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Mason Radial Head Fractures: Surgical Management

Nisar Ahmed, Syed Muhammad Mohtashim Ali, Malik Muhammad Hamdan Tafheem

ABSTRACT:

Objective: To evaluate the efficacy of radial head replacement in Mason Type III and IV radial head fracture. To evaluate the clinical outcomes of patients who received radial head replacement implant.

Study design & setting: This is a cross-sectional, analytical study, conducted in the Orthopedic Department of Doctor's Hospital Kharian.

Methodology: Study was conducted from 15th April 2023 to 15th February 2024, Stability was assessed, radial head replacement was performed, and bone fragments were extracted during surgery. Radiographic evaluations were carried out to confirm the diagnosis at presentation, to determine the surgical outcome post-procedure, and during follow-up. SPSS-22 was used for data entry and statistical analysis, Cross-tabulation and chi-square test was performed, P-value of < 0.05 was considered significant.

Results: The research comprised 70 patients, whose average age was 38.5 ± 9.4 years. Upon presentation, their mean hemoglobin level was 12.1 ± 1.5 mg/d. The mean time of the operation was recorded as 68.5 ± 18.9 minutes, with a minimum of 45 minutes and a maximum of 100 minutes. The frequency of the Mayo elbow performance score was determined using pre-validated categories: >90 for outstanding performance, 89–75 for good performance, 74–60 for fair performance, and <60 for bad performance, the study participants were divided into 38 (54.2%), 18 (25.7%), 10 (14.2%), and 4 (5.7%) groups, respectively.

Conclusion: Redo surgery and rate of infection are greater in patients who underwent surgery after 24 hours of injury as compared to patients who were operated within 24 hours.

Keywords: Implant of radial head, Mason III, Mason IV, Orthopedic surgery, Radial Head fracture

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INTRODUCTION:

Radial head fractures constitute 4% of all reported fractures while a whopping 33% of elbow fractures are reported worldwide.[1] They most commonly present with pain of the affected side, elbow swelling, mild restriction of mobility, tenderness, and stiffness. This benign-looking presentation is deceptive to the surgeon who can render this fracture as a simple or uncomplicated elbow fracture, leading to inadequate management and/or joint dysfunction.[2] Elbow dislocation is associated with 10% of radial head fractures and makes it more challenging to deal with,[3] and is also a poor prognostic factor in terms of patient outcome.

In 1954, Mason established a predictive tool for the classification of radial head fractures that has been used as a gold standard for many years.[4] In 1962, Johnston rephrased four forms of radial head fractures,[5] namely, Type I - <2mm displacement, Type II ->2 mm displacement, Type III – Comminuted, and Type IV -Associated proximal radial dislocation, and now the classification is also known as Mason-Johnston Classification.

Mason Types I and II are likely to be dealt with conservative management or ORIF (screws) respectively.[6] Type II with bigger displacement may require radial head replacement, while types III and IV are complex and more challenging to deal with owing to the communited fragments causing collateral soft tissue damage and ligamentous loss that sways the limb toward instability. Literature states proximal migration of radius and longitudinal instability, decline grip strength, and ulnar neuropathy. The management of these two types is a thought for debate and causes a battle between two schools of thought, one favoring ORIF while others

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incline toward reconstruction of the native radial head. Both these procedures pose a risk of complications postoperatively in terms of limb deformity.[7] The primary aim is to preserve the integrity of the Medial Collateral Ligament (MCL) as it is the prime contributor to joint stability.

In surgically difficult radial head fractures, radial head replacement serves as an option for acute management. Different prostheses have been developed to perform this surgery, which is diverse in geometry, design, and options for fixation. Loosening of this radial head can cause paresthesia, pain, stiffness, or expansion of the radial neck. [8] The radial head is an important adjunct for the provision of the valgus.

