

Open Reduction and Internal Fixation of a Comminuted Displaced Radial Head Fracture in a 12-Year-Old Female: A Case Report

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Learning Point of the Article:

This article highlights the successful use of surgical management and early rehabilitation strategy of a rare significantly displaced intra-articular radial head fracture in a skeletally immature patient to achieve complete recovery.

Abstract

Introduction: Radial head (RH) fractures are relatively uncommon injuries in children, typically resulting from a fall onto an outstretched hand, and can pose significant challenges in diagnosis and management, particularly when they are displaced or involve the articular surface.

Case Report: A 12-year-old female sustained a comminuted displaced partial-articular fracture of the RH following a fall onto her arm during a netball game. Open reduction and internal fixation were performed using headless compression screws. Post-operative recovery was uneventful with a full range of motion at 3-month follow-up.

Conclusion: This case highlights the successful surgical management and early rehabilitation strategy of a rare, significantly displaced intra-articular RH fracture in a young child.

Keywords: Radial head, fracture, pediatric.

Introduction

Intra-articular radial head (RH) fractures in pediatric patients are uncommon, and those with significantly displaced fragments present unique management challenges due to the complexity of the elbow physal anatomy, small size of fragments and the potential for growth disruption at the associated growth plate. While undisplaced fractures can often be treated conservatively, grossly displaced intra-articular fracture is an indication for operative fixation to restore joint congruity and function while minimizing growth plate disturbance.

This case report aims to contribute to the limited body of evidence on surgical management of comminuted displaced intra-articular RH fractures in skeletally immature patients,

emphasizing the role of advanced imaging, meticulous surgical technique and structured rehabilitation in optimising outcomes.

Case Report

A 12-year-old fit and well female presented to the emergency department with pain and restriction in movement after falling onto her left arm during a netball game. Clinical examination revealed localized tenderness laterally over the RH with no significant swelling, ecchymosis or any open wounds. Neurovascular function was intact.

Investigations

Lateral and attempted anteroposterior plain radiographs of the

Author's Photo Gallery



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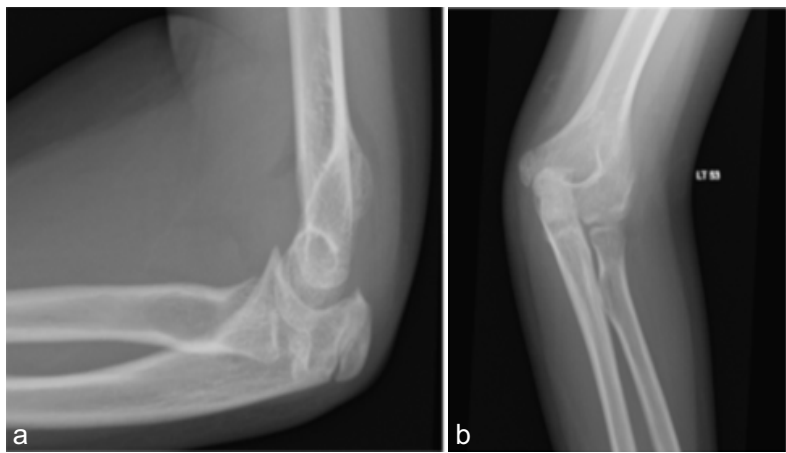


Figure 1: (a) Lateral radiograph of elbow showing a proximally displaced radial head fragment. (b) Attempted anteroposterior radiograph of elbow with radial head fracture fragments hidden behind the capitellum.

elbow demonstrated a displaced fracture of the RH in a skeletally immature patient (Fig. 1a and b). A pre-operative computed tomography (CT) of the elbow (Fig. 2a and b) revealed a comminuted partial-articular Salter-Harris (SH) Type 3 fracture involving 50% of the anterior RH, which was in two fragments, both having migrated posteriorly and proximally. Re-formatting of the CT images estimated the two fragments to be 4.2 mm in depth and each approximate quarters of a RH with an original diameter of 15.9 mm. The scan also confirmed posterior subluxation of the RH with the appearance of a posterior capitellum Osborne-Cotterill lesion. The ulno-humeral joint was congruent, and all ossification centers were present in accordance with her age. Relevantly, the physis seen of the non-fractured proximal radius appeared to be ossified. There were no other obvious injuries to bone

or growth plates.

Treatment

The significance of the disruption to the RH articular surface and displacement of the fragments, along with subluxation at the radiocapitellar joint, were all indications for surgery to reduce and fix the fracture while restoring joint congruency and stability. Appropriate explanation, discussion, and informed consent with the patient and her parents were carried out, but due to the availability of an upper limb surgeon, surgery was delayed until 12 days post-injury.

