Indian Journal of Orthopaedics Surgery 2022;8(4):244–251

Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Orthopaedics Surgery

Journal homepage: https://www.ijos.co.in/

Original Research Article

A comparative study of outcome of radial head fracture treated with radial head replacement and radial head excision alone

Narendra Varma[1], Gokul Anand[1], Boblee James[1,*], Kamalakannan[1]

[1]*Dept. of Orthopaedics, Aarupadai Veedu Medical College and Hospital, Puducherry, India*

ARTICLE INFO

Article history:
Received 18-10-2022
Accepted 29-10-2022
Available online 30-11-2022

Keywords:
Radial head
Elbow instability
Excision arthroplasty
Replacement arthroplasty

ABSTRACT

Introduction: Radial head fractures are the most common fractures of the elbow with an estimated incidence of 2.5 to 2.9/10,000 people/ year. The incidence of radial head fractures is reported to be between 1.7 to 5.4 percent of all fractures.

Aim: This study aims to assess the clinical outcome of excision arthroplasty and prosthesis replacement in treatment of comminuted radial head fractures.

Materials and Methods: Patients with radial head fracture presenting to orthopaedics department and emergency room were included for the study. Excision arthroplasty was performed in 25 patients and replacement arthroplasty was performed in 25 patients. The functional outcome of both the procedure were compared using DASH, MEPS and Broberg and morrey scoring system.

Results: Based on the DASH score Replacement group showed good improvement at the end of the 6^{th} month follow-up with the mean score of 15.9 (P=0.042). Based on the MEPS score the mean MEPS score showed replacement group had a good improvement at the end of 6^{th} month follow-up with the mean score of 15.9 (P=0.042).

Conclusion: From this study we concluded, radial head replacement is a reasonable option for unreconstructable radial head fractures. Radial head replacement can achieve effective radiocapitellar contact that will improve the stability in valgus, posterolateral, and axial loading of the forearm. This treatment option has satisfactory short- and mid-term results even with other combined elbow injuries.

1. Introduction

Over the last three decades, our growing understanding of the elbow has offered invaluable insight into the complexities of a complex diarthrodial joint.[1–6] The radial head is an important component that enables for the elbow's natural stable mobility through a synergistic link between a bony base and its surrounding soft tissue. Previously thought to be a disposable skeletal component, research have shown that damage or fracture to the radial head can result in substantial impairments and functional restrictions.[2,7–10]

According to some studies, radial head fractures make up between 1.7 and 5.4 percent of all fractures. 20% of all elbow fractures are radial head fractures, which are common injuries. The most common elbow fractures are radial head fractures, which occur between 2.5 and 2.9 times per 10,000 people annually. Women are more likely than men to have radial head fractures, and those between the ages of 20 and 60 are the ones who suffer them most frequently. More displaced and comminuted fractures typically include collateral ligament injuries and may be accompanied by fractures of the coronoid, capitellum, or proximal ulna. Undisplaced and moderately displaced radial head fractures sometimes occur as independent events.

* *Corresponding author*.
E-mail address: narendravarma353@gmail.com (B. James).

https://doi.org/10.18231/j.ijos.2022.045

Elbow and/or forearm dislocations are also possible in high-energy trauma. Axial instability of the forearm and the Essex-Lopresti lesion result from injury to the distal radial ulnar joint ligaments and interosseous membrane. The majority of radial head and neck fractures are solitary, modestly displaced fractures. An favourable functional prognosis is typically achieved with nonsurgical treatment of these fractures.[11]

It has been documented that fractures can happen on their own or in combination with other relevant osseous and soft tissue injuries. Determining the likely patterns of injury is crucial when deciding on the best course of treatment to regain elbow function. Although plain radiographs are routinely utilised for diagnosis, additional imaging modalities including CT are becoming used to better understand the damage patterns that develop.[12]

The two most often used methods for treating radial head and neck fractures that provide access to the lateral elbow are the modified Kocher technique and the Kaplan approach.[13] Kocher's method, which takes use of the oblique gap between the anconeus and the extensor carpi ulnaris (ECU), focuses on the posterolateral elbow.[14] To gain access to the radial head during the traditional Kocher operation, the lateral collateral ligament is severed (LCL). By anteriorly retracting the ECU, the modified Kocher approach, on the other hand, protects the lateral ulnar collateral ligament (LUCL). To protect this vital component, a capsulotomy may be performed prior to the LUCL.[15,16] The radial collateral ligament (RCL)-annular ligament complex must be dissociated for this technique's distal extension.

