively younger as it has been established that RHF are more common in young population due to traumatic incidents. Our results indicate declined pain VAS score after surgery with good to excellent Mayo elbow performance score, only 4 patients showed poor performance, a published case series exhibited comparable results after radial head replacement confirmed no signs or symptoms of unsteadiness at final evaluation with excellent patient self-reported results in 87% of patients who underwent radial head replacement for radial head fractures.( Nosenzo A , 2021) Reported complications such as post-operative pain, stiffness, reduced strength, post-traumatic arthritis, unsteadiness, valgus and rotation issues like the functional range of movement of the elbow are from 30° to 130° flexion.( Viveen J, , 2019) lower Pain VAS score has been indicated in much retrospective analysis of radial head replacement studies, Mayo elbow performance scores have been used and results showed good outcomes post-operatively.( Harrison JW, 2007) The importance of time within presentation and surgery has been proved as crucial in other studies too, our study

participants had only 4 patients with a waiting time of 48 hours with poor elbow performance and failure of surgery.<sup>25</sup> Success rates of radial head replacement outcomes after recent injury ranges from 60%-80%, while our study indicated 26/30 (86.7%) success after radial head fractures, similar to other published studies indicating > 85% success rate overall (Catellani F, 2018 - Somerson JS, 2019) The need for revision classified with Mason type of fracture indicated that in Mason type I and type II injuries, the major cause of revision are stiffness and symptomatic osteoarthritis. Mason type III specifically showed nonunion or necrosis and damage of reduction along with stiffness. Mason type IV fractures or also known as fracture-dislocations, multiple complications were reported including instability and stiffness as a major component of revision. (Vlček M, 2019) Other complications such as aseptic loosening, Elbow instability, and osteoarthritis were not reported in our study participants. The limitation of this study is the small sample size and short follow-up duration. Degenerative arthritis was not concluded as follow-up was only limited. A multicenter study with a larger sample size from all age groups and a longer follow-up time is essential to eradicate all confounding factors related to study results. A larger randomized control trial will help determine the results accuracy of different techniques and procedures of radial head fracture as well.

## CONCLUSION

In our study, the outcomes indicated that chances of revision of surgery and infection are higher in patients who underwent surgery after 24 hours of injury as compared to patients with the less waiting time. The success rates are similar with many published studies, Mayo elbow performance score results were good and elbow stability and motion were restored in almost all patients after surgery.

## CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

## ACKNOWLEDGEMENT

Add acknowledgements here

## AUTHOR CONTRIBUTIONS

MRJ: Objective, ERC approval, patient recruitment

SMKK: Subject specialist

MS: Surgery assistance

MAS: Surgery assistance

SK: Follow up

AAS: radiological investigation assessment

ST: write-up and analysis

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