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Case Report

Type I Monteggia Fracture with Associated Ipsilateral Capitellar and Humeral Diaphyseal Fractures in an Adult

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Abstract: Background: Monteggia fractures entail a proximal ulnar fracture with associated radial head dislocation. Primarily observed as a fracture in the pediatric population, there have been rare occurrences in adults. In rare instances, various associated fractures have been reported with Monteggia fractures. However, during our literature review, a type I Monteggia fracture had not been reported along with ipsilateral diaphyseal humerus and capitellar fractures. Here, we present a successful post-operative outcome for a unique fracture distribution and form of fixation that has yet to be reported in the literature.

Keywords: Monteggia fracture; capitellum fracture; humeral diaphyseal fracture

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1. Introduction

A Monteggia fracture is defined as a proximal ulnar fracture with concomitant radial head dislocation. Primarily recognized in the pediatric population, it occurs in 0.7% of all adult elbow fractures and dislocations [1,2]. This phenomenon was first described by Giovanni Battista Monteggia, an Italian surgeon, in 1814. Since its discovery, this fracture type has been continuously studied and further classified. In 1958, Uruguayan orthopedic surgeon Jose Luis Bado further classified these lesions. Due to his difficulty with closed reduction methods, Bado realized that the direction of the radial head followed the direction of the ulna fracture, and so he began to classify them as Types I–IV: anterior, posterior, lateral, and associated radius fracture, respectively. In 1991, Jupiter then subdivided the most common Bado type II lesion, which is a posterior displacement of the radial head, into four subtypes based on the ulna fracture's location and the involvement of the coronoid process and/or radial head fracture. The Jupiter classification, by incorporating the coronoid and radial head, helped to anticipate ulnohumeral instability, surgical complexity, implant needs, and functional outcomes related to Bado Type II's [3]. Bado further described injuries that he judged as equivalent to each variant type [4]. Bado Type I fractures make up only 15% of all Monteggia fractures seen in adults, and Bado Type I equivalent fractures are even more rare [5]. Although primarily an isolated injury, there have been reports of ipsilateral injuries to the radial head, lateral condyle, distal radius, ulnar metaphysis, and distal humerus [6–8]. Here, we present a unique case of a Bado Type I injury with associated capitellar shear and humerus transverse fractures in an adult male that has yet to be reported in the literature. For this fracture pattern to occur, a unique mechanism and force vector is required, and the recognition of it has clinical relevance. For a patient to sustain a Monteggia type I and a humeral transverse fracture, a significant posterior to anterior force must be applied, causing hyperextension of the extremity. In an isolated Bado Type I, typically the capitellum is spared as the force from the broken ulna is transmitted through the interosseous membrane, causing anterior dislocation of the radius and typically sparing the capitellum. However, in this case, the capitellum was sheared off due to an axial load on the forearm. The combination of these two force vectors causing this fracture pattern is atypical. The recognition of this fracture pattern is important clinically as it suggests there may be more severe injuries to other vital structures of the elbow joint, such as the radial head, trochlea, lateral collateral ligament, or cartilage, which will have implications for both operative planning and functional outcome. This study presents a novel description of a Monteggia fracture equivalent, provides a viable surgical treatment option, and most importantly highlights the importance of recognizing an atypical pattern of injury.

2. Case Presentation

A 22-year-old male presented to the emergency department after sustaining an injury in a head-on motor vehicle collision at highway speeds. The patient had pain and deformity of the right upper extremity. The initial assessment showed the patient to be hemodynamically stable with tenderness to palpation over the midarm, elbow, and proximal forearm. A physical exam of the right arm showed intact skin, gross deformity, and tense but compressible compartments. The radial pulse was palpable, and all digits had brisk capillary refill. No sensory or motor deficits were found. Other injuries included a right distal femur fracture, L1-5 transverse processes fractures, mesenteric contusions, left rib fracture, and a left pneumothorax.

