Radial head arthroplasty for acute type III radial head fracture, case report and review of literature

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Keywords:
Radial head, fracture, arthroplasty, fixation, excision.

Abstract

Introduction and importance: Radial head fractures represent common intra-articular elbow fractures that frequently associates an episode of elbow instability, a mechanical block to elbow motion, or an injury to the distal radioulnar joint. The diagnosis is clinical and radiological. X-rays are used for the diagnosis, and the CT scan is used for the planning of surgical intervention. Conservative treatment is preferred for non-displaced fractures, while surgical treatment is reserved for displaced fractures or in the case of mechanical block or instability. Fixation, excision, and replacement are the main options of surgical treatment. Radial head arthroplasty is indicated for comminuted radial head fractures involving more than 30% of the articular surface. In this case report we aim to share the first case of radial head arthroplasty in Sudan. It has been done at Bashaer university hospital in Khartoum.

Case presentation: a 44-year-old man, a laborer, fell at work and came to the ER with severe left elbow pain and swelling. He had no other injuries, and his medical background is unremarkable.

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Clinical findings and investigations: the left elbow was grossly swollen with ecchymosis of the anterior skin. Both supination and pronation movements of the left elbow were restricted. X-rays revealed a comminuted radial head fracture. A CT scan was also performed.

Interventions and outcome: surgical treatment was decided upon and performed three days following trauma. Radial head bipolar arthroplasty was the procedure of choice. The patient has been followed for three months, and the clinical and functional outcomes were impressive.

Conclusion: comminuted radial head fractures are challenging intra-articular injuries that require careful surgical intervention. Radial head replacement can be a suitable option for the treatment of these injuries with good stability, low rate of complications, and impressive patient satisfaction.

Introduction

Background:

About one-third of elbow fractures and 2% to 4% of adult fractures are radial head fractures (1). The most common mechanism of injury is a fall on an outstretched arm with a pronated forearm (2, 3). Radial head fractures are more common in females than in males (4). Typically, even when displaced by more than 2 mm, most radial head fractures without comorbid fractures or ligament damage are essentially stable (5). In 1954, Mason classified radial head fractures into three types (6). Mason defined a Type 1 fracture as small cracks, and the bone pieces remain fitted together (displaced), a Type 2 fracture as a slightly displaced fracture that involves a larger piece of bone, and a Type 3 fracture as a comminuted, displaced fracture affecting the entire radial head (6). Mason classification was modified by Bromberg and Morrey in 1987 (7). The treatment of type 3 radial head fractures is still debatable. Open reduction and internal fixation (ORIF), radial head arthroplasty, and radial head excision are surgical alternatives for treatment (8, 9). Complications of radial head excision include cubitus valgus, proximal migration of the radius, posterolateral rotatory instability of the elbow, and elbow and wrist degenerative arthritis (10). Since the radial head is crucial in preserving the stability of the elbow, several researchers advise preserving it by ORIF or radial head arthroplasty (11, 12). When the articular surface is affected to greater than 30%, radial head replacement is advised (13). Other indications of radial head replacement are displaced, unstable, fragmented fractures of the radial head that occur during elbow fracture-dislocation (14). In the present study, we report a case of a Mason type III fracture treated with radial head replacement.

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Patient information:

The patient is a 44-year-old male who is working as a laborer. He came with a history of falling on outstretched hand at work. He has no known allergies or chronic illnesses. He is not using long-term medications. He is neither a smoker nor an alcohol consumer.

Clinical findings:

The left elbow is swollen, with ecchymosis on the anterolateral side. There is a limitation of supination and pronation movements, and the lateral side of the elbow joint is tender.

Diagnostic assessment and interpretation:

An X-ray of the right elbow (AP and lateral views) showed a comminuted radial head fracture. A CT scan was also done and gave more details about the comminution of the fracture and the extension into the radial neck. No other associated injuries were detected.

