

A COMPARATIVE STUDY ON FUNCTIONAL OUTCOME OF ELBOW KINEMATICS IN RADIAL HEAD EXCISION VERSUS RADIAL HEAD REPLACEMENT

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Received : 01/08/2024
Received in revised form : 21/09/2024
Accepted : 04/10/2024

Keywords:

Radial Head Excision, Mayo elbow performance score, Radial Head Replacement, Arthroplasty, Excision.

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DOI: 10.47009/jamp.2024.6.5.73

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (5); 392-397



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Abstract

Background: Radial head fractures are relatively common, accounting for 1.5–4% of all adult fractures. The therapy for these fractures is determined on age, kind of damage, and whether the physics is closed segment or not. The aim of the study is to compare long and short-term functional outcomes of radial head excision with radial head arthroplasty based on Mayo elbow performance score in comminuted radial head fractures and elbow injuries. **Materials and Methods:** A prospective study was conducted at B.L.D.E, Shri. B.M. Patil Medical College, Hospital and Research Centre, Vijayapura, focusing on patients with radial head comminuted fractures, terrible triad elbow and above 18 years of age for 12 months. The study will analyze Mayo's elbow performance score at 3 months, 6 months, and 12 months. Patients with multiple comorbid conditions, multiple fractures in the same limb, or local tissue conditions making surgery inadvisable are excluded from the study. **Result:** The study compared elbow treatment outcomes using the Mayo Elbow Performance Score (MEPS) among 46 participants. Results showed that 60.86% of patients had excellent results, while 34.78% had good results. After a year, the distribution changed, with 47.82% reporting great results, 39.13% reporting good, and 8.69% reporting fair results. Excision showed persistent growth in great outcomes, while arthroplasty showed a higher percentage of outstanding results at 3 months but decreased over 12 months, with minor improvements in good and fair outcomes. The study compared the effectiveness of excision and arthroplasty procedures at 3-, 6-, and 12-months post-operation. Excision patients had a mean MEPS score of 82.39%, while arthroplasty patients had a higher score of 87.61. The excision group showed a more significant enhancement at 6 months and a 12-month improvement at 91.74, suggesting long-term benefits over arthroplasty. The study's results reveal a significant gender imbalance, with 56.52% of the sample being male and 43.47% female, highlighting the importance of accurate population representation in research. The study involved 46 participants aged 18-30, 45.6% between 31-50, and 30.4% over 51. Road traffic accidents were the primary cause of trauma among those undergoing excision or arthroplasty procedures, outweighing falls and assaults. Radial head fractures were the most common, affecting 32 participants and accounting for 69.5% of cases. This information is crucial for understanding injuries treated with these procedures. The study highlighted the complexity of injuries, highlighting the need for tailored treatment strategies, with moderate to severe pain in 4 out of 23 cases. The difference between the results was statistically significant ($p < 0.01$). **Conclusion:** The study compares excision and arthroplasty for managing complex radial head fractures. Arthroplasty offers superior short-term MEPS outcomes, while excision shows steady improvement and better long-term outcomes. The study emphasizes the need for tailored surgical approaches.

INTRODUCTION

Radial head fractures are a significant cause of elbow fractures, accounting for one-third of elbow fractures and 1-4% of adult fractures. Historically, excision of the radial head was suggested due to its limited impact on the elbow's anatomy and biomechanics. However, long-term series and laboratory tests show that this method has negative impacts. Injury-related factors often impact treatment and outcome. Elbow trauma is the cause of most proximal radius fractures, which can cause either direct or indirect injury, including fractures and ligament problems. The radial head is cartilage-covered, oval-shaped, and has a 40-degree center depression. In a healthy range, the elbow can flex from 0 to 150 degrees, extend from 0 to 5 degrees, pronate from 85 degrees, and supinate from 75 degrees.

There are three types of injuries: ligamentous/interosseous, lateral collateral ligament (LCL), medial collateral ligament (MCL), and Essex-Lopresti. When the internal ligament complex is wounded, the radial head stabilizes in the valgus position, while when not injured, it does not participate. Treatment for radial head fractures aims to restore the radial head and surrounding tissues, preserving elbow stability. The prognosis is influenced by associated injuries, such as complex fractures and damage to the elbow joint's medial and lateral ligaments.

Radial head excision has gained popularity over time for comminuted fractures. Two methods of treating comminuted radial head fractures are radial head excision and radial head arthroplasty. Radial head excision is recommended in specific situations with severe pain, while open or arthroscopic approaches may be necessary for fragment removal if they might obstruct joints, are too tiny for osteosynthesis, or cause joint blockage.