Roentgenograms revealed an anterior radial head dislocation at the radiocapitellar joint as well as a comminuted proximal ulnar diaphyseal fracture. A comminuted, transverse fracture within the humeral diaphysis with posterior medial angulation and a comminuted, longitudinal fracture through the capitellum were also seen (Figures 1 and 2). The fractures were placed in a posterior long arm splint with an attempt at closed reduction to allow for soft tissue rest. On repeat radiographic examination, there was no significant improvement of the anterior radial head dislocation (Figure 3). The patient had a floating elbow, and because of the tense nature of his soft tissues and increasing pain medication requirements, the recommendation for surgical intervention was given to the patient for concern for compartment syndrome. Verbal and written consent was obtained, and surgical repair was performed the same day of injury.

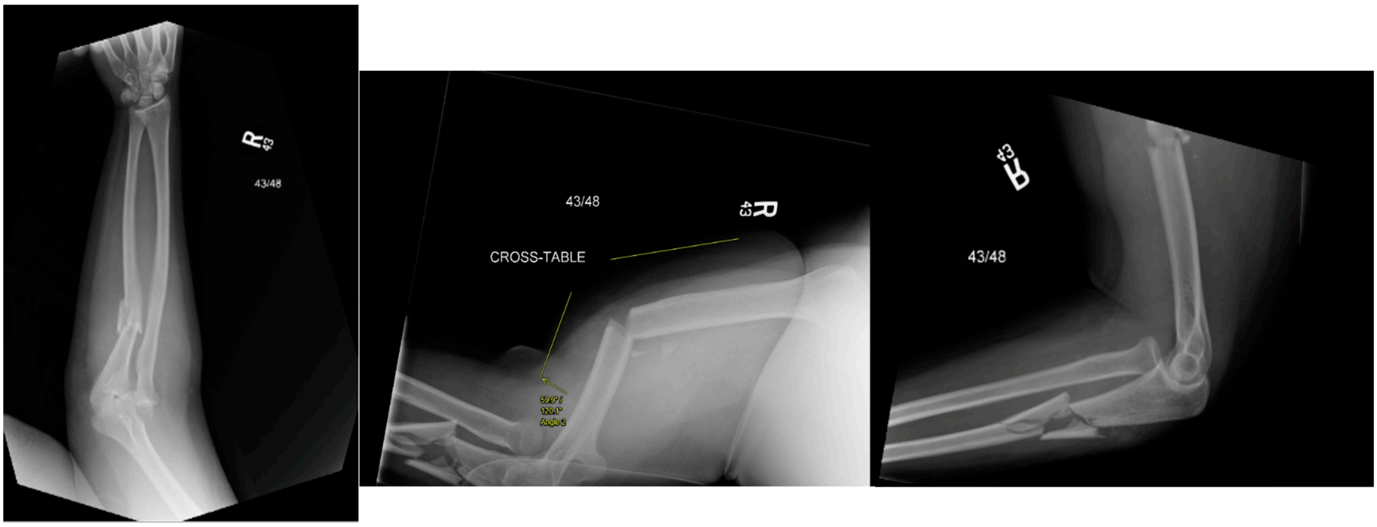

Figure 1. AP, lateral, and cross-table lateral radiographs of right elbow and humerus demonstrating Type I Monteggia fracture with humerus fracture at the time of injury.