Few prospective short- and long-term patient-reported outcome data are available for uncomplicated solitary radial head and neck fractures, making it difficult to determine the benefits and outcomes of non-operative treatment.[17] Hence we aimed to assess the clinical outcome of excision arthroplasty and prosthesis replacement in treatment of comminuted radial head fractures.

2. Materials and Methods

This study is a observational comparative study carried out in the Department of Orthopaedics, Aarupadai Veedu Medical College and Hospital, Puducherry during the period from January 2020 to April 2022.

2.1. Study participants

Patients with radial head fracture presenting to orthopaedics department and emergency room.

2.2. Sample size

Period sample, a minimum of 50 patients.

2.3. Inclusion criteria

1. Patient diagnosed with isolated radial head fracture.
2. Absence of concomitant fractures in the affected limb.
3. Absence of previous injuries in that joint.
4. Osseous maturity with closure of physes.
5. Patient aged between 18-70 years.

2.4. Exclusion criteria

1. Concomitant presence of neurological lesion.
2. Dislocation of elbow, associated coronoid fracture.
3. Patients less than 18years of age.

2.5. Study procedure

1. After obtaining written, informed permission, inpatients who fulfil the study's inclusion and exclusion requirements were chosen.
2. The research proforma was included information on demographics, history, the clinical examination, and the specifics of the investigations.
3. Standard pre-operative investigations was performed, and radiographs was acquired to investigate the fracture anatomy.
4. A pre-operative examination and written informed consent were obtained for the procedure.
5. All patients had surgery while supine and using a pneumatic tourniquet while the afflicted extremity was abducted.

3. Operative Procedure

The radial head fractures were exposed using the Kocher method in order to perform radial head excision and implant a modular bipolar radial head prosthesis.

1. The most popular technique is the Kocher lateral approach between the anconeus and extensor carpi ulnaris.[2]
2. The Kaplan method, which is positioned more anteriorly, between the extensor digitorum communis and the extensor carpi radialis longus, is an additional choice.
3. The annular ligament is left unaffected so that it may be sutured if necessary after the surgery.

If the radial collateral ligament remained unharmed at the time of the trauma, special care is taken to preserve it (especially its ulnar section).

1. When approaching the neck of the radius, pronation of the forearm places the inter-osseous nerve at a safe distance.
2. One posterior skin incision can be used to conduct primary internal fixation of the olecranon through the posterior method in a patient who simultaneously has proximal fractures of both forearm bones.

3. After that, the radial head is accessed either by an olecranon fracture or a lateral arthrotomy. Although the health of the capitellar cartilage has no influence on the therapeutic conditions, it is one of the components that determine the long-term prognosis, thus it should be assessed during the arthrotomy.
4. The procedure for implanting a radial head prosthesis, whether with or without auxiliary tools, may seem straightforward. However, two guiding principles must be followed.
5. The natural radial head's thickness and diameter must be replicated by the implant, and it must be positioned at the same height.
6. The reconstruction of the natural head on the operating table, similar to fitting a jigsaw together, demonstrates that all intra-articular pieces provide information regarding the implant diameter that most closely resembles the natural radial head.
7. To ensure that the best size has been selected, a fluoroscopic examination is advised after the trial prosthesis has been inserted.
8. Low-viscosity cement could be preferred when using a cemented stem.
9. To allow cement fixing under pressure and prevent distal cement leakage, the shaft can be blocked off by a piece of the head or an artificial stopper.
10. Lastly, if the concurrent lesions are not addressed, radial head replacement may not always guarantee stability of the elbow and forearm scaffold.
11. The smallest size will be chosen if a choice between two sizes is uncertain. The second technical difficulty is resembling the original radial head's height.
12. The native geometry must be as closely matched as feasible.
13. On fluoroscopy pictures, a variety of anatomical landmarks may be used to calculate the ideal implant height. These features include symmetrical appearance of the medial and lateral sides of the humero-ulnar joint space, alignment of the implant on the ulnar notch, and no overshoot.

It is essential to conduct tests using trial implantation.

