

A SHORT-TERM COMPARATIVE ANALYSIS OF RADIAL HEAD FRACTURES MANAGED USING RADIAL HEAD PLATING VERSUS RADIAL HEAD EXCISION.

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ABSTRACT:

Introduction: The elbow is a complex joint connecting the upper arm and forearm, consisting of multiple joints, including the radiocapitellar joint. The disc-shaped radial head moves against a round structure on the humerus called the capitellum. This interaction enables movements like turning the palm up (supination) and down (pronation), as well as bending and straightening the elbow. The radial head plays a crucial role in these movements, making it essential for positioning the hand in space.

Aims and Objectives: The study aims to compare the functional outcomes of different surgical treatments for radial head fractures, such as radial head plating and excision, focusing on range of motion, functional recovery, and return to pre-injury activities.

Materials and Methods: Following institutional board approval and patient consent, a prospective case-controlled clinical study was conducted with 30 patients, all classified as ASA physical status 1 and 2. Each patient underwent anterior-posterior and lateral elbow radiographs. Preoperative assessments included range of motion, pain levels, and joint stability. Of the patients, 11 underwent radial head plating, while 19 had radial head excision. Postoperative evaluations were carried out during follow-up visits, assessing range of motion, return to work, and grading using the Mayo Elbow Performance Score (MEPS).

Results: Among the 30 patients, MEPS indicated that 18.18% of those treated with radial head plating achieved excellent results, 45.45% good, and 36.36% fair. In the excision group, 36.84% achieved excellent outcomes, while 63.15% had good results. The interval between trauma and surgery was typically 3 to 5 days. Postoperative hospital stays were shorter for patients who underwent radial head excision (2 to 3 days) compared to those with plating (5 to 7 days). The mean time for bone union in the plating group was 8 to 10 weeks, with one case of delayed union taking 12 weeks for radiographic evidence of osseous healing. The average time to return to normal activities was 11 weeks for radial head excision and 13 weeks for radial head plating.

Conclusion: Radial head excision has certain advantages over radial head plating, including better stability, strength, and favorable functional outcomes. In this study, patients undergoing excision experienced shorter rehabilitation times compared to those treated with open reduction and internal fixation (ORIF). Excision resulted in a shorter operative time, reduced hospital stay, and quicker rehabilitation. However, ORIF showed superior functional outcomes with fewer complications when adequate fixation was achieved.

INTRODUCTION

The elbow is a complex joint that connects the upper arm to the forearm, comprising multiple joints, including the radiocapitellar joint. The radial head, which is disc-shaped, rotates and moves against the capitellum, a rounded part of the humerus. This interaction allows movements like turning the palm upwards (supination) and downwards (pronation) while also enabling the bending and straightening of the elbow. The function of the radial head is crucial for these motions, allowing precise control of hand movements in space.

The elbow joint is enclosed by a thick capsule and stabilized by numerous ligaments, which help maintain its integrity and prevent instability. Several muscles attach to the bones around the elbow, though the bulk of these muscles lies away from the joint itself. This is why the bones of the elbow are easily felt through the skin, as there is minimal soft tissue padding around them, making the elbow more susceptible to fractures. Additionally, important nerves and blood vessels, such as the ulnar nerve, cross the elbow—mainly in the front and inner side. When the ulnar nerve is hit, it causes sharp pain, commonly known as striking the "funny bone."

Most radial head fractures can be managed without surgery, provided the bone fragments are well-aligned and the elbow retains adequate mobility. Non-surgical treatment typically involves a brief period of rest in a sling, followed by gradual motion exercises. Patients are advised to avoid lifting, pushing, or pulling heavy objects with the affected arm for 6-12 weeks. Light activities, like typing, may be resumed earlier depending on pain

levels. During follow-up appointments, X-rays are used to monitor the progress of bone healing. Physical therapy is often recommended to help restore the range of motion.

