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Percutaneous reduction and flexible intramedullary nailing for Monteggia fracture in a skeletally mature patient



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ABSTRACT

INTRODUCTION: Monteggia lesions are defined as a fracture of the proximal ulna with an associated radial head dislocation. Management of these injuries varies depending upon the patient population, ranging from non-operative treatment with closed reduction and immobilization to surgical fixation. Percutaneous techniques of radial head reduction are often reserved for skeletally immature patients.

PRESENTATION OF CASE: In this case report, a 14-year-old female presented with left elbow pain three days after a fall. Radiographs and CT images from an outside hospital revealed a displaced left radial head fracture and a non-displaced proximal olecranon fracture, consistent with a Monteggia equivalent fracture. The patient underwent percutaneous reduction and internal fixation of the radial head with a flexible intramedullary nail (Metaizeau technique), and open reduction and internal fixation of the olecranon. She developed a 25 degree left elbow flexion contracture and, five months after her index procedure, underwent arthroscopic release and removal of hardware. The radial head reduction was near anatomic and she regained full extension.

DISCUSSION: This report demonstrates that percutaneous reduction with intramedullary nailing and fixation techniques can be performed successfully in skeletally mature patients.

CONCLUSION: Given their less invasive nature, we recommend attempting percutaneous interventions in some skeletally mature individuals for fracture reduction and fixation.

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1. Introduction

A Monteggia fracture is a rare injury consisting of a proximal ulnar fracture with associated radial head dislocation. Notable differences exist in the treatment and outcomes of Monteggia fractures in pediatric and adult populations, with children often having a better prognosis. Surgical fixation of these fractures through percutaneous techniques is typically reserved for skeletally immature pediatric patients.

This case report depicts a skeletally mature patient with a left Monteggia equivalent fracture who underwent percutaneous reduction and flexible intramedullary nailing of a displaced radial head fracture, and open reduction and internal fixation (ORIF) of a proximal olecranon fracture. Her unique case demonstrates that percutaneous techniques can be utilized in fracture reduction and fixation in skeletally mature patients.

2. Presentation of case

A skeletally mature 14-year-old right-hand-dominant female with no significant past medical history presented with left elbow pain. Three days prior to presentation, she fell from a height of 3.7 meters, landing onto her left arm. She was taken to an outside hospital where left elbow radiographs and a CT scan were performed. The images are shown in [Figs. 1 and 2](#). These revealed a comminuted, displaced left radial head fracture and a non-displaced proximal olecranon fracture, consistent with a Monteggia equivalent fracture. The patient was subsequently placed into a posterior long arm splint and was instructed to follow-up with an orthopaedist as an outpatient. Upon presentation to the clinic, the patient noted improving, but persistent, pain about the lateral aspect of her left elbow, for which she was medicating with acetaminophen with codeine. She denied any neurological deficits. Of note, the patient was the eldest of three children, born via normal spontaneous vaginal delivery with normal developmental milestones, and was two years post-menarchal. She had no prior surgeries and no known drug allergies.

On physical examination, the patient was a well-developed female in no acute distress. The posterior splint was removed, and the skin was intact with a significant amount of swelling

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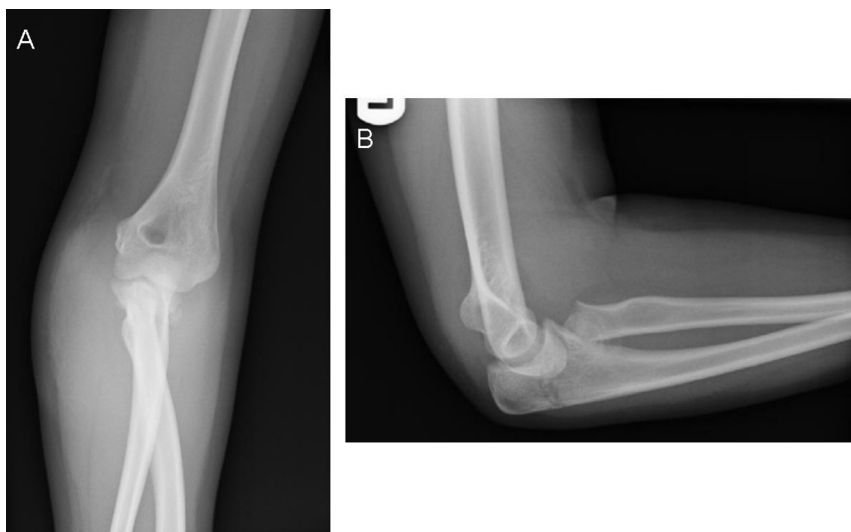


Fig. 1. Radiographs of left elbow at initial presentation. (A, AP) and (B, lateral) Demonstrate a non-displaced olecranon fracture as well as a comminuted, displaced radial head fracture.

around the left elbow. There was tenderness to palpation at this site, but no tenderness or swelling proximally or distally. The patient’s elbow range of motion was limited secondary to pain. She had intact extensor pollicis longus, flexor pollicis longus, and interosseous function, and no pain or difficulty with active metacarpal-phalangeal joint extension. Sensation was grossly intact to light touch throughout the entire upper extremity. There were no other areas of pain or deformity.