Preoperative X-ray:

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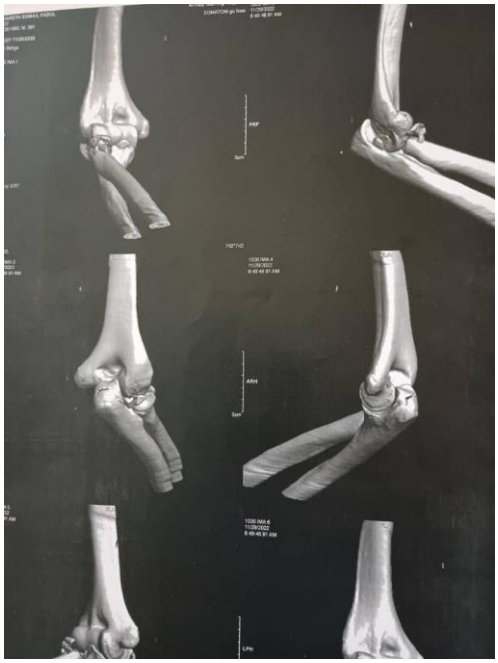
Preoperative CT scan:



Intervention:

Positioning: The procedure is performed with the patient in the supine position, the upper extremity supported on a hand table, and the forearm pronated. A tourniquet was used.

Approach: The lateral approach was used.

Intermuscular plane between

- Anconeus (radial nerve)

- Extensor carpi ulnaris (posterior interosseous nerve).

Landmarks

- Lateral humeral epicondyle
- Radial head 2.5 cm distal to lateral epicondyle, head (or crepitus in fractured) palpable with pronation/supination.

Incision

- 5cm longitudinal, gently curved, incision based on the lateral epicondyle and extending distally over the radial head.
- Superficial dissection:
    - The deep fascia in incised in line with the incision.
    - The plane is between ECU and anconeus distally.
- Deep dissection
    - Pronation of the forearm is maintained to move PIN away from the field.
    - The proximal fibers of supinator muscle were split, staying on the posterior cortex of the radius away from PIN.
    - The capsule is opened longitudinally.

All radial head and neck fragments were resected with preservation of the annular ligament for later repair. Trimming of the radial neck is performed in order to fit the prosthesis with a small rongeur. Opening of the medullary canal is done. Sizing of the prosthesis is performed. Reconstruction of the radial head and neck with the excised fragments is attempted to identify the appropriate diameter and length of prosthesis. The annular ligament is repaired with non-absorbable sutures.

Follow-up and outcome:

The patient has passed through an uneventful postoperative period, and his left upper limb is placed in back slab for two weeks. Physiotherapy started after two weeks, and the patient was followed for three months and showed good progress clinically and functionally.

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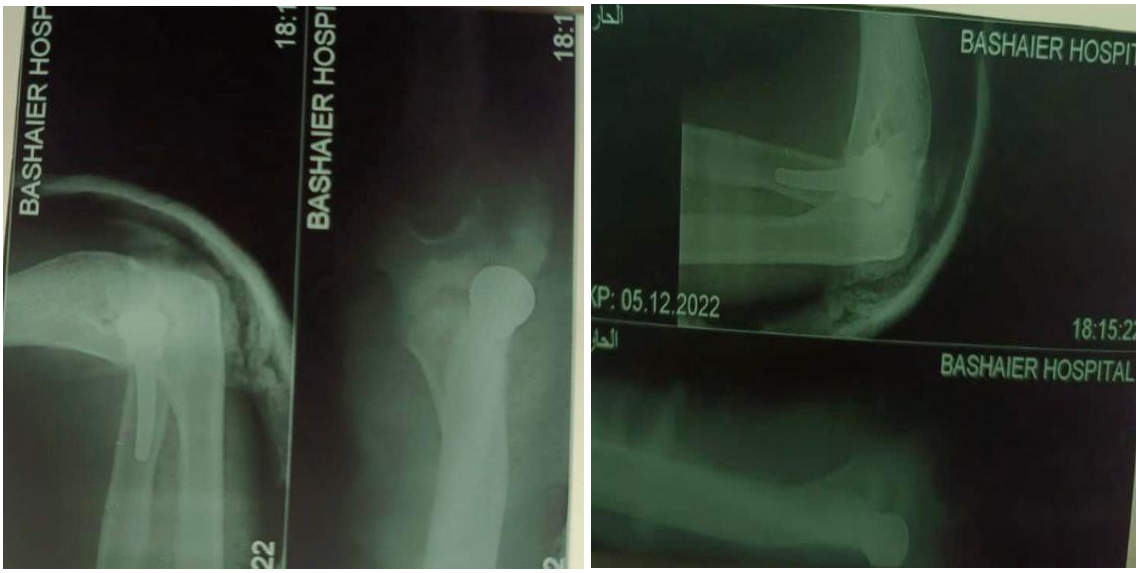
Postoperative x ray:



Discussion

According to several biomechanical researches, the radial head plays a crucial role in preventing longitudinal and valgus instability, which raises the likelihood of prosthetic replacement over radial head excision alone. On the other hand, there is still little consensus regarding the dependability of a variety of prosthetic devices that vary from one another in terms of the head's characteristics (anatomic, non-anatomic, monopolar, bipolar), the stem's design (loose-fit, press-fit, short, or long), the type of fixation (cemented, un-cemented), and the presence of modularity. It is challenging to select a prosthetic model that provides excellent clinical results, ease of implantation, and a low failure rate because of conflicting and contentious findings in the current literature that have an impact on routine surgical activity. This study was motivated by the need to assess the performance, dependability, and shortcomings of a single bipolar RHP, highlighting the failure rate and potential correlation between radiological indications and clinical findings. Theoretically, bipolar prostheses have a better radio-capitellar congruency because of the head-neck system's tri-axial rotation, which reduces the contact pressures on the capitulum during flexion-extension and pronation-supination movements as well as the stress at the implant-bone interface during forearm rotation (15). The main reason for prosthetic revisions, chronic lateral forearm pain, could be avoided by preventing articular cartilage wear by exposing subchondral capitellar bone [16]. Additionally, the combination with a press-fit stem with a textured surface is intended to promote bone in-growth by direct bone formation within the pores or apposition of bone from the surrounding bone tissue into the porous zone [17]. Our

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current trial demonstrates positive MEPS results and favourable midterm clinical outcomes. At the follow-up, there were no occurrences of elbow gross instability and no concurrent ligament injuries were discovered. It is still debatable whether monopolar or bipolar prostheses restore elbow stability more effectively biomechanically; according to some authors, the variable coupling between bipolar implants and the capitellar surface opposes translation forces worse than monopolar implants do, leaving residual elbow instability [18]. Chanlalit et al. [19] replicated the terrible triad injuries in a cadaveric study using 8 fresh-frozen elbow specimens, demonstrating that monopolar RHP ensures greater radio-capitellar stability than bipolar RHP and that anatomically shaped heads are preferred over non-anatomic heads. The subluxation force of the bipolar prosthesis was significantly lower (1 +/ 1 N) than that of the monopolar non-anatomic implant (12 +/ 1) is statistically comparable to the latter (18 +/− 2 N). As opposed to this, Hartzel et al. [20] evaluated the instability of monopolar and bipolar prostheses in a cadaveric investigation following a dreadful triad simulated injury and LCL reconstruction: Enhancing valgus and external rotation laxity revealed no differences. This theory is supported by in vivo investigations; the risk of instability is not raised with a bipolar design in the presence of an intact or properly healed LCL, and residual laxity does not result in clinically obvious elbow instability.

Conclusion:

Radial head bipolar arthroplasty is an effective surgical procedure in the treatment of acute radial head fractures with severe comminution (type 3). This procedure requires a meticulous approach, good experience, and a suitable implant.

Consent:

Written consent had been obtained from the patient, for the procedure and for the publication of this case report. The approval of the Research Ethics Review Committee at Bashaer University Hospital is secured.