Surgical intervention becomes necessary if the bone fragments are misaligned, obstruct joint movement, or if the bone is shattered into multiple pieces. Surgery involves making an incision on the outer side of the elbow, where the fragments are stabilized using screws, plates, or wires. The goal is to restore proper alignment without impeding the elbow's range of motion. If the radial head is too fragmented to be repaired, a metal radial head replacement may be performed, where the broken fragments are removed and replaced with a prosthetic component. Post-surgery, a splint or brace may be applied to restrict movement, and patients are advised to limit pushing, pulling, or lifting over 5 pounds for 6-12 weeks to facilitate healing. Physical therapy is often recommended to prevent stiffness in the elbow, and regular follow-up appointments with the surgeon ensure proper recovery progress.

Aim of the Study: The aim is to evaluate the outcomes of different surgical procedures for radial head fractures, using the Mayo Elbow Performance Index (MEPI) score. This study focuses on assessing elbow function and the functional abilities of patients during follow-up evaluations. The operative methods examined include radial head excision and radial head plating.

MATERIALS AND METHODS:

This prospective study involves 30 adult cases of radial head fractures treated through surgical fixation or excision. It includes both comminuted and simple fractures of the radial head in adults. The study specifically excludes compound fractures, malunited fractures, complicated fractures, and fractures occurring in pediatric patients.

Inclusion Criteria:

- Radial head and neck fractures of the elbow in adults over 18 years of age.
- Comminuted and displaced fractures.

Exclusion Criteria:

- Compound fractures
- Malunited fractures
- Complicated fractures

Criteria for Analysis: The following parameters were used to evaluate the cases:

- Age range of patients
- Gender distribution
- Affected side (right or left)
- Mechanism of injury
- Type of fracture
- Time elapsed between injury and surgery
- Presence of associated injuries
- Occurrence of complications
- Additional procedures required to address complications
- Time between injury and hospital admission
- Assessment using the Mayo Elbow Performance Score (MEPS)

Procedure and Post-Operative Protocol:

Upon arrival at the emergency department, all patients were stabilized. Any major associated injuries were addressed first. Once the patient's condition improved, X-rays of the elbow (AP and lateral views) were taken. Initial attempts were made to reduce the fractures using a closed method under sedation, followed by placing an above-elbow splint. For fractures with significant comminution, radial head excision was performed. Simpler fractures were managed with plate fixation.

Open Reduction and Internal Fixation with Radial Head Plates:

During the surgical procedure, a tourniquet was routinely employed. Access to the radial head was gained through the lateral side of the elbow, utilizing the Kocher approach. This technique involved developing a cleavage plane between the anconeus muscle and the extensor carpi ulnaris (ECU). The lateral collateral ligament (LCL) was retracted medially along with the ECU, and an incision was made in the annular ligament along the mid-lateral plane to protect the lateral ulnar collateral ligament (LUCL). To enhance the quality of the repair post-fixation or arthroplasty, a Z-shaped capsulotomy was performed.

After identifying the fracture site, the fragments were mobilized with minimal stripping of the periosteum. The medullary cavity was cleared of any hematoma, and the fractured segments were aligned using bone-holding forceps. A radial head plate of appropriate length was then selected and positioned laterally on the radial head, secured with 2.7mm locking cortical screws. Each fracture was fixed to ensure at least six cortical engagements on either side of the fractured segment.

Both surgical sites were thoroughly washed, and the LCL and annular ligament were repaired. Closure of the subcutaneous tissue and skin was performed subsequently. A compression bandage was applied, the tourniquet was released, and an above-elbow splint was applied to support the joint.

Post-Operative Protocol:

During the initial post-operative period, the upper limb was secured in an above-elbow splint and elevated to reduce swelling in the fingers. The surgical site was examined on the second post-operative day (POD), with sutures removed on the tenth POD. The level of immobilization for the upper limb was based on the stability of the fixation. Follow-up X-rays were conducted at four and six weeks to assess callus formation. By the end of the sixth week, rehabilitation exercises for pronation and supination of the forearm were introduced.