Given the patient’s fracture pattern, she was indicated for surgical fixation. Four days after presenting to the clinic (seven days post-injury), the patient was taken to the operating room where a 1.57 mm K-wire was inserted into the fracture site and levered up to perform a percutaneous reduction (Fig. 3A). A nearly anatomic reduction was achieved, and great care was taken to not penetrate the anterior tissues near the posterior interosseous nerve. Since the fracture was still impacted and slightly rotated, the decision was made to insert a flexible intramedullary nail for internal fixation (Metaizeau technique). To accomplish this, a previously bent 2.5 mm nail was inserted into the radial head. This

was rotated around, an excellent reduction was obtained, and the pin was then cut short at the skin level. The olecranon was then observed to be unstable under fluoroscopy. A Rush rod was initially attempted for fixation, but as this did not produce a stable reduction, an olecranon plate was placed which obtained excellent fixation both proximally and distally. The plate was secured with both locking and non-locking screws, as well as a diaphyseal shaft screw (Fig. 3B and C). After, the reductions were noted to be stable.

The patient progressed well post-operatively. At her first post-operative visit ten days after surgery, her pain was controlled without medications and she remained neurologically intact. The K-wire was then removed one week later, and the patient was started on gentle left elbow range of motion exercises in a sling. Her range of motion five weeks after surgery was from 35 to 100 degrees of flexion-extension, 10 degrees of pronation and 50 degrees of supination. She was started on more aggressive range of motion therapy, resulting in an improvement to 25–125 degrees of flexion-extension by post-operative week 13.

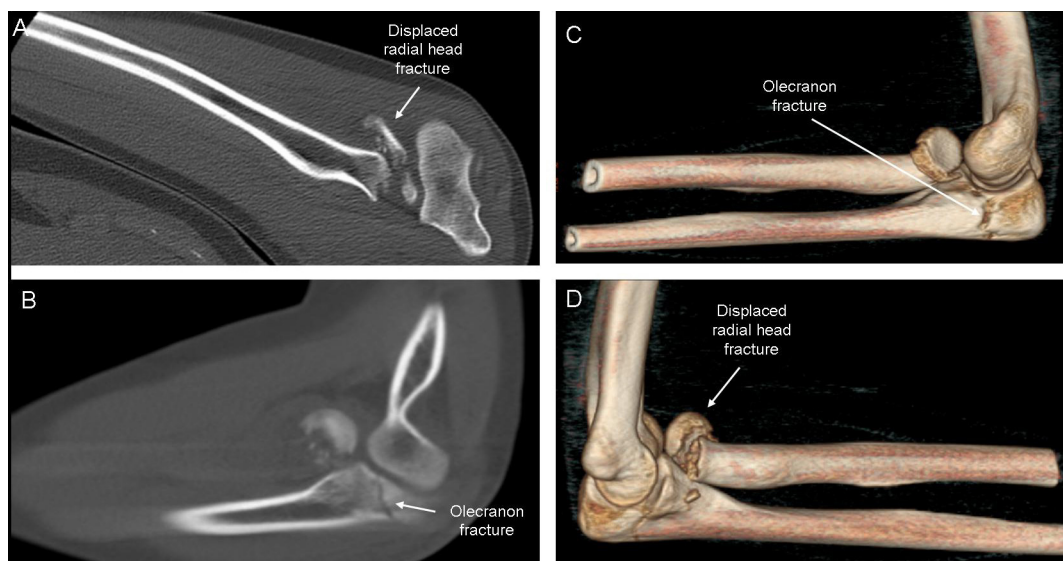


Fig. 2. CT of left elbow at initial presentation. (A, axial) and (B, sagittal) Show the olecranon and displaced radial head fractures. (C) and (D) Provide three-dimensional CT reconstructions of the fracture pattern.