1. If the implant is too low, the length of the prosthetic neck can be raised by selecting an appropriate modular stem.
2. The radial neck can be recut at the level of the radial notch of the ulna to lower an overly high implant.
3. Due to the radius's fragility, the preparation of the bone should be done with extreme care to prevent neck microfractures.
4. The radial collateral ligament complex, which is frequently dislocated proximally, as well as the muscles placed on the lateral epicondyle, must be reattached to minimise elbow instability. Trans-osseous suture fixation or bone anchors can also be employed.
5. Early mobilisation within a safe range is advised for the first 6 weeks following surgery. The elbow shouldn't be stretched all the way.

The forearm should be held in a pronated position after the radial collateral ligament complex has been repaired. To ensure that patients with elbow instability stay within the safe range of motion, which should be assessed intraoperatively, tremendous care must be given.

3.1. *Postoperative care*

After surgery, the elbow is immobilised using a brachio-palmar plaster slab for an average of 10 days (7–14 for both groups) in neutral pronosupination, at 90° flexion, enabling passive motions to start.

The focused rehabilitation programme started with physical movements and muscle strengthening in the third week..

3.2. *Follow up period*

Regular follow up, immediate post-operative period and 1 , 3 , 6 months.

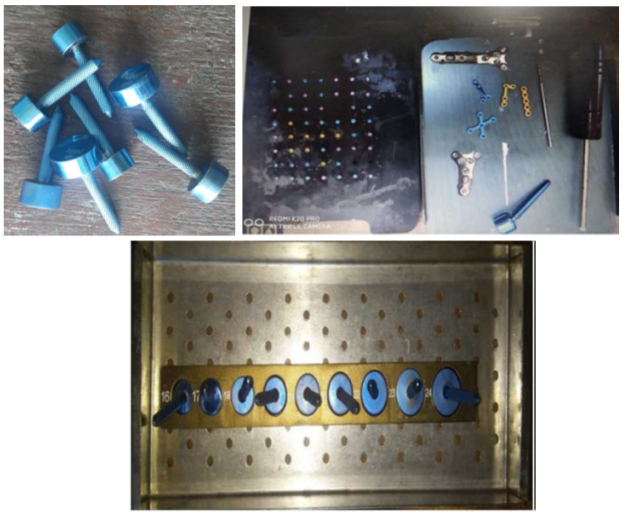

Fig. 1: Implants

3.3. *Functional assessment*

1. The disabilities of the arm, shoulder, and hand score (DASH), the Mayo elbow performance score (MEPS), and the strength test were all included in the outcome evaluation.
2. The Bromberg and Morrey scale will be used to measure the strength disparity between the damaged and contralateral side.

3. Normal strength, minor loss (noticeable weakness but not limited to the patient; 80% of the contralateral side), moderate loss (limiting in some tasks; 50% of the opposite side), or severe loss (limiting for all activities of daily living).
4. A Jamar dynamometer was used to measure the hand's strength..

Fig. 2: Case 1: MRS Lakshmi 49/F- Mason type-III – radial head excision follow up at 6 months –excellent

4. Results

The following observations were made from the data's collected during the study of 50 cases of Radial Head fractures who were treated with Radial Head Replacement and radial head excision in the Orthopaedics department of Aarupadai Veedu Medical College in the period of November 2019 to October 2021. Among 50 cases 25 were undergone Radial Head Replacement and 25 were treated with Radial Head Excision.

Regarding occupation in our study we observed daily wages, sports person, students, farmer etc. (Table 1)

Our study showed most of the patients had RTA followed by accidental fall and sports injury.(Table 2)

The mean hospital stay between the groups were Replacement (4.84 days) and Excision (3.9 days).(Table 3)

Based on the DASH score Replacement group showed good improvement at the end of the 6^{th} month follow-up period with the mean score of 15.9 (P=0.042).(Table 4)

Based on the MEPS score the mean MEPS score showed replacement group had a good improvement at the end of 6^{th} month follow-up period.(Table 5)

Based on the MEPS score among 25 patients 23 patients in replacement group and 21 patients in excision group had good and excellent outcome. (Table 6)

Based on the Bromberg and Morrey scale 4 patients got normal strength and 14 cases had slight loss at the end of the 6^{th} month follow-up period, in excision group none of the patients got normal strength 16 patients had slight loss of strength at the 6^{th} month follow-up.(Table 7)