Radial Head Excision:

Comminuted fractures that could not be adequately fixed were routinely excised. A tourniquet was applied during the surgical procedure. The radial head was accessed through the lateral aspect of the elbow, employing the Kocher approach for exposure. A cleavage plane between the anconeus and extensor carpi ulnaris was established, and the lateral collateral ligament (LCL) was retracted medially alongside the ECU. The annular ligament was incised in the mid-lateral plane to prevent injury to the lateral ulnar collateral ligament (LUCL). Performing a Z-shaped capsulotomy is recommended to facilitate a better repair following plate fixation or arthroplasty. Careful identification and removal of the fracture fragments were conducted, using a nibbler check under image intensification to ensure no fragments were overlooked. The wounds were then sutured as previously described.

Post-Operative Protocol:

The upper limb was maintained in an elevated position. A wound assessment was performed on the second post-operative day (POD). Sutures were removed on the tenth POD, and an above-elbow splint was applied. After three weeks, the splint was removed following check X-rays. Active mobilization exercises for the elbow commenced at the end of the third week. By the sixth week, the cast was taken off, and active pronation and supination exercises were initiated.

RESULTS:

The average duration for fracture healing was approximately 8 weeks, with patients who underwent radial head plating also healing in about 8 weeks. Most fracture patterns demonstrated healing between 8 and 10 weeks, with all fractures achieving osseous union. One patient experienced delayed union, taking 12 weeks to show radiographic evidence of healing.

Six patients exhibited limited pronation and supination, with five of these patients treated via radial head plating and one patient undergoing radial head excision. In contrast, seven patients who had excision surgery achieved excellent results concerning their range of motion. The average pronation was measured at 84°, while the average supination was 85°.

Patients who had radial head excision regained their pronation and supination by the end of the sixth week, whereas those who had open reduction and internal fixation (ORIF) achieved this by the ninth week. Post-operative stiffness developed in six patients, four of whom were treated with ORIF and two with radial head excision. However, all these individuals ultimately gained a fair range of motion by the end of 12 weeks following rigorous physiotherapy.

Nearly all patients who received either dual plating or hybrid fixation were able to return to their normal activities successfully. Patients treated with radial head plating resumed their usual activities around 12-14 weeks post-surgery, while those who underwent radial head excision returned by approximately 10-11 weeks.

Among the 26 patients, 21 (81%) reported no elbow pain, five experienced mild pain, and four had moderate pain. The mean arc of motion ranged from 9° to 139° of flexion, with an average Mayo Elbow Performance Score of 95 points. This score was categorized as good or excellent for 26 elbows (87%) and fair for four elbows.

Three patients reported wrist pain, which was mild in two cases and moderate in one. Nineteen elbows demonstrated normal strength when compared to the unaffected side, while two patients exhibited some degree of elbow instability upon examination. The mean carrying angle of the affected elbow was significantly greater than that of the uninjured elbow, measuring 21° compared to 10°.

One patient required antibiotics for a superficial wound infection in the immediate post-operative phase, but no deep infections were reported. Occasional pain and/or paresthesia were noted in two patients; however, these symptoms diminished over time, and by the final follow-up, they did not require treatment. The analysis was conducted using the modified Mayo Elbow Score Index, yielding the results described above.

Overall Results

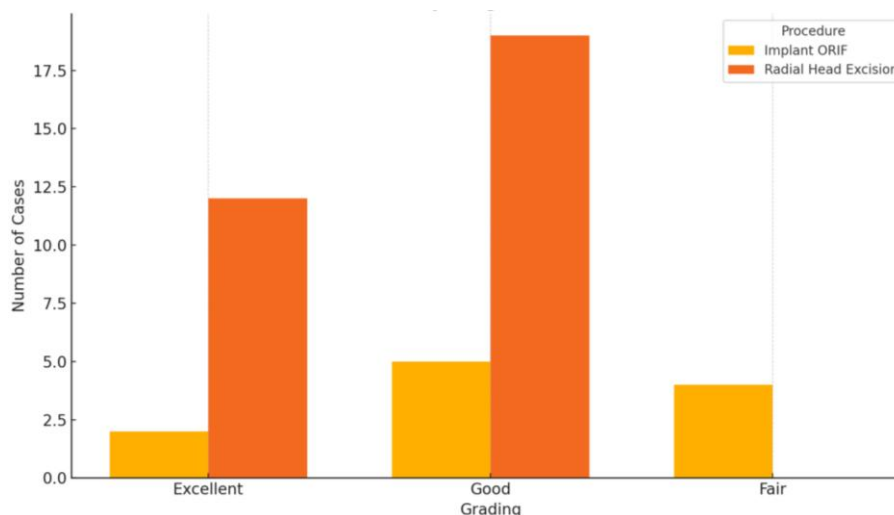
Table 1: Overall Results

Grading	Number of Cases	Percentage
Excellent	9	30.0%
Good	17	56.7%
Fair	4	13.3%
Total	30	100.0%