Auxiliary arthroplasty can provide further stability in case of radial head fractures associated with other lacerations. Non-union, osteoarthritis, and other situations also warrant the need for an auxiliary prosthesis. Prosthesis failure and rejection are documented in numerous literature, but the cause of failure and prognosis of redo surgery are not identified to date.[9] The incidence of radial head fractures is highest in the younger population with a mean age of 43 at the time of injury which is heavily dependent on the mobility of the elbow. The rate of redo surgery has been documented up to 15% at 2 years. Lack of evidence limits our understanding regarding common causes of adjustment following radial head fractures and relevant management options. When radial head fractures are the result of high-energy traumatic processes, they may be linked to other injuries that are clinically significant. When assessing radial head fractures, ligament disruption and related elbow fractures—particularly coronoid fractures—must be taken into account. The degree of soft tissue damage, related fractures, and bone involvement all play a role in determining how best to treat these complicated injuries.[10]

Our study aims to evaluate the efficacy of radial head replacement in Mason Type III and IV radial head fracture, clinical outcomes of patients who received this implant, by MAYO scoring scale, causes of failure and need and type of redo surgery at tertiary care hospital of Pakistan.

METHODOLOGY:

This is a cross-sectional, analytical study, conducted in the orthopedic department of the Doctor's Hospital Kharian, data was collected after getting prior approval from the Institutional Review Board (IRB# 09-24). Data collection was started from 15th April 2023 till 15th February 2024, Radial head fractures were classified as per the Mason classification system modified by Johnston, and only Mason type III and IV fractures were included. Informed consent in the language of understanding was obtained before enrollment.

Upon radiological assessment, patients with minimally displaced fractures (Mason type I) and >2mm fractures (Mason type II) were excluded from the study. Only severely comminuted fractures (Mason Type III and IV) were included along with associated injuries.

Sample size was calculated with the help of another published study conducted on Pakistani population, reporting results of 105 patients from tertiary care hospital, Hayatabad, Peshawar. The population quantity was kept same (n=105) in WHO sample size calculator, keeping confidence level of 95%, margin of error as 5%. the estimated minimum smaple size was 70.

Demographic details, site of the fracture, and presence of any additional injury. Pre-operative hemoglobin, date of surgery, duration of surgery, and intra-operative complications, post-operative pain VAS score, complications, hospital stay, reported success or failure of surgery and, post-operative hemoglobin levels were documented.

The main useful score for assessing elbow function, including elbow stiffness, is the Mayo Elbow Performance Index (MEPI). For patients, the most frequent challenge is a variety of movements (ROM, flexion-extension). Numerous research has supported the Mayo score, which is among the best for identifying the physiological activities of the elbow.[12] This score falls under one of the four main categories of elbow performance: function, motion, stability, and pain. The distribution of points is dependent on the degree of pain, motion in the arc degree, stability points, and day-to-day functioning. For instance, the pain function has 45 points, the motion function has 20, the stability function has 10, and the function has 25 points for flawless performance.

After finishing, the total number of points represents elbow performance. The outcomes are divided into four categories: Achieving a score of >90 indicates excellent performance, 89-75 indicates good performance, 74-60 indicates acceptable performance, and <60 indicates bad performance overall.

For this process, the Kochers technique was employed. Stability was assessed, radial head replacement was performed, and bone fragments were extracted during surgery. Soft tissue was rebuilt or healed as needed, and the incision was bandaged in layers. An aggressive rehabilitation regimen was undertaken when the patient was pain-free or under excellent analgesia.

Patients were asked to attend a medical facility every 30 days for four months after being released from the hospital. Patients were questioned about their generalized daily activities, issues they were having with the afflicted arm, any discomfort they were experiencing, and any other clinical signs they had noticed. Re-do the procedure if the first attempt failed.

Radiographic evaluations were carried out to confirm the diagnosis at presentation, to determine the surgical outcome post-procedure, and during follow-up. X-rays were employed as a radiological method. Statistical package of social science version 22 was used for data entry and statistical analysis,

for independent variables frequencies and percentages were analyzed. Mean ± standard deviation was used to report descriptive data such as age, hemoglobin values, hospital stay in days, and duration of surgery in minutes. Cross-tabulation was performed to assess the correlation between the two variables, chi-square test was performed to check the significance of the data. The P-value of < 0.05 was considered significant.