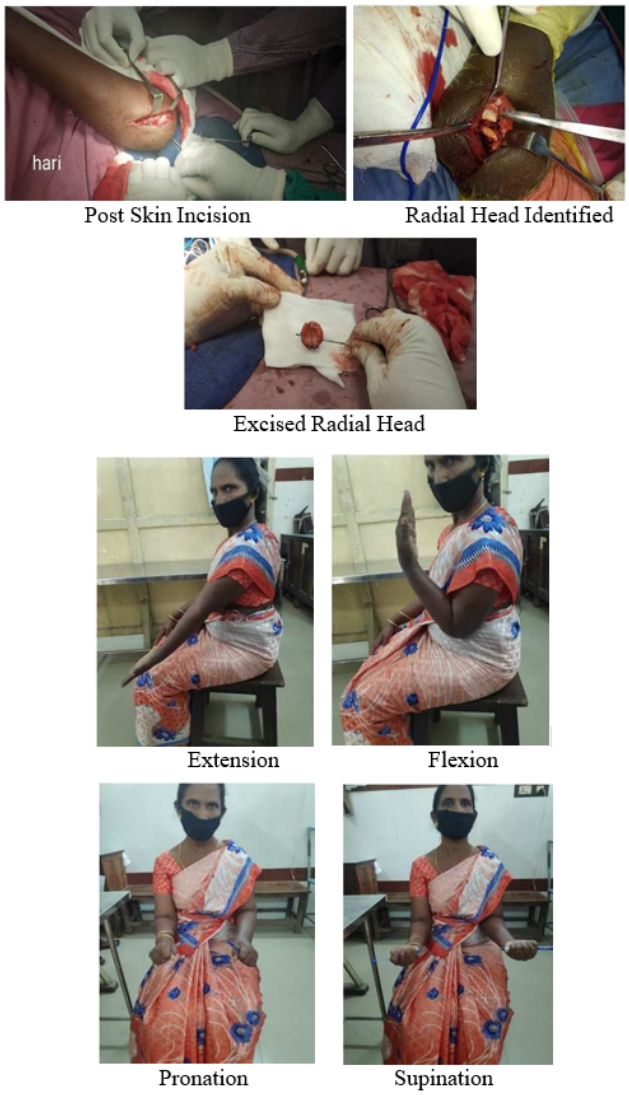

Fig. 3: Case 1 Intra-op image

Regarding the functional outcome replacement group patients had good functional outcome in terms of flexion, extension, pronation and supination.(Table 8)

Regarding complication only 2 patients had complication in replacement group but in excision group 12 patients had complications after surgery.(Table 9)

5. Discussion

A radial head fracture is one of the horrific triad injury's components, and for it to heal satisfactorily, it needs the right kind of therapy. Highly comminuted radial head fracture from the horrifying triad injury is often treated with arthroplasty and prosthesis. Radial head excision and replacement are routinely used to treat comminuted radial

Table 1: Distribution of study group based on the occupation

Occupation	Replacement		Excision		Total	
	N	%	N	%	N	%
Daily wages	4	16%	2	8%	6	12%
Sports person	3	12%	4	16%	7	14%
Student	5	20%	4	16%	9	18%
Farmer	3	12%	2	8%	5	10%
Housewife	3	12%	4	16%	7	14%
Milkman	2	8%	1	4%	3	6%
Postman	1	4%	1	4%	2	4%
Driver	2	8%	3	12%	5	10%
Others	2	8%	4	16%	6	12%
Total	25	100%	25	100%	50	100%

Table 2: Distribution of study group based on the mode of injury

Mode of injury	Replacement		Excision		Total	
	N	%	N	%	N	%
RTA	8	32%	7	28%	15	30%
Accidental fall	4	16%	4	16%	8	16%
Self-fall	3	12%	4	16%	7	14%
Assault	2	8%	1	4%	3	6%
Sports injury	3	12%	5	20%	8	16%
Others	5	20%	4	16%	9	18%
Total	**25**	**100%**	**25**	**100%**	**50**	**100%**

Table 3: Comparison of study group based on the hospital stay

Hospital stay (Days)	Replacement		Excision		Total	
	N	%	N	%	N	%
<3	8	32%	11	44%	19	38%
4 – 6	11	44%	9	36%	20	40%
>6	6	24%	5	20%	11	22%
Mean	4.84 days		3.96 days		4.36 days	
Mean difference	0.88					
Min – Max	2 – 8 days		2 – 7 days		2 – 8 days	
P value	0.062					