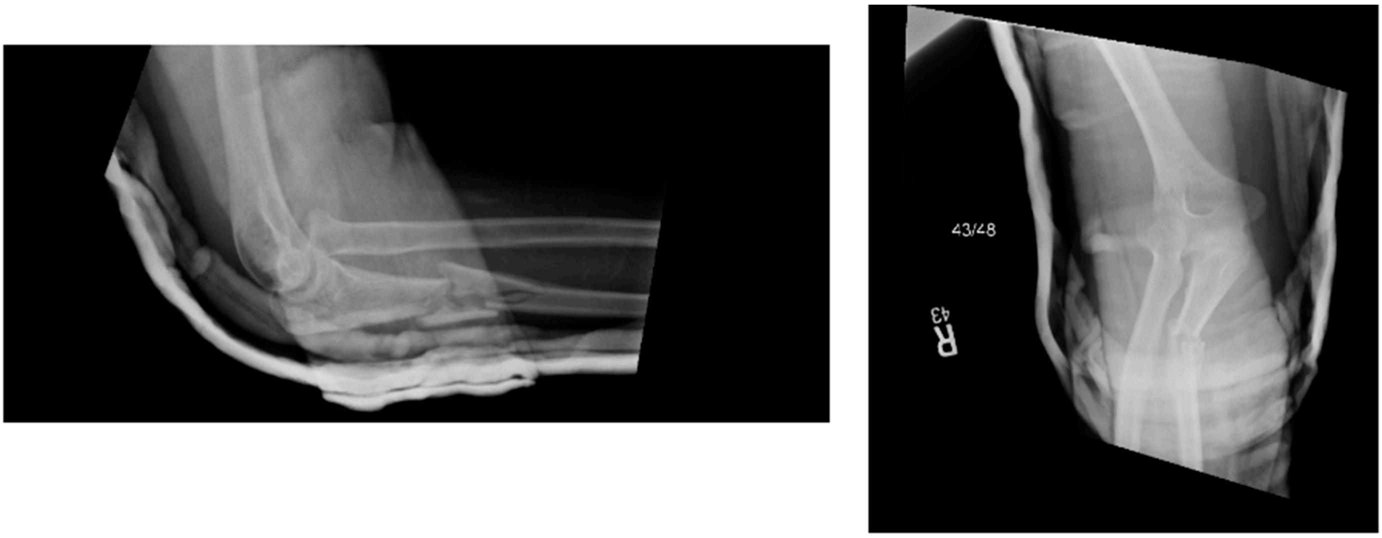

Figure 2. AP and lateral radiograph of right elbow demonstrating ulnar reduction after application of posterior arm splint.