RESULTS:

The research comprised 70 patients, whose average age was 38.5 ± 9.4 years. Upon presentation, their mean hemoglobin level was 12.1 ± 1.5 mg/d. The mean time of the operation was recorded as 68.5 ± 18.9 minutes, with a minimum of 45 minutes and a maximum of 100 minutes. A hospital stay of 2.7 ± 1.3 days was average. The post-operative hemoglobin (HB) value was 10.4 ± 1.3, and the mean hemoglobin decline was 1.2 ± 0.8. After calculating the mean time between injury-related presentations and surgical procedures, the result showed 2.1 ± 1.0 days, with a minimum of 1 day and a high of 4 days between breaches. To evaluate the impact of treatment, the time interval between the diagnosis and radial head replacement was analyzed. The results showed that 59 (84.2%) had surgery within 2 days of presentation, 7 (10%) had to wait 3 days before surgery, and only 4 (5.7%) had to wait 4 days, redo surgery was needed in 7 (10%) patients with delayed presentation. The p-value was reported as significant and 0.004. (Table 1)

The frequency of the Mayo elbow performance score was determined using pre-validated categories: >90 for outstanding performance, 89–75 for good performance, 74–60 for fair performance, and <60 for bad performance. Within the aforementioned categories, the study participants were divided into 38 (54.2%), 18 (25.7%), 10 (14.2%), and 4 (5.7%) groups, respectively.

DISCUSSION:

Management of radial head fractures has advanced in the past decade. A rise in reported cases and late diagnosis are extra challenges of radial head fracture. As most of the time the RHF is supplemented with collateral elbow injuries, restoration of mobility, strength, and function of the arm is a prime priority. Mason type I fracture comprises minimally displaced fractures of less than 2 mm of displacement and no mechanical block to forearm rotation and can be managed conservatively. Mason II poses some mechanical block to forearm rotation with intra-articular displacement > 2 mm and needs Open Reduction and Internal Fixation (ORIF) for optimum results, but with displacement > 3 fragments and marked communication, radial head replacement provides the ideal management option. Mason III and IV are surgically managed by Radial Head Replacement, with the main target to achieve practical elbow mobility along with stability with minimal complications, and since these targets cannot be achieved by ORIF alone, radial head replacement becomes

Table 1: Association of time from injury to surgery with the success of procedure

Variables		Surgery after 1 day	Surgery after 2 days	Surgery after 3 days	Surgery after 4 days
Redo Procedure	**Yes**	0	0	3 (4.2%)	4 (5.7%)
Pain VAS Score	**Mild**	6 (8.5%)	5 (7.1%)	1 (1.4%)	0
	Moderate	5 (7.1%)	4 (5.7%)	5 (7.1%)	10 (14.2%)
	Severe	2 (2.8%)	1 (1.4%)	11 (15.7%)	20 (28.5%)
Complications	**Infection**	0	0	5 (7.1%)	8 (11.4%)
Hospital Stay (Days)	**2 days**	34 (48.5%)	22 (31.4%)	3 (4.2%)	0
	3 days	0	2 (2.8%)	2 (2.8%)	3 (4.2%)
	4 days	0	1 (1.4%)	1 (1.4%)	2 (2.8%)

Figure 1: Radiological presentation of pre-operative and post-operative elbow adjustment

the ideal choice. Press-fit of anatomical reimplants showed complications in literature thereby supporting the use of metallic or amooth implants. Bipolar implants have longer-lasting results.[17,18]