MATERIALS AND METHODS

The prospective study conducted at the Department of Orthopedics in B.L.D.E, Shri. B.M. Patil Medical College, Hospital and Research Centre, Vijayapura with the diagnosis of Radial head comminuted fracture and age above 18 years for 12 months. The patients will be informed about the study in all respects and informed written consent would be obtained.

Results will be analyzed by the Mayo's elbow performance score at 3 months, 6 months and 12 months. The inclusion criteria were Mason's Type 2,3,4 radial head fractures, Age of patient between 18-60 years, not more than 2 weeks delayed presentation Terrible triad of elbow, Essex Lopresti injury. Patients with age < 18 years and >60 years of age, Open fractures will be excluded from the study, Patients with comorbid conditions preventing surgical procedures, Multiple fractures in same limb,

Patients with local tissue condition making surgery inadvisable were excluded.

Investigations and Management:

Investigation done in the study were X Ray of Elbow AP and Lateral, Complete blood count, Bleeding time, clotting time, Random blood sugar, Blood urea and Serum creatinine, HIV and HBsAg, Blood grouping and Rh- typing, ECG, Chest X-ray-Postero-anterior view, Other specific investigations whichever needed, CT Scan, MRI.

Management were Preliminary treatment on admission- slab application, pain management, Anesthesia used – Brachial block / General Anesthesia.

Follow-up: Active range-of-motion exercises of the elbow will be started immediately after the surgery. Suture removal will be done on the 12th postoperative day, the cases will be followed up on a fortnightly basis in the first month, after that till the acceptable uncomplicated range of motion will be regained. After that, the patient will be followed up every 3 months. The results will be analyzed by the Mayo elbow performance score.

Mayo Elbow Performance Score:

Part 1: Pain (VAS) The patient is asked by the therapist how bad and how often they are in pain. Patients with no pain receive 45 points, those with light pain receive 30, those with moderate pain receive 15, and those with severe pain receive zero points.

Part 2: Arc of motion at the beginning, patients extend their elbows fully. The patient tries to bend his arm. When arc reaches more than 100° 20 points are awarded, if arc is between 100° and 50° 15 points, and the. Five points are awarded when the arc is no more than 50°.

Part 3: Stability There are ten points awarded when the elbow is deemed stable. Five points for an elbow that is somewhat unstable. Elbow instability is not rewarded with points. In terms of stability, valgus, varus, and posterolateral rotatory instability are assessed for the affected elbow.

Part 4: ADL A sketch of the patient's ability to engage in daily life is created based on five ADLs, each of which is assigned five points. The tasks include brushing your hair, taking care of your personal hygiene, eating, and putting on your shoes and shirt. Total Score: < 60 – poor; 60-74 – fair; 75-89 – good; 90-100 – excellent.

RESULTS

Among 46 participants the study compared the outcomes of excision and arthroplasty for treating elbow conditions using the Mayo Elbow Performance Score (MEPS). After three months, 60.86% of patients reported excellent results, while 34.78% had good results. The proportion of patients with good outcomes dropped to 52.17% at the 6-month follow-up. After a year, the distribution changed, with 47.82% of patients claiming great

results, 39.13% reporting good results, and 8.69% reporting fair results. In contrast, 39.13% reported great outcomes at the three-month point, 52.17% at the six-month follow-up, and 8.69% at the 12-month follow-up. By 12 months, the outcomes had significantly improved, with 60.86% of patients reaching outstanding results and 39.13% retaining good results.

Overall, while both treatments improved with time, excision exhibited a continuous increase in great outcomes while decreasing in fair outcomes, demonstrating persistent growth. Arthroplasty had a larger percentage of outstanding results at 3 months but gradually decreased over 12 months, with a minor rise in good and fair outcomes.

The study compared the effectiveness of excision and arthroplasty procedures at 3-, 6-, and 12-months post-operation. Patients who underwent excision had a mean MEPS score of 82.39, while those who underwent arthroplasty had a higher mean score of 87.61. The difference was statistically significant at the 3-month mark. As the follow-up period extended to 6 months, the mean MEPS score for the arthroplasty group decreased to 83.70. However, the excision group showed a more significant enhancement at 6 months, indicating similar performance in mid-term recovery. The 12-month evaluation showed a significant improvement in the mean MEPS score for the excision group, reaching 91.74, compared to arthroplasty's 84.57. This highlights the long-term benefits of excision over arthroplasty, suggesting it's a preferred treatment option for patients requiring surgical intervention for improved elbow performance and recovery.

The sample of 46 participants, with 26 males and 20 females, reveals a significant gender imbalance. The majority, 56.52%, is male, while the remaining 43.47% is female. This gender distribution is crucial for analyzing findings and ensuring the research's implications accurately reflect the population [Figure 2]

The sample comprises 46 participants, with 23.6% falling within the 18-30 age range, 45.6% in the 31-50 age group, and 30.4% in the over 51 age group, indicating a significant concentration in this age group, potentially impacting research findings in [Table 2].