Results by Procedure

Table 2: Results Based on Surgical Procedures

Procedure	Grading	Number of Cases	Percentage
Implant ORIF	Excellent	2	18.18%
	Good	5	45.45%
	Fair	4	36.36%
Radial Head Excision	Excellent	12	36.84%
	Good	19	63.15%
	Fair	0	0%



Statistical Analysis

The average score on the Mayo Elbow Score Index for patients who underwent excision was 8.103, while those who had dual plating achieved an average score of 9.298. The standard deviations were 2.17 for patients who received hybrid fixation and 2.15 for those who underwent dual plating. The calculated P value was 0.0013, indicating that the findings support the conclusion that excision is more effective than open reduction and internal fixation (ORIF).

DISCUSSION

The objective of this study was to evaluate the outcomes of treating radial head fractures of the elbow through surgical methods, primarily radial head excision and radial head plating. Radial head fractures are common injuries among adults, representing about 1.5% to 4% of all fractures and roughly 33% of elbow fractures. These fractures can occur in isolation but are often associated with other fractures and ligament injuries. Integrating clinical presentations, physical examinations, and imaging results into an effective treatment plan can be quite complex. The nature of the radial head fracture significantly impacts the chosen technique to achieve the best possible outcome.

Typically, the injury mechanism for radial head and neck fractures involves falling onto an outstretched hand with a partially flexed elbow and a pronated forearm. This results in a longitudinal force on the radius against the capitellum. The trauma force travels along the forearm, applying a valgus stress to the elbow, which compresses the radial head against the capitellum, leading to a fracture due to shear between the vertically oriented trabeculae. This mechanism may also injure the capitellum. Clinically, these fractures present with moderate to severe pain, local tenderness, swelling, and a positive fat pad sign on radiographs, confirming the diagnosis. Conventional X-rays, including anteroposterior and lateral views, are usually sufficient for detecting

radial head and neck fractures, though internal and external oblique views may occasionally be necessary. Computed tomography with reconstructed images can also assist in decision-making.

Mason's classification, which categorizes radial head and neck fractures based on severity, is used in clinical practice to determine the appropriate treatment approach. Mason initially divided radial head fractures into three types: type I for undisplaced marginal fractures, type II for displaced marginal fractures, and type III for comminuted fractures. Johnston later introduced a fourth type, type IV, encompassing any radial head fracture accompanied by dislocation of the humeroulnar joint.

In this study, 30 cases of radial head fractures in adults were selected. Most patients were middle-aged males, with injuries primarily resulting from road traffic accidents or accidental falls. Patients with simple Mason type II fractures were treated with plating, while those with comminuted fractures underwent radial head resection. Compound fractures were excluded from the analysis.

Traditionally, radial head fractures are classified based on their radiographic appearance, yet these classifications do not account for associated ligamentous injuries to the elbow. Early classification systems were developed by Carstam, Bakalim, and Mason, while Johnston later added a category for fractures linked to elbow dislocation. The Modified Mason Classification is currently the most widely used system for radial head fractures and can guide treatment decisions for each fracture type.

According to the Modified Mason Classification, type I includes marginal fractures that are undisplaced or minimally displaced, with intra-articular displacement less than 2mm. Non-operative treatment, including the use of an arm sling and early mobilization, typically yields favorable results, even in the presence of elbow dislocation. Type II fractures are marginal with more than 2mm of displacement. If a mechanical block to elbow motion exists, open reduction and internal fixation (ORIF) are recommended; otherwise, treatment may follow the type I approach. In cases involving elbow dislocation or interosseous ligament tear (Essex-Lopresti), ORIF using screws or plates is advised.