The goal of our study is to evaluate the efficacy of radial head replacement after MASON type IV radial head fracture. The allotment 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 sizes, our study had a larger number of included patients as no loss to follow-up was reported. [19,20 The] Age of study participants was reportedly lower than in another study where the maximum age was 74 years,[21] the age plays a significant role in healing mechanism and pain tolerance and threshold of patients. Our study participants were comparatively younger as it has been recognized that RHF has a higher incidence in younger populations due to traumatic etiology. Our results showed a lower pain VAS score in the post-operative period, with good to excellent MAYO elbow performance score. the outcomes from the published case series indicate that radial head replacement yielded favorable results. Only four patients exhibited poor performance, while the majority reported excellent self-reported outcomes. This suggests that radial head replacement could be an effective treatment option for radial head fractures. Such findings underscore the potential benefits of this procedure in clinical practice.[22] Lower Pain VAS score has been reported in many retrospective analyses of radial head replacement studies, Mayo elbow performance scores have been used for quantification and results showed good results post-operatively. [23] Reported complications such as post-operative pain, reduced strength, stiffness, post-traumatic arthritis, unsteadiness, valgus, and rotation issues like the functional range of movement of the elbow are from 301 to 1301 degree flexion.[24] The importance of time of presentation and its relation with the outcome of surgery has been proved as crucial in other studies too, our study participants had only 4 patients with a waiting time of 48 hours that showed poor elbow performance scores and led to surgical failure.[25] Success rates of radial head replacement outcomes after recent injury range 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.[26-27] The need for revision or redo surgery, classified with Mason type of fracture indicated that in Mason type I and type II injuries, the chief reasons for revision are stiffness and symptomatic osteoarthritis. Mason type III specifically displayed nonunion, deranged reduction, or necrosis. In Mason type IV fractures also known as fracture-dislocations, numerous complications were described including instability and stiffness further leading to revision.[28] Other complications such as aseptic loosening, Elbow instability, and osteoarthritis were not reported in our study participants.

Another study highlights that the need for radial head arthroplasty is indicated when open reduction and internal fixation are surgically not possible for comminuted radial head fractures, and it offers grander outcomes when compared to radial head excision. Arthroplasty shows superiority in elbow stability, improved range of motion, postoperative pain, and fewer complications. However, radial head resection might still be amenable for isolated fractures without any collateral ligament damage or in elderly patients with lower functional needs. This outlines the significance of bearing in mind patient-related factors in determining the optimal treatment approach.[29]

However, another contrasting study undermines the role of radial head prosthesis in Mason IV fracture-dislocation, done by Nestorson J et al. They retrospectively reviewed and compared two surgical options on a smaller sample size of patients: radial head excision and radial head arthroplasty, both combined with lateral ligament repair. 18 patients underwent arthroplasty while 14 patients underwent resection. After a follow-up of at least 2 years, functional outcomes showed no noteworthy differences between the groups in terms of functional scores, range of motion, or patient-reported outcomes. However, the arthroplasty group had a higher rate of auxiliary surgeries while the group with radial head resection displayed more marked ulno-humeral osteoarthritis. Overall, functional outcomes were consistent with previous findings for similar injuries. Secondary osteoarthritis after radial head resection did not influence functional outcomes.[30]

The limitation of our study is the small sample size and short follow-up duration. A multicenter study with a larger sample size from all age groups and a longer follow-up time is vital to remove all confusing factors related to study results. A larger randomized control trial will help determine the accuracy of different techniques and procedures of radial head fracture as well. Degenerative arthritis was not assessed as follow-up was only limited.

CONCLUSION:

In our study, the results specified that the likelihood of revision surgery and rate of infection is greater in patients who underwent surgery after 24 hours of injury as compared to patients who were operated on within 24 hours. The success rates are comparable with many available studies, Mayo elbow performance score results were decent and elbow stability and motion were restored in almost all patients after surgery.

Authors Contribution:
Nisar Ahmed: Objective, data Collection
Syed Muhammad Mohtashim Ali: Data analysis, Interpretation
Malik Muhammad Hamdan Tafheem: Manuscript write-up

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