The study found that road traffic accidents were the primary cause of trauma among 46 participants who underwent excision or arthroplasty procedures, outweighing falls and assaults. This information is crucial for understanding the nature of injuries treated with these procedures showed in [Table 3].

The study analyzed fractures in 46 participants who underwent excision or arthroplasty procedures. Radial head fractures were the most common, affecting 32 participants and accounting for 69.5% of cases in [Table 4].

Other fracture types included elbow dislocation, olecranon, and lateral epicondyle fractures. The study highlighted the complexity of injuries and the need for tailored treatment strategies. Pain was moderate

to severe in 4 out of 23 cases, and elbow stiffness occurred in 3 cases of arthroplasty and 1 in the excision group which recovered after physiotherapy. Post-operative wound infections resolved uneventfully under higher antibiotic coverage and regular sterile dressings., and one patient developed posterior interosseous nerve palsy which recovered over 6 months.

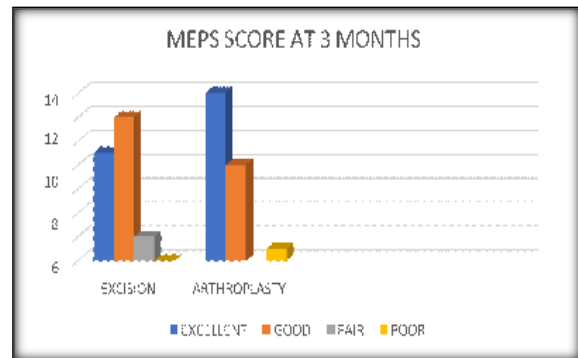


Figure 1: MEPS Scores At 3 Months

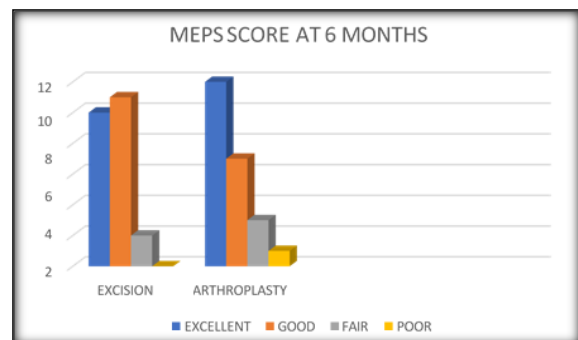


Figure 2: MEPS Scores At 6 Months

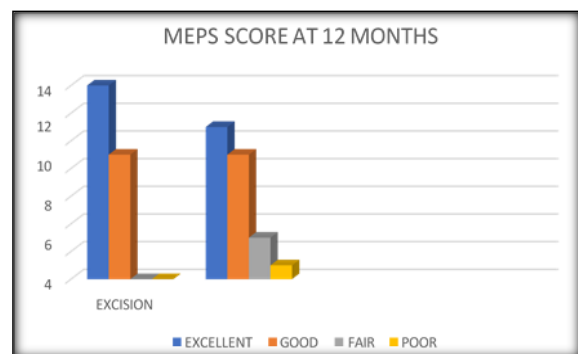


Figure 3: MEPS Scores At 12 Months

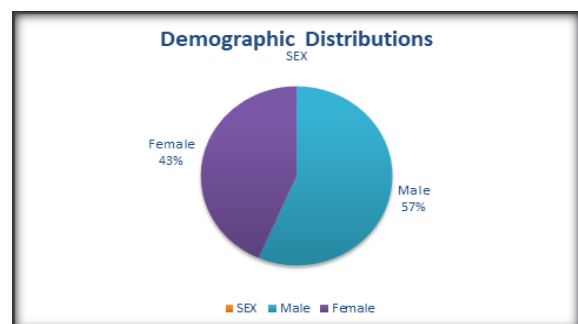


Figure 4: Demographic Distribution



Figure 5: Pre OP and Post OP radiograph



Figure 6: 12 Month Follow Up - Radial Head Arthroplasty

Table 1: Comparative MEPS Scores for Excision and Arthroplasty Procedures

Months	Excision	Arthroplasty	P Value
3 months	82.39 (mean) 7.959 (SD)	87.61 (mean) 8.643 (SD)	0.039
6 months	83.70 (mean) 7.719 (SD)	83.70 (mean) 9.197 (SD)	1.000
12 months	91.74 (mean) 6.326 (SD)	84.57 (mean) 10.862 (SD)	0.009