Type III fractures are characterized by comminution of the radial head or complete displacement of the radial neck. If there is no concurrent elbow dislocation or interosseous ligament disruption, early radial head excision may be performed. However, in cases of interosseous ligament disruption, excision and insertion of a radial head prosthesis is recommended. Often, the extent of comminution is more significant than what preoperative imaging suggests, resulting in about 70% of cases necessitating radial head excision, with or without replacement.

Intraoperatively, the absence of soft tissue attachment to the radial head fragments can complicate fixation due to concerns regarding avascular necrosis and non-union. In instances where radial head excision was chosen, complications such as decreased grip strength, wrist pain, valgus instability, heterotopic ossification, and post-traumatic arthritis of the trochlea-olecranon joint may arise. Additionally, postero-lateral rotatory instability, a previously unrecognized complication following radial head excision, can occur. Hall and McKee identified this instability in patients post-excision, attributing it to undetected lateral ulnar collateral ligament deficiency prior to surgery, which may lead to unexplained elbow pain and instability.

Long-term outcomes for radial head and neck fracture treatments, particularly following excision, have yielded mixed results. Herbertson and colleagues found that after a displaced radial head or neck fracture, excision often results in good or fair outcomes, with no significant differences between early and delayed radial head excisions for Mason type II or III fractures. Outcomes tend to correlate more with the fracture type, particularly with Mason type III fractures showing poorer results than with the timing of excision.

To mitigate complications, particularly in younger patients, replacing the radial head with a prosthesis is a viable alternative. In elderly patients with low-energy injuries or minimal associated soft tissue disruption, radial head resection is an acceptable approach and is typically not linked to long-term issues. Janssen and Vegter demonstrated that while over half of patients exhibited radiographic signs of proximal migration of the radius after radial head excision, few reported significant wrist symptoms. This indicates that radial head excision can be an effective treatment option that frequently results in good or fair outcomes when appropriately indicated.

Furthermore, it emphasizes the necessity of evaluating associated soft tissue injuries alongside radial head fractures, as this can significantly influence the choice of treatment and long-term prognosis for individual patients. Although the Modified Mason Classification does not incorporate associated soft tissue injuries, it remains valuable in guiding surgeons toward the most suitable treatment for each fracture type.

For effective internal fixation, the device must hold the fracture firmly while minimizing angular and rotational motion, which can be achieved through the use of radial head plates. During radial head plating, care was taken to limit injury to the bone's blood supply by carefully stripping the periosteum with a periosteal elevator, only as much as necessary for plate application. Fragments were meticulously aligned with interdigitating bone spicules fitted properly, and comminuted fragments were accurately positioned. Plates were chosen to ensure a minimum of four to six cortical purchases on either side of the fracture fragments, and they were contoured before application to the bone.

Our findings indicate that good fracture union occurred in 80% of cases. We compared the results of ORIF with those of excision, and apart from the incidence of infection, we did not encounter significant complications in fractures treated with ORIF. One instance of tourniquet palsy was observed, which ultimately resolved. The duration of tourniquet application was shorter for excision procedures, minimizing the likelihood of this neurological complication.

ORIF provides several advantages over dual plate osteosynthesis, including enhanced stability, greater strength, and improved functional outcomes. Our study revealed that the rehabilitation period was considerably shorter for patients treated with excision compared to those undergoing ORIF, with functional recovery averaging over 9 weeks for ORIF and approximately 6 weeks for excision. The average hospital stay postoperatively was also shorter, averaging 3 days for excision compared to 5 days for ORIF.

Overall, excision results in a shorter surgical time, reduced hospital stay, and earlier rehabilitation than ORIF. Given these findings, excision appears to be a more effective option than ORIF for managing radial head fractures.

CONCLUSION

The key factor distinguishing the outcomes in our study was the functional rating score, which reflects the degree of functional recovery. We observed that the functional rating score for patients who underwent excision was superior to that of those who had ORIF. We attribute this difference to the enhanced recovery of both physiological and physical function following excision.

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