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Case Series

Outcome of radial head and neck fractures with radial head replacement

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ABSTRACT

Radial head and neck fractures are a significant concern in elbow injuries, often stemming from incidents like falls or accidents, which can severely affect elbow stability and function. This study, conducted at Shadan Institute of Medical Sciences in Hyderabad, India, focused on 15 patients with severe radial head fractures classified as Mason type III and IV. The research aimed to evaluate the effectiveness of radial head replacement utilizing implants from leading manufacturers such as DePuy Synthes® and Zimmer Biomet®. The surgical procedures were carried out successfully without any notable intraoperative complications, with an average surgery duration of 60 minutes. Postoperative complications, though relatively rare, included issues such as elbow stiffness and peri-prosthetic osteolysis, which were manageable. However, the majority of patients exhibited improved functional outcomes, as indicated by excellent Mayo elbow performance scores during the 6-month follow-up. This intervention not only enhances elbow stability but also facilitates soft tissue healing and promotes better range of motion. Consequently, radial head replacement emerges as a highly effective approach for managing severe radial head fractures, leading to considerable improvements in patient outcomes and quality of life.

Keywords: Radial head fractures, Radial head replacement, Mason classification, Mayo elbow performance score, Functional outcomes, Orthopaedic surgery

INTRODUCTION

Fractures affecting the radial head and neck contribute to approximately one-third of all elbow fractures, with an estimated incidence ranging from 2.5 to 2.9 per 10,000 per year. These fractures commonly occur due to falls on an outstretched hand with a partially flexed and pronated elbow.[1]

The radial head plays a crucial role in maintaining elbow stability, alongside the ulnohumeral articulation and the medial and lateral collateral ligaments, which serve as the primary static stabilizers. Additional stabilizers include the joint capsule, common flexor and extensor origins, and the muscles crossing the elbow, which function as dynamic stabilizers. In cases of injury to the coronoid process or medial collateral ligaments (MCL), the radial head becomes a vital stabilizer.[2]

For comminuted radial head fractures, excision of the radial head may result in strength loss, valgus instability, and proximal migration of the radius causing wrist pain. Radial head replacement is a preferred intervention to restore normal anatomy and functions of the elbow, radioulnar, and wrist joints.[3]

Classification of radial head fractures

Mason classification

Type I: fissure or marginal fractures without displacement, type II: marginal sector fracture with displacement, and

type III: comminuted fracture involving the whole head of the radius.[4,5]

Broberg and Morrey modification of the original mason classification

Type I: fracture undisplaced or displaced less than 2 mm, involving less than 30% of the articular surface, type II: fracture displaced greater than 2 mm, involving greater than 30% of the articular surface, type III: comminuted fractures, and type IV: radial head fracture associated with an elbow dislocation.

These fractures are either stable with no associated elbow or forearm ligament injury or unstable with associations such as elbow dislocation or part of an Essex-Lopresti (interosseous ligament of the forearm) injury.[6] A significant gap between fracture fragments usually indicates an associated ligament injury or associated fracture.

Radial head replacement is indicated in cases of unreconstructable radial head fractures associated with unstable coronoid process fractures, following radial head excision with evidence of medial collateral ligament insufficiency or ulnohumeral instability, and unreconstructable radial head fractures linked to interosseous membrane injury and distal radioulnar joint subluxation (Essex-Lopresti injury). On the contrary, the procedure is contraindicated in simple fractures, reconstructable multifragmentary fractures, and stable elbow conditions. The advantages of radial head replacement include its swift execution, favourable functional recovery, and the promotion of elbow stability. However, potential disadvantages encompass early prosthesis loosening, the risk of elbow stiffness associated with an oversized prosthesis, and the potential for an unstable elbow when the prosthesis is undersized.