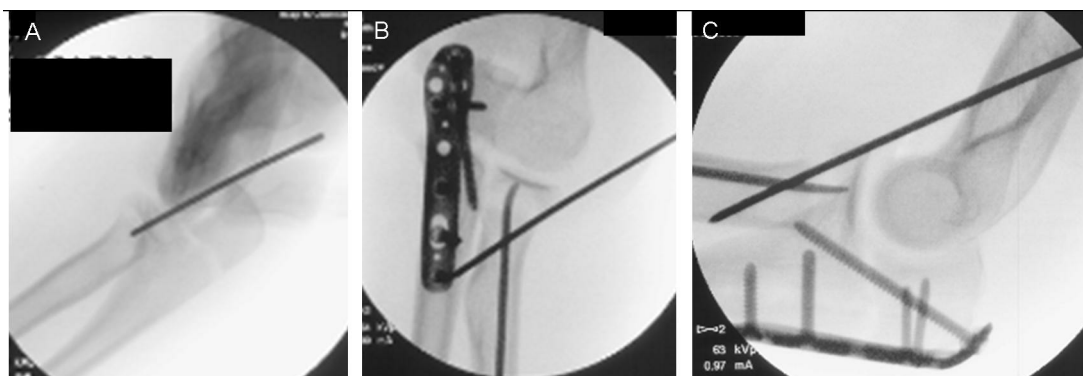


Fig. 3. Intra-operative fluoroscopic images from initial reduction and ORIF. (A) Demonstrates the initial radial head reduction with K-wire. (B) and (C) Show the left elbow after placement of the intramedullary nail and ORIF.

At five months post-operatively, after noting mild prominence of the olecranon plate and a residual left elbow flexion contracture of 25 degrees, the patient underwent arthroscopic release of the anterior capsule as well as excision of scar tissue which had formed in the anterior compartment. The radial head was noted to be in near anatomic alignment under arthroscopic examination. Then, the intramedullary nail and olecranon plate/screws were removed (Fig. 4) at 8 months post-operatively. The patient attained full left elbow extension, flexion to 130 degrees, and supination-pronation to 85 degrees post-operatively.

3. Discussion

A Monteggia fracture refers to a fracture of the proximal ulna with associated dislocation of the radial head. These fractures were initially classified by Bado.¹ Type 1 fractures are an anterior radial head dislocation and proximal third ulna fracture, type 2 fractures are a posterior radial head dislocation and proximal ulna fracture, type 3 fractures are a lateral radial head fracture and proximal ulna fracture, and type 4 injuries refer to a dislocation of the radial head in any direction with fractures of both the proximal radius and ulna. A relatively uncommon injury, Monteggia and equivalent fractures account for approximately 1–2% of all forearm fractures.²

The management of Monteggia fractures in pediatric patients is typically dictated by the characteristics of the ulna fracture.^{3–5}

In children, plastic deformation or incomplete fractures are initially treated with closed reduction followed by immobilization in full supination and 110 degrees of elbow flexion for six weeks. If irreducible, then operative fixation is indicated. Complete fractures are treated operatively. Transverse olecranon fractures are typically treated with intramedullary wire fixation. This technique is used almost exclusively in the pediatric population as it often does not achieve a precise reduction; children, however, can tolerate this due to their remodeling capacity. In the case of long oblique or comminuted fracture patterns in children, treatment should consist of internal fixation with a plate (often one-third tubular or semitubular) and screw construct rather than intramedullary nail fixation.⁶ In regards to the radial head, dislocation is typically evidenced radiographically when a line drawn through the center of the proximal radial shaft and head does not intersect the capitellum.² For incomplete fractures, closed reduction is often attempted by flexion, supination, and direct pressure on the radial head. Alternatively, closed reduction of the radial head can be achieved through traction and counter-traction applied to the forearm, followed by rotation of the forearm until the maximum prominence of the radial head is palpated. A varus force is subsequently applied to the elbow and the radial head is reduced by direct digital pressure. Furthermore, Leonidou et al. reported success with closed reduction and conservative management in their series of 40 pediatric Monteggia fracture cases.⁴