Table 4: Statistical comparison of DASH score between the study group

Follow up period	Replacement		Excision		P value
	Mean	SD	Mean	SD	
Immediate post-op	34.3	9.1	36.6	8.5	0.151
1^{st} month	27.7	7.3	30.7	9.4	0.073
3^{rd} month	22.3	8.5	25.6	7.9	0.064
6^{th} month	15.9	7.2	19.1	8.3	0.042*

Table 5: Statistical comparison of MEPS score between the study groups

Follow up period	Replacement		Excision		P value
	Mean	SD	Mean	SD	
Immediate post-op	65.32	6.31	61.24	7.12	0.062
1^{st} month	68.75	5.39	64.24	6.35	0.072
3^{rd} month	84.36	5.22	75.26	6.31	0.033*
6^{th} month	92.66	6.1	86.33	7.55	0.021*

Table 6: Comparison of improvement between the groups based on MEPS score

Follow up period	Replacement (25)				Excision (25)			
	Poor	Fair	Good	Excellent	Poor	Fair	Good	Excellent
Immediate post-op	15	8	2	0	18	6	1	0
1^{st} month	7	8	8	2	14	8	3	0
3^{rd} month	1	5	10	9	6	10	8	1
6^{th} month	0	2	8	15	0	4	14	7

Table 7: Comparison of strength improvement between the groups based on bromberg and morrey scale

Follow up period	Replacement (25)				Excision (25)			
	Severe loss	Moderate loss	Slight loss	Normal strength	Severe loss	Moderate loss	Slight loss	Normal strength
Immediate post-op	18	7	0	0	21	4	0	0
1^{st} month	10	14	1	0	18	7	0	0
3^{rd} month	3	17	5	0	8	15	2	0
6^{th} month	0	7	14	4	0	9	16	0

Table 8: Comparison of functional outcome at 6^{th} month follow-up between the groups

Function	Replacement	Excision	P value
Flexion (°)	126.9 ± 11.3	121.5 ± 19.6	< 0.05
Extension deficit (°)	11.7 ± 12.7	16.5 ± 15.5	0.932
Pronation (°)	71.4 ± 14.2	61.5 ± 17.8	< 0.05
Supination (°)	67.4 ± 14.1	63.0 ± 16.2	< 0.05

Table 9: Comparison of complications between the groups

Complications	Replacement		Excision		Total	
	N	%	N	%	N	%
Yes	2	8%	10	40%	12	24%
No	23	92%	15	60%	38	76%
Total	25	100%	25	100%	50	100%

head fractures.

In this study, 50 patients underwent surgery and were then thoroughly monitored for 6 months. Of these patients, 25 had broken the head of their radial bone and underwent radial head excision, while the other 25 had fractured their radial bone and underwent radial head replacement. Both groups were selected at random to allow for an appropriate comparison of the patients in the two groups has a 43.9-year-old mean age, with patients in both groups ranging in age from 20 to 62. Between the ages of 31 and 50, 44% of the patients were present. Men made up 60% of the study sample, while women made up 40%. 32 patients received treatment, and 25 of them suffered self-inflicted falls, 6 automobile accidents, and 1 assault-related injury. Thirty-two of the patients (left elbow injuries in 19; right elbow injuries in 13) Of the 32 patients, 11 suffered further injuries.

The common fracture of the radial head accounts for one-third of all elbow fractures and 1.5% to 4% of all adult fractures. These fractures can occur up to 85% of the time between the third and sixth decade of life. According to prior study, patients are 45 to 45.9 years old on average, with female patients being 7 to 16.8 years older than male patients.