CASE SERIES

This is a prospective interventional clinical study conducted at the Department of Orthopaedics in Shadan Institute of Medical Sciences, Hyderabad, India, focusing on the management of 15 radial head fractures through radial head replacement. The implants used were of two major manufacturers- DePuy Synthes® and Zimmer Biomet®. The study includes fractures falling under Mason type 3 (# with more than 3 fragments), Mason type 4 fractures, Essex-Lopresti lesions, terrible triad injuries, and cases involving elbow instability. Exclusion criteria encompass Mason type 1 and 2 fractures (#), Mason type 3 fractures with only 3 fragments, as well as cases involving infection, sepsis, or osteomyelitis. The data collection process involves gathering information on the history and nature of the injury, conducting local and systemic examinations, performing radiological examinations (X-ray elbow, AP and lateral views, CT with 3D reconstruction), routine preoperative investigations, establishing a diagnosis, implementing radial head replacement surgery, documenting complications, and monitoring follow-ups. Assessments are conducted at 6 weeks, 12 weeks, and 6 months, focusing on clinical evaluation of pain and stiffness, radiological assessment, functional ability of the elbow, and the occurrence of any complications. The Mayo elbow performance score is utilized to assess overall elbow function.[7]

Rehabilitation protocol for radial head replacement

The patient is immobilized in an above-elbow slab until suture removal.

After 2 weeks, both active and passive range of motion exercises for the elbow are initiated.

Range of motion exercises for forearm pronation/supination are performed with the elbow at 90 degrees flexion. Supination range of motion is specifically limited to when the elbow is flexed to 90 degrees.

Terminal elbow extension is executed with the forearm in a neutral or pronated position until 3 months postoperatively.

Varus/valgus forces across the elbow are to be avoided until 3 months postoperative.

Activities that create axial load on the involved extremity should be avoided until 3 months postoperatively.

Follow-up

Patients undergo reviews at the 6th week, 12th week, and subsequently every 3 months. Clinical and radiological assessments are conducted during these follow-up visits.

Radiological assessments focus on parameters such as radio-capitellar congruence, overstuffing, periprosthetic osteolysis, and the presence of heterotopic ossification.

The clinical outcome at the 6-month mark is determined using the Mayo elbow performance score (MEPS).[7]

Table 1: Mayo elbow performance score (MEPS).[7]

Criteria	Points	Definition (score)
Pain	45	None (45), mild (30), moderate (15)
Motion	20	Arc>100° (20), arc 50-100° (15), arc <50° (5)
Stability	10	Stable (10), moderate instability (5), gross instability (0)
Function	25	Comb hair (5), feed (5), perform hygiene (5), putting on shirt (5), putting on shoe (5)
Total	100	

Classification: excellent >90; good 75-90; fair 60-74; poor <60

This research was conducted from November 2018 to November 2023, during which 15 patients underwent radial head replacement for radial head fractures. All participants met the inclusion criteria, and there were no instances of loss to follow-up during the study.

The mean age of the patients in our study was 37.5 years, ranging from 17 to 70 years, with 73% of them being under 45 years old. Fracture distribution by gender showed 9 males and 6 females. Among the fractures, 10 involved the right elbow, while 5 affected the left elbow.

Road traffic accidents (RTA) accounted for the majority (60%) of fractures, while 40% resulted from accidental falls. The majority (87%) of fractures were classified as simple (closed), with 2 patients having compound fractures. According to the MASON classification, 66% of fractures were categorized as mason type III, and 33% belonged to mason type IV. No pre-operative or post-operative nerve injuries were reported.

All 15 patients underwent cemented radial head replacement, with no intraoperative complications noted. The average surgery duration was 60 minutes, ranging from 45 to 120 minutes, with longer durations observed for radial head fractures with associated injuries.

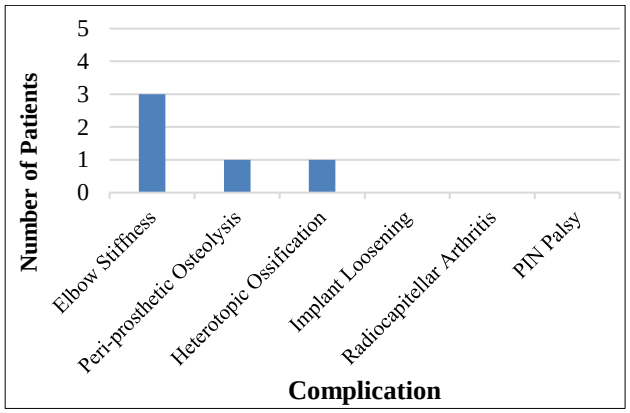

Figure 1: Post-operative complications of radial head replacement.