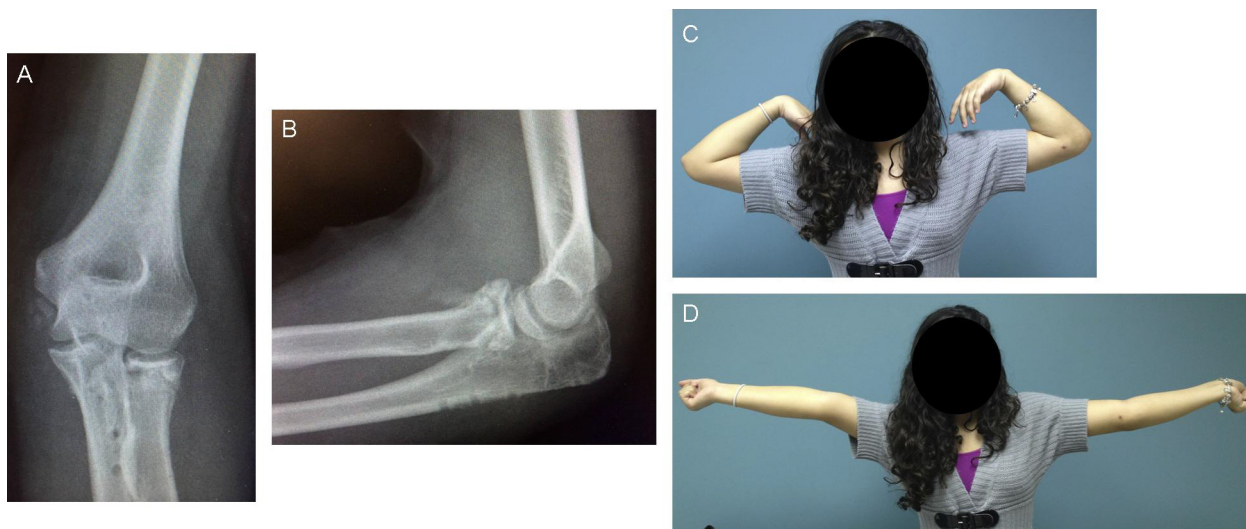


Fig. 4. Final follow-up radiographs and clinical photos. (A, AP) and (B, lateral) Show healed radial head and olecranon fractures with maintained reduction of the radial head. (C) and (D) Demonstrate the patient's flexion and extension motion, respectively.

Operative intervention, however, may be needed if closed reduction fails.

Additionally, radial head and neck fractures may present together with a Monteggia fracture.⁷ The degree of radial head displacement can be assessed by drawing a line down the center of the radial shaft and comparing it to a line perpendicular to the radial head articular surface. Operative reduction of a displaced radial head/neck fracture is indicated when there is over 30 degrees of residual angulation after attempted closed reduction.⁸ Multiple techniques for reducing such a fracture in skeletally immature patients have been described. Percutaneous approaches include the use of a Steinmann pin, K-wires or intramedullary nails. One such method is the centromedullary Metaizeau technique.⁸ Reduction is initially attempted by applying pressure on the lateral aspect of the elbow while performing repetitive supination-pronation maneuvers. After, an incision is made just proximal to the distal radial physis and a flexible K-wire or intramedullary nail is introduced into the shaft. The nail is then advanced proximally in a retrograde fashion until reaching the distal aspect of the displaced radial epiphysis. Rotation of the intramedullary nail allows for manipulation, and ultimate reduction, of the radial head/neck fracture fragment. If reduction is not possible with the nail, a K-wire can be inserted percutaneously through the lateral aspect of the radial head and used as a lever to assist reduction. Several studies have reported good radiographic and functional outcomes in children treated with the Metaizeau technique.^{9,10}

4. Conclusion

Our patient is a skeletally mature individual who sustained a Monteggia equivalent fracture with a displaced radial head fracture treated with the Metaizeau technique. Near anatomic reduction, full supination and pronation, and, ultimately, full extension, was

achieved. Consequently, we demonstrate that percutaneous reduction with intramedullary nailing through the Metaizeau technique, traditionally described for skeletally immature pediatric patients, can be performed successfully in skeletally mature patients. Given their less invasive nature, percutaneous interventions may be an option in some skeletally mature individuals for radial head/neck fracture reduction and fixation prior to open or more invasive procedures.

Conflict of interest statement

The authors declare that there is no conflict of interest regarding the publication of this paper.

Ethical approval

Written informed consent was obtained from the patient for publication of this case report and case series and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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Author contribution

Bryan G. Beutel: Data collection, data analysis, writing major portion of the manuscript, final approval of the version submitted. Christopher S. Klifto: Data analysis, writing major portion of the manuscript, final approval of the version submitted. Alice Chu: Data analysis, critical revision.

Key learning points

- Metaizeau technique traditionally described for skeletally immature patients.
- Percutaneous reduction with intramedullary nailing through the Metaizeau technique can be performed successfully in skeletally mature patients.
- Percutaneous interventions may be option for treating radial head/neck fracture in skeletally mature individuals prior to more invasive procedures

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