Our investigation found that RTA was the main contributor to 30% of patient injuries, with unintentional falls and sports injuries (16%) following closely behind. Type-III Massons were more common in this research (70%) than type-IV Massons (20%). In retrospective studies, modular monopolar or bipolar prostheses are frequently implanted for irreparable Mason type III or type IV fractures. According to the average duration of stay, the replacement group (4.84 days) had to stay in the hospital longer than the excision group (3.9 days). The modified Mason classification is the one that is most frequently applied to articular radial head fractures. Mason divides radial head fractures into four different types: type I, which stands for minimally or non-displaced fractures; type II, which stands for marginal sector fractures with displacement; type III, which stands for comminuted fractures affecting the entire radial head; and type IV, which stands for RHFs connected to elbow dislocation. Two groups of patients, each with 25 patients, were enrolled in our study: those who underwent radial head replacement

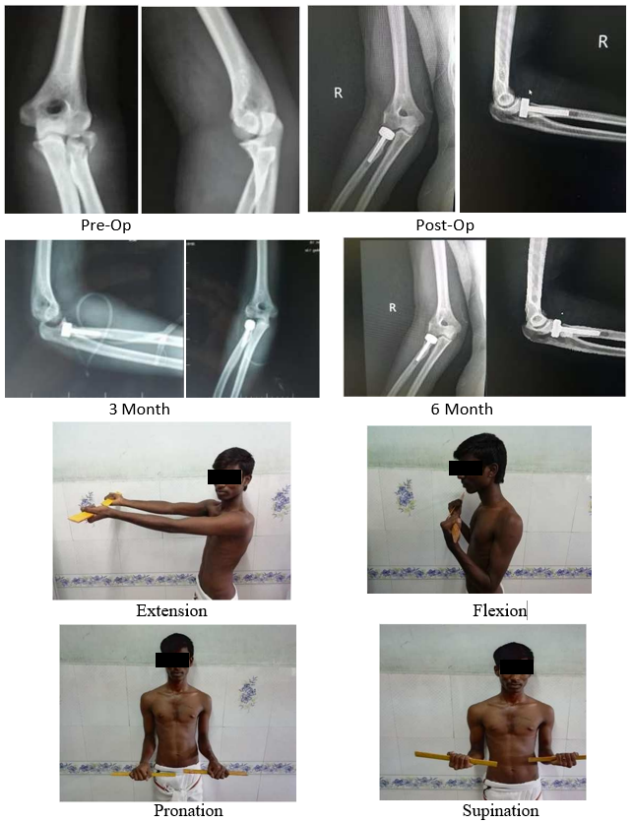

Fig. 4: Case 2: Siva perumal-23/M- Mason type III - radial head prosthesis follow up at 6 months - excellent

Fig. 5: Case 2: Intra op images

and those who had radial excision. They were all fractures of types III and IV according to Masson.

With various scales and results, we compared the radial head replacement group with the radial head excision group in this study. According to our study, the average hospital stay was 0.88 days longer in the group receiving radial head replacements. With a p value of 0.042*, the DASH score evaluation revealed that the radial head replacement group had substantially better improvement than the excision group.

In this study, we also examined MEPS scores across the groups, and it was found that, at the conclusion of the six-month follow-up period, the replacement group had improved more than the excision group, with a mean score that was higher (92.66) and a significant p value of.0021*. By the end of the sixth month, 15 out of 25 cases had good improvements, according to the MEPS score, whereas only 7 instances in the excision group had outstanding results.

Using the Bromberg and Morrey Scale, we compared the strength between the groups. At the end of the six-month follow-up period, 4 cases had normal strength, while 14 had slightly decreased. In the excision group, on the other hand, there were no cases that had normal strength and 16 cases that had slightly decreased. At the conclusion of the six-month period, when we evaluated the functional outcomes across the groups, the replacement group performed better than the excision group. In the replacement group, the mean flexion was 126.9°, while in the excision group, it was 121.5°. In the replacement group, there were just 2 cases with minor issues, but there were 12 cases with various difficulties in the excision group.

The best way to handle comminuted Mason type III radial head fractures with concurrent ligament injury is still up for debate. Several surgical techniques, including ORIF, radial head excision, and radial head replacement, have been suggested for these complex lesions. The proximal radial epiphysis is anatomically enclosed by the joint capsule. In a juvenile skeleton, there aren't many blood vessels that cross the physis. The proximal radial epiphysis's limited vascular supply, which comprises of a few small intraarticular arteries running through the radial neck and a few intraosseous veins, resulting in a scant circulatory supply to the radial head.

Although the majority of studies concluded that radial head excision was a long-term effective treatment for isolated, displaced, and comminuted radial head fractures, it is essential to check the elbow for any associated injuries prior to resection, especially ligamentous injuries as results in this group were reported to be subpar. Therefore, radial head excision in the presence of MCL or interosseous membrane injuries is contraindicated unless both injuries are treated simultaneously.