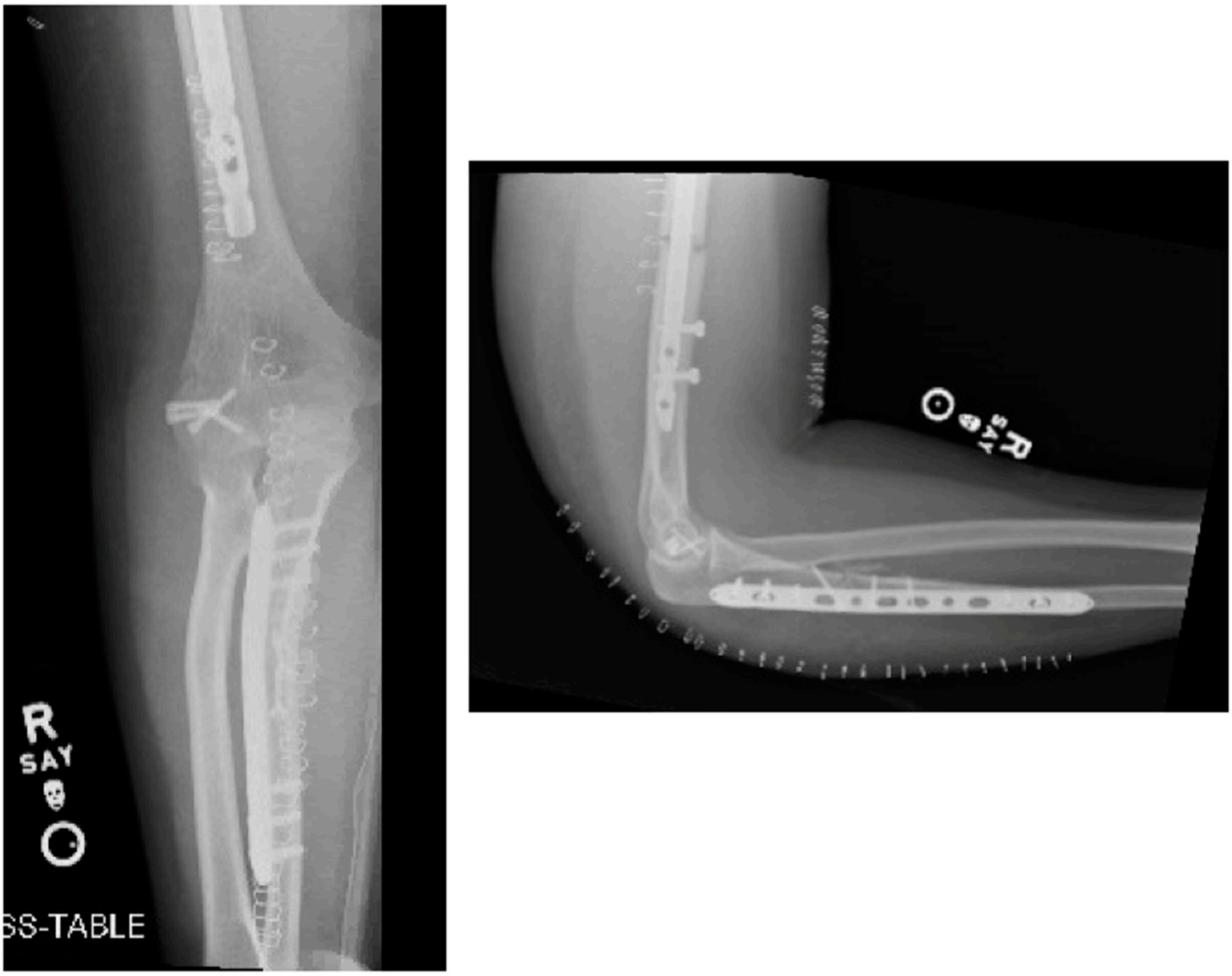

Figure 3. AP and lateral radiograph of right elbow demonstrating reduction and fixation postoperatively.

The patient was placed supine on a radiolucent table and an anterolateral approach to the shoulder was made with a 3–4 cm incision along the anterolateral aspect of the acromion; the fascia and rotator cuff were split longitudinally. The humerus was repaired in an antegrade fashion; however, a small lateral incision was made due to difficulty with the reduction of the humerus and the passing of the guide wire. The radial nerve was visualized and was in continuity. An 8.5 mm intramedullary nail, three proximal locking screws in the humeral head, and two distal interlocking screws were used (Figure 4). Next, the comminuted ulnar fracture was identified with two butterfly fragments in the midshaft via Boyd's approach. The fragments were reduced, achieving an anatomic length of the ulna. Three 2.7 mm lag screws were used to maintain the anatomic reduction of the ulna. However, radiocapitellar instability was still evident. Next the radial head was identified, along with a fractured capitellum. Four 2.5 mm screws were used for the reduction of the capitellum. The radial head was then able to be reduced and soft tissue swelling subsided, and the forearm and humerus soft tissue were soft and compressible. The lateral ulnar collateral ligament was identified and appeared intact. No further damage to the radiocapitellar or ulnohumeral cartilage was evident. Lastly, the complete fixation of the ulna was obtained by placing a neutralizing dorsal 3.5 mm small fragment plate along the dorsal cortex of the ulna. Reduction and stability of the elbow were confirmed with live fluoroscopic examination, verifying radiocapitellar and ulnohumeral stability from a 0 to 130 degree arc of motion. The patient was placed in a long posterior splint from the proximal humerus to the wrist. The elbow was placed at 90 degrees with neutral pronation and supination. The splint remained in place until the fixation of his various injuries, and until he could work with physical therapy (PT) and occupational therapy (OT) on postoperative day 5, at which time the splint was removed and the patient was placed in a hinged elbow brace. Due to the polytraumatic nature of his injuries, he was allowed to bear weight as tolerated through the humerus with a platform walker. Although he was not allowed to bear weight through the forearm, he was allowed a 30–90 degree arc of motion to his elbow with the hinge elbow brace in place at all times. The patient recovered without complication and was discharged on postoperative day 8.

The patient was evaluated in the clinic on postoperative day 11 and was doing well. His incisions were well healed. The physical exam revealed that the elbow range of motion was a 45 to 100° flexion–extension arc. Pronation and supination were assessed at approximately 30° and 40°, respectively. Physical therapy was prescribed to work on the elbow range of motion. The patient was seen one month later, with notable stiffness in the elbow. Physical therapy, unfortunately, had been deferred due to the COVID-19 pandemic and the range of motion was 40 to 110° of flexion–extension arc. Pronation was roughly 70° and supination was around 70°, both passively and actively. At that time, PT was re-ordered and the patient was given a strict home exercise regimen, and he was encouraged to perform this regardless of his PT appointments. At 6-month follow up, the patient had completed physical therapy rehabilitation, which had consisted of only two appointments due to COVID-19 restrictions. The range of motion examination showed a flexion and extension arc ranging from 20° to 130°. Pronation and supination were both at 70°.