She underwent open reduction and internal fixation (ORIF) under general anesthesia in the supine position with a high arm tourniquet and standard preparation with betadine and chlorhexidine. A lateral longitudinal incision over the left elbow was made using the

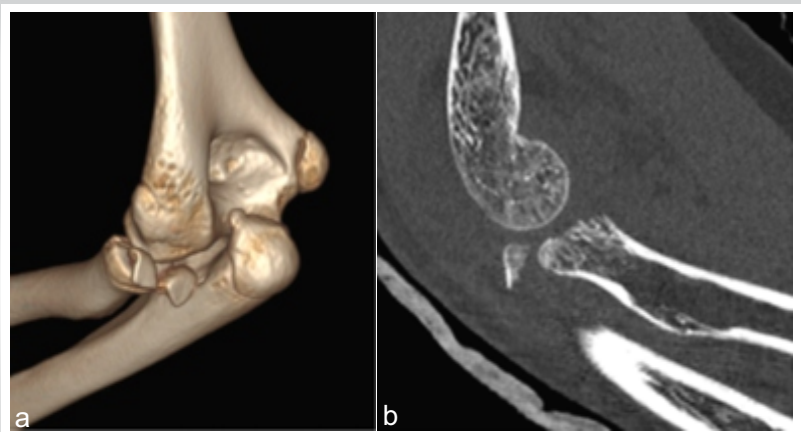


Figure 2: (a) Computed tomography (CT) 3D reconstruction demonstrating two radial head fragments displaced dorsal to radiocapitellar joint. (b) Sagittal section of CT demonstrating posteriorly displaced radial head fragment.

extensor digitorum communis (EDC) splitting approach. The lateral ulnar collateral ligament was found to be intact with no significant Osborne-Cotterill lesion. The annular ligament was incised longitudinally to expose the RH and fracture.

Two fracture fragments representing >50% of the RH were identified posteriorly within the capsule. These fragments were reduced and fixed together extracorporeally on the table using a 1.7 mm cannulated headless compression screw (HCS). The reconstituted half of the RH was then reduced and fixed to the intact RH and neck under direct vision and with intra-operative image intensifier using two 2.2 mm cannulated HCS in a tripod configuration. All screw heads were buried under cartilage to avoid articular prominence (Fig. 3a and b).

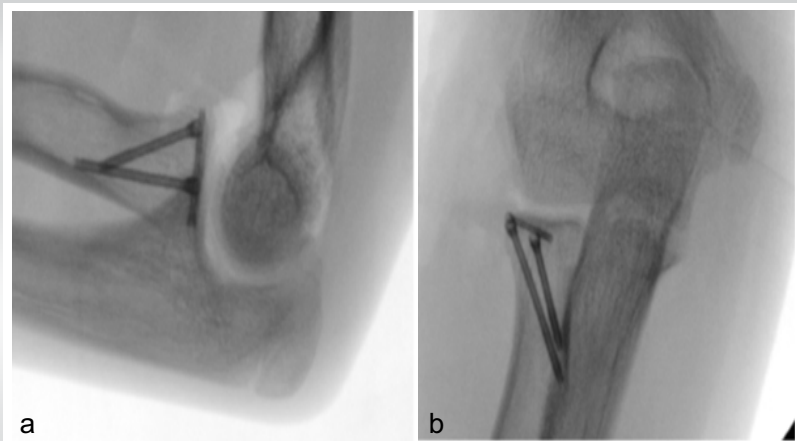


Figure 3: (a) Lateral intraoperative fluoroscopy demonstrating one transverse headless compression screw (HCS) and two HCS in tripod configuration. (b) Anteroposterior intraoperative fluoroscopy demonstrating one transverse HCS and two HCS in tripod configuration.



Figure 4: (a) Lateral view of elbow 2 weeks post-operative radiograph. (b) Anteroposterior view of the elbow 2 weeks post-operative radiograph.

After fixation, examination with intra-operative imaging confirmed a stable fracture and congruent radiocapitellar and ulnohumeral joints. Full range of motion (ROM) of the elbow and forearm in all directions was demonstrated, and elbow stability under varus and valgus stress was evident. The annular ligament and EDC were repaired, followed by appropriate wound closure, dressing, and application of a bulky bandage using wool and crepe, but no plaster immobilization.

Post-operative rehabilitation

Postoperatively, the patient was given adequate analgesia and given instructions for gentle active elbow mobilization limited from 30 to 130° of flexion and 60° of pronation to 60° of supination for the first 4 weeks before allowing a full ROM. She was encouraged to mobilize her shoulder, wrist, and fingers immediately and advised to avoid lifting, loading, and resistance for 6 weeks, after which there were no restrictions.

Outcome and follow-up

The patient was reviewed at 9 days, 6 weeks, 3 months, and 12 months postoperatively patient with formal physiotherapy starting at 2 weeks following surgery. She made an uneventful recovery with near full ROM at 6 weeks. Relevant post-operative radiographs at that stage demonstrated satisfactory position of implants and fragments with evidence of lateral callus (Fig. 4a and b). She had a full pain-free ROM and function at both 3-month and 12-month follow-up (Fig. 5a, b, c).