References

1. Crönlein M, Zyskowski M, Beirer M, Imhoff FB, Pförringer D, Sandmann GH, Kirchhoff C, Biberthaler P, Siebenlist S. Using an anatomically preshaped low-profile locking plate system leads to reliable results in comminuted radial head fractures. Archives of Orthopaedic and Trauma Surgery. 2017 Jun;137(6):789-95.

 online ISSN 1858-6279 ISSN 1858-6155

2. Tarallo L, Mugnai R, Rocchi M, Capra F, Catani F. Mason type III radial head fractures treated by anatomic radial head arthroplasty: Is this a safe treatment option?. Orthopaedics & Traumatology: Surgery & Research. 2017 Apr 1;103(2):183-9.
3. Jordan RW, Jones AD. Suppl-8, M8: Radial Head Fractures. The Open Orthopaedics Journal. 2017;11:1405.
4. Kaas L, van Riet RP, Vroemen JP, Eygendaal D. The epidemiology of radial head fractures. Journal of shoulder and elbow surgery. 2010 Jun 1;19(4):520-3.
5. Van Riet RP, Morrey BF, O'Driscoll SW, Van Glabbeek F. Associated injuries complicating radial head fractures: a demographic study. Clinical Orthopaedics and Related Research (1976-2007). 2005 Dec 1;441:351-5.
6. ML M. Some observations on fractures of the head of the radius with a review of one hundred cases. Br J Surg. 1954;42:123-32.
7. Broberg MA, Morrey BF. Results of treatment of fracture-dislocations of the elbow. Clinical Orthopaedics and Related Research®. 1987 Mar 1;216:109-19.
8. Lópiz Y, González A, García-Fernández C, et al. Comminuted fractures of the radial head: resection or prosthesis? Injury 2016;47:29–34.
9. [8]. Akman YE, Sukur E, Circi E, et al. A comparison of the open reduction-internal fixation and resection arthroplasty techniques in treatment of Mason Type 3 radial head fractures. Acta Orthop Traumatol Turc 2017;51:118–22.
10. Businger A, Ruedi TP, Sommer C. On-table reconstruction of comminuted fractures of the radial head. Injury 2010;41:583–8.
11. Hilgersom NF, Eygendaal D, van den Bekerom MP. Is radial head resection the first choice treatment of comminuted radial head fractures without associated instability? Injury 2017;48:560–2.
12. Kiran Kumar GN, Sharma G, Farooque K, et al. On-table reconstruction and fixation of Mason type III radial head fractures. Chin J Traumatol 2015;18:288–92.
13. Ring D. Displaced, unstable fractures of the radial head: fixation vs. replacement—what is the evidence?. Injury. 2008 Dec 1;39(12):1329-37.
14. Johnston GW. A follow-up of one hundred cases of fracture of the head of the radius with a review of the literature. The Ulster medical journal. 1962 Jun;31(1):51.
15. Chanlalit C, Shukla DR, Fitzsimmons JS, An KN, O'Driscoll SW (2012) The biomechanical efect of prosthetic design on radiocapitellar stability in a terrible triad model. J Orthop Trauma 26(9):539–544. https://doi.org/10.1097/BOT.0b013e318238b3a2

 online ISSN 1858-6279 ISSN 1858-6155

16. Giannicola G, Sacchetti FM, Antonietti G, Piccioli A, Postacchini R, Cinotti G (2014) Radial head, radiocapitellar and total elbow arthroplasties: A review of recent literature. Injury 45:428–436. https://doi.org/10.1016/j.injury.2013.09.019
17. Pilliar RM, Lee JM, Maniatopoulos C (1986) Observations on the efect of movement on bone ingrowth into porous-surfaced implants. Clin Orthop Relat Res 1986:108–113
18. Allavena C, Delclaux S, Bonnevialle N, Rongières M, Bonnevialle P, Mansat P (2014) Outcomes of bipolar radial head prosthesis to treat complex radial head fractures in 22 patients with a mean follow-up of 50 months. Orthop Traumatol Surg Res. 100(7):703– 709. https://doi.org/10.1016/j.otsr.2014.06.019
19. Schneeberger AG, Adams R, Morrey BF (1997) Semiconstrained total elbow replacement for the treatment of post-traumatic osteoarthrosis. J Bone Joint Surg Am 79(8):1211–1222. https://doi. org/10.2106/00004623-199708000-00014
20. Hartzler RU, Morrey BF, Steinmann SP, Llusa-Perez M, SanchezSotelo J (2014) Radial head reconstruction in elbow fracture-dislocation: monopolar or bipolar prosthesis? Clin Orthop Relat Res 472(7):2144–2150. https://doi.org/10.1007/s11999-014-3672-0

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