Postoperative care did not differ from routine operative care for either the patient's elbow or humerus. Although his functional rehabilitation was delayed, it is difficult to assess whether the delay was due to the COVID-19 pandemic and difficulty with outpatient PT follow up, or to the severity of his injuries. Typically, following routine PT protocols for each injury, we would have expected the patient to return at the 6-week point with a range of motion of the elbow close to what he had at his 6-month mark [9–12]. Radiographs showed that the right humerus, ulna, and capitellum healed without implant complications. The right elbow was stable and maintained good alignment (Figure 5).

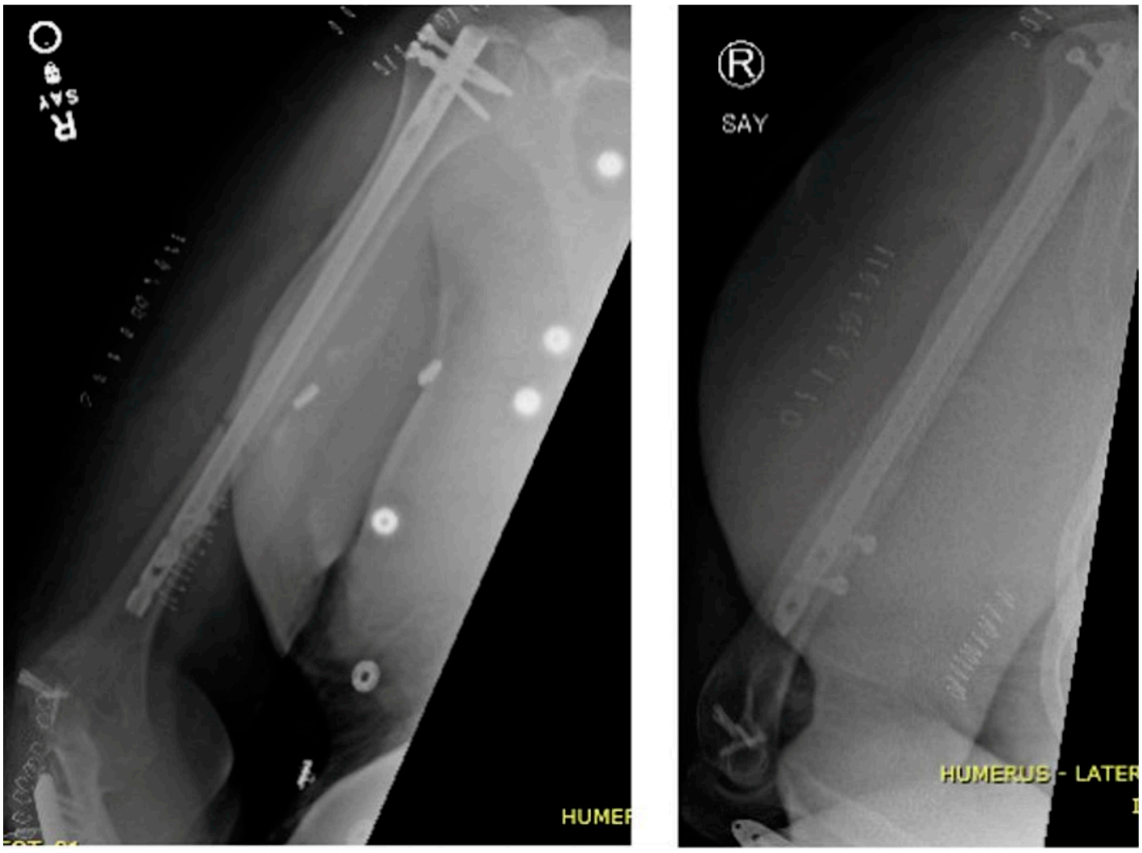

Figure 4. AP and lateral radiograph of right humerus demonstrating reduction and fixation postoperatively.