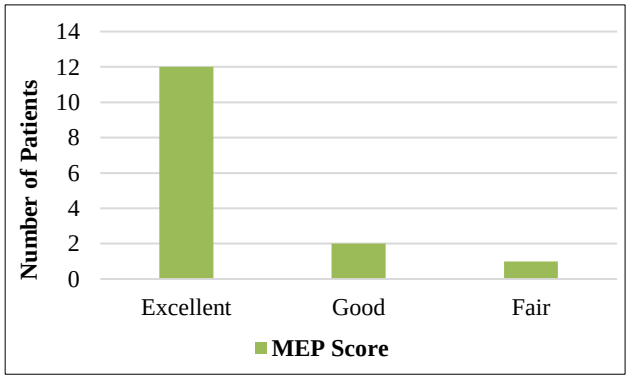

Figure 2: Functional outcome at 6-month follow-up according to the Mayo elbow performance (MEP) score.

Three patients developed elbow stiffness, and two of them were managed with regular physiotherapy and continuous passive motion (CPM). Mobilization under anesthesia was performed for one patient. One patient exhibited peri-prosthetic osteolysis, and another developed heterotopic ossification. No instances of implant loosening or arthritis of the radiocapitellar joint were observed during the follow-up period.

At the 6-month follow-up, 2 patients had a good MEP score, 12 patients had an excellent MEP score, and only 1 patient had a fair MEP score. The functional outcome was better in isolated radial head fractures compared to radial fractures with associated fractures.

Figure 3: Pre-operative radiograph of one of the patients (Mason type III).

Figure 4: Post-operative radiograph of the same patient anteroposterior view.

Figure 5: Post-operative radiograph of the same patient lateral view.

DISCUSSION

The management of comminuted radial head fractures with associated ligament disruption remains a topic of debate. Treatment options include open reduction and internal fixation (ORIF), radial head excision, and radial head replacement.[8]

The proximal radial epiphysis is enclosed within the joint capsule, with limited blood supply. Intraarticular vessels along the radial neck and intraosseous vessels supply the radial head, primarily through an intraosseous vessel[9] entering the nonarticular anterolateral surface. Fractures of the radial head disrupt this vascular supply, and the technical difficulty of ORIF in comminuted radial head fractures makes it less advisable due to potential complications such as osteonecrosis and non-union of displaced fragments.[10,11]

Excision of the radial head in cases with interosseous membrane disruption or medial collateral ligament (MCL) injury may lead to instability in the wrist or elbow.[12] Studies report poor results, including stiffness, weakness, and pain, following radial head excision.[13] Reports in the literature suggest that radial head excision is contraindicated for patients with an incompetent medial collateral ligament, disrupted forearm interosseous ligament, or elbow dislocation; as it can result in complications such as valgus elbow instability, elbow stiffness, and proximal migration of the radius.[12,14,15]

Radial head arthroplasty is recommended for displaced comminuted radial head fractures not amenable to fixation, fractures with associated elbow dislocation, and comminuted radial head fractures with disruption of the medial collateral, lateral collateral, or interosseous ligaments.[16] In cases of non-united radial head fractures, prosthetic radial head replacement is indicated to prevent elbow arthrosis and restore elbow stability, flexion, extension, pronation, and supination.[17] Various prosthetic materials, including silicone rubber, acrylic, cobalt-chromium, vitallium, and titanium, have been used.[18-22] Studies show that metallic implants effectively restore elbow stability, and new modular prostheses with improved sizing and anatomical restoration are technically easier to insert intraoperatively.[23]

Historically, monoblock and bipolar metallic radial head prostheses were employed, but imperfect size matching and difficult insertion posed challenges.[24] Bipolar designs had issues with polyethylene wear and a tendency to become angulated under load.[25] The radial head implant acts as a spacer, promoting soft tissue and ligament healing, improving elbow mobility, and restoring elbow anatomy.[26]

CONCLUSION

Based on our observations, we have determined that the implementation of radial head replacement in Mason type III and IV radial head and neck fractures enhances stability against valgus force in the elbow. It also reinstates the axial load-bearing function of the radial head and facilitates the proper healing of soft tissues without the occurrence of proximal migration of the radius. Nearly all patients in our study exhibited improved range of motion and maintained a stable elbow without experiencing pain.

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