Due to the increased occurrence of problems in patients who underwent radial head resection, as well as the greater need for reoperation and a poorer clinical score, Lópiz et al. recommended radial head replacement as the first-line treatment option in a recent study.

6. Conclusion

This investigation led us to the conclusion that radial head replacement is a viable treatment option for irreparable radial head fractures. Effective radiocapitellar contact can be made via radial head replacement, which will increase

the forearm's stability under valgus, posterolateral, and axial stress. Even with several combined elbow injuries, this course of therapy yields acceptable short- and midterm outcomes. Therefore, while treating a comminuted radial head fracture, surgeons may opt to radial head replacement procedure.

7. Source of Funding

None.

8. Conflict of Interest

Nil.

References

1. Beingessner DM, Dunning CE, Gordon KD, Johnson JA, King GJW. The effect of radial head fracture size on elbow kinematics and stability. *J Orthop Res*. 2005;23(1):210–7.
2. Bryce CD, Armstrong AD. Anatomy and biomechanics of the elbow. *Orthop Clin North Am*. 2008;39(2):141–54.
3. King GJ, Zarzour ZD, Patterson SD, Johnson JA. An anthropometric study of the radial head: implications in the design of a prosthesis. *J Arthroplasty*. 2001;16(1):112–6.
4. Lindenhovius AL, Felsch Q, Doornberg JN, Doornberg JN, Ring D, Kloen P, et al. Open reduction and internal fixation compared with excision for unstable displaced fractures of the radial head. *J Hand Surg Am*. 2007;32(5):630–6.
5. Morrey BF, An KN, Stormont TJ. Force transmission through the radial head. *J Bone Joint Surg Am*. 1988;70(2):250–6.
6. Morrey BF, Tanaka S, An KN. Valgus stability of the elbow. A definition of primary and secondary constraints. *Clin Orthop Relat Res*. 1991;265:187–95.
7. Itamura JM, Roidis NT, Chong AK. Computed tomography study of radial head morphology. *J Shoulder Elbow Surg*. 2008;17(2):347–54.
8. Rosenblatt Y, Athwal GS, Faber KJ. Current recommendations for the treatment of radial head fractures. *Orthop Clin North Am*. 2008;39(2):173–85.
9. Smith GR, Hotchkiss RN. Radial head and neck fractures: anatomic guidelines for proper placement of internal fixation. *J Shoulder Elbow Surg*. 1996;5(2 Pt 1):113–7.
10. Riet RPV, Glabbeek FV, Neale PG, Bortier H, An KN. The noncircular shape of the radial head. *J Hand Surg Am*. 2003;28(6):972–8.
11. Guitton TG. Advancements in classification, treatment and outcome of radial head fractures. Netherlands; 2011.
12. Soren S, Nayak AK, Nayak RK, Panda SK, Parida PR. Evaluation of results of fracture head and neck of radius managedby varius methods. *Panacea J Med*. 2021;11(2):269–73.
13. Cheung EV, Steinmann SP. Surgical approaches to the elbow. *J Am Acad Orthop Surg*. 2009;17(5):325–33.
14. Kocher T. Operations at the elbow. In: Kocher T, editor. Text-Book of Operative Surgery. New York: Macmillan; 1911. p. 313.
15. Husband JB, Hastings H. The lateral approach for operative release of post-traumatic contracture of the elbow. *J Bone Joint Surg Am*. 1990;72(9):1353–8.
16. Mansat P, Morrey BF. The column procedure: a limited lateral approach for extrinsic contracture of the elbow. *J Bone Joint Surg Am*. 1998;80(11):1603–15.
17. Ramavat SD, Patel Z. Results of operative management of radial head fractures by internal fixation and excision and conservative management: A study of 60 cases. *Int J Orthop Sci*. 2021;7(1):667–9.

Author biography

Narendra Varma, Post Graduate

Gokul Anand, Associate Professor

Boblee James, Professor and HOD

Kamalakannan, Assistant Professor

Cite this article: Varma N, Anand G, James B, Kamalakannan. A comparative study of outcome of radial head fracture treated with radial head replacement and radial head excision alone. *Indian J Orthop Surg* 2022;8(4):244-251.