Table 2: Age Distribution of Study Participants

Age	Frequency	Percentage
18-30	11	23.6%
31-50	21	45.6%
>51	14	30.4%

Table 3: Mode of Trauma Among Study Participants

Mode of Trauma	Frequency	Percentage
RTA	32	69.56%
Fall	11	23.91%
Assault	3	6.52%

Table 4: Types of Fractures Among Study Participants

Fracture Type	Frequency	Percentage
Radial Head Fracture	32	69.5%
Terrible Triad Elbow	8	17.3%
Radial Head Fracture With Olecranon Fracture	3	6.4%
Elbow Dislocation With Radial Head Fracture With Olecranon Fracture With Lateral Epicondyle Fracture	2	4.3%
Monteggia Fracture	1	2.1%

DISCUSSION

Comminuted radial head fractures often require replacement or resection, with replacement or excision being the best option if safe fixation is not possible. However, in isolated, irreconstructible fractures where comminution prevents internal fixation, excision without replacement is recommended. The treatment protocol for Mason type III radiology in orthopedics remains unclear, but surgical alternatives like arthroplasty, excision, and ORIF are available. Blood supply in the proximal radial epiphysis is constrained, with intraosseous vessels being the primary source. Researchers Yamaguchi and colleagues found this conclusion^[12] Comminuted Mason type III radial head fractures,

linked to ligament damage, are a contentious issue. Various surgical procedures, including radial head replacement and excision, are proposed for treatment. The proximal radial epiphysis is found in the joint capsule, with limited blood flow due to the skeleton's juvenile skeleton and a few small intraarticular arteries and intraosseous vessels. Treatment decisions remain contentious.^[13] Yamaguchi noted intraosseous veins as the primary source of blood supply to the radial head, a single vessel entering the body through the nonarticular anterolateral surface. Fracture of the radial head could disrupt circulatory supply, and the ORIF of comminuted radial heads is often challenging. The ORIF technique is not a reliable method for treating comminuted fractures due to the risk of osteonecrosis, non-union, or fragment fragment

displacement. Radial head excision can cause discomfort in the wrists and forearms and elbow instability, but these issues are not problematic if they do not restrict joint movement. Herbertsson et al,^[19] found satisfactory outcomes with radial head excision. Ashwood et al,^[13] successfully treated Mason type 3 radial head fractures with a Monoblock titanium prosthesis, achieving good results for 31% of their patients and exceptional results for 50%. Moro et al,^[14] performed radial head arthroplasty in nine out of twenty-five cases, achieving favorable or excellent results in sixty-eight percent. A short-term follow-up found modest to moderate physical impairment of the elbow and wrist. Research by Josefsson and colleagues showed that removal of the radial head may result in discomfort, stiffness, and weakness. Individuals with comminuted radial head fractures who have disruption of medial collateral, lateral collateral, or interosseous ligaments are candidates for replacement. Patients with non-united radial head fractures may experience articular injuries to the ulna's radial notch and capitellum, leading to elbow arthrosis. Prosthesis replacement can better restore the stability of the elbow, flexion, extension, and rotational motion of the forearm. Mebouinz et al,^[16] conducted a study on eleven patients who underwent radial head excision for a comminuted radial head fracture. The study found that the majority of patients, with an average follow-up of 47.6 months, had a stable and painless elbow. The Mayo Elbow Performance Score of 83.2 points indicated that radial head excision is still a helpful surgical technique for radial head fractures. However, high complications included instability or valgus deformity of the elbow joint. Two out of the eleven cases had elbow instability under valgus load, and seven had a valgus deformity. The radial head is crucial for maintaining stability and transferring force from the hand to the shoulder. It is not recommended to undergo radial head resection alongside concurrent fractures or ligamentous injuries. Radial head excision has been linked to proximal migration of the radius and contemporaneous disturbance of the distal radioulnar joint. In cases of radial head fractures and combined injuries, it is essential to eliminate associated injuries altering physiologic elbow kinematics, especially those producing elbow instability or interosseous membrane injury. Based on the current experience, the best course of action for treating radial head fractures is radial head excision, as it results in superior functional outcomes over longer periods, as demonstrated by the Mayo Performance Elbow score.

CONCLUSION

This study evaluates the outcomes of excision and arthroplasty for managing complex radial head fractures. Arthroplasty shows superior short-term MEPS outcomes, with a higher percentage of excellent results at 3 months. However, excision

shows steady improvement, resulting in better long-term outcomes at 12 months. The study's generalizability is ensured by the varied age range among participants. The fractures' complexity, primarily caused by road traffic accidents, underscores the need for tailored surgical approaches. Despite initial advantages, excision offers more consistent long-term benefits, especially in cases of terrible triad injuries. Further research with larger samples and extended follow-ups is recommended to validate these findings.

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