Discussion

RH and neck fractures represent approximately 14% of all pediatric fractures and about 4–7% of elbow injuries in children [1,2]. The mechanism of injury often involves a fall on an outstretched arm, commonly producing valgus stress and axial loading, and resulting in compressive forces between the RH and the capitellum [3,4]. The resulting injury is frequently a radial neck fracture, undisplaced or displaced. In the case we present, the posterior subluxation at the radiocapitellar joint seen on CT and anterior fracture fragments was a suggestion that the mechanism of injury also involved a supinated forearm and posterior force on the RH, likely as part the posterolateral rotatory instability spectrum. In pediatric patients, an associated capsuloligamentous injury is rarely seen due to the elasticity of the soft tissues [5].

Pediatric fractures differ significantly from adult fractures due to their open growth plates. The incomplete and varied extent of ossification of the epiphyses and physes, dependent on age, complicates both diagnosis and treatment [6]. Radial neck fractures in children are usually caused by a fall on an outstretched hand with valgus stress at the elbow. The Judet



Figure 5: (a) Normal appearance of arm after 3 months post-operative. (b) Full range of motion (ROM) on extension and flexion of elbow after 3 months post-operative. (c) Full ROM on supination and pronation after 3 months post-operative.

classification for pediatric radial neck fractures and the modified Mason classification for adult RH fractures help guide treatment decisions [7].

Non-operative treatment is generally preferred for non-displaced or minimally displaced fractures. With radial neck fractures in children, less than either 30° angulation or 3 mm translation are indications for conservative management [1]. For RH fractures, surgical intervention must be considered for intra-articular fractures with significantly displaced fragments, especially if a mechanical block to motion exists or if satisfactory reduction cannot be restored by closed means [8,9,10]. Kalbitz et al. discussed his series of 67 pediatric RH fractures, but of these, only 2 of these were SH Type 3, both without comminution, and there was no described treatment for these specifically [1]. We were unable to locate any evidence available specifically for the treatment of displaced intra-articular pediatric RH fractures.

In our case, the fracture was partial-articular, significantly displaced, and comminuted with a subluxated proximal radius. If treated non-operatively, predictably, there may be a high chance of a resulting restriction in movement, particularly extension and pronosupination, due to the posterior positioning of the displaced fragments. The lead author felt ORIF was essential for this injury pattern to restore joint congruency, allow early mobilization, and retain function.

A lateral EDC-split approach was chosen for optimal visualization of the RH and neck and reduced risk to the posterior interosseous nerve compared to the Kaplan approach [11,12]. Headless screws were selected for fixation due to their compressive stability, low profile, and minimal risk of hardware prominence – especially critical with articular fragments [13,14,15]. The other issue here was due to the young age of the patient (i.e., 12 years of age) and comminution; the fragments were small and may not have been amenable to systems with larger 3.5 mm or 2.5 mm HCS. We were able to utilize smaller 2.2 mm and 1.7 mm HCS options to capture and fix these lesser-sized fragments with adequate compression and without further fragment blow-out. This is an important consideration in a young pediatric patient where RH fracture reduction and stabilisation are key to preserve the joint, and RH replacement is not an option, logically and practically.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Prolonged immobilization in adults increases the risk of elbow stiffness, the most common complication following RH surgery [16,17]. Elbow stiffness is rarely an issue, though in the pediatric population with adequately positioned or reduced fractures. Post-fixation rehabilitation still requires a cautious approach to prevent subsequent implant failure and fracture re-displacement, particularly in a non-adherent or non-compliant child. Patient and parent education and information are paramount, and post-operative rehabilitation may need to be cautiously tailored. Early but protected ROM, as implemented in our case, allowed satisfactory outcomes without short-term complications.

Complications such as growth disturbance, physeal closure, and the rare occurrence of heterotopic ossification (HO) in children can lead to long-term complications such as loss of motion and function, so such injuries require ongoing surveillance [14,18]. Our patient's recovery was uncomplicated and showed good functional results with early motion following anatomic fixation.

Conclusion

Displaced intra-articular RH fractures in children are uncommon but can significantly affect function if mismanaged, so require precise evaluation and treatment planning. In severely displaced cases, ORIF can provide reliable fracture stabilisation and allow early rehabilitation. Continued follow-up is essential to detect potential growth-related complications.

Clinical Message

This case report demonstrates that prompt surgical intervention combined with an early, structured rehabilitation protocol can result in excellent functional and radiological outcomes in skeletally immature patients with rare, significantly displaced intra-articular radial head fractures. The case emphasises the importance of achieving anatomical reduction and stable fixation in order to restore elbow congruity, facilitate early mobilisation, and minimise the risk of long-term complications such as stiffness, functional deficit, and growth disturbance in this uncommon paediatric injury pattern.



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