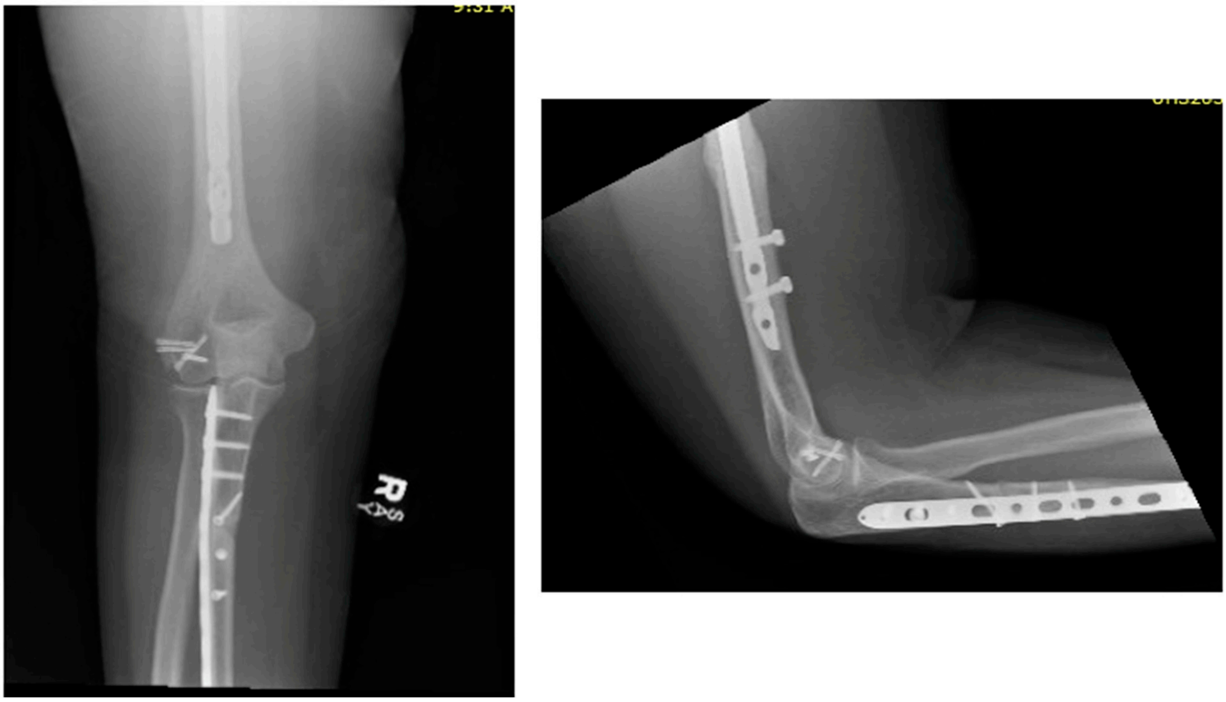

Figure 5. AP and lateral radiograph of right elbow demonstrating adequate reduction and healing at 6 months follow-up.

3. Discussion

To our knowledge, there are no cases in the literature to describe this injury pattern and choice of fixation, especially in the adult population. In the pediatric literature, there have been some rare cases of Monteggia equivalents described, such as ipsilateral fractures in the radial head, lateral condyle, distal radius, and ulnar metaphysis [13–15]. We only found one case in the pediatric literature that described an associated supracondylar humerus fracture which did undergo open reduction and internal fixation with good functional outcome [16]. More importantly, the literature for adults is even more limited. We found only two examples of Monteggia equivalents, neither of which involved the capitellum or humeral shaft. One variant involved an ipsilateral distal radius fracture, and another variant involved an ipsilateral diaphyseal ulna and radius fracture [17,18].

Our case described a Monteggia type I fracture associated with an ipsilateral capitellum and humeral shaft in the adult population previously not described in the orthopedic literature. More importantly, this case highlights the importance of recognizing the fracture pattern, as its unique mechanism could suggest further damage to the articular surface. A typical Monteggia fracture does not have an axial vector component and will spare the capitellum from damage. In our case, we were unable to attain appropriate radiocapitellar alignment without the fixation of the capitellum even with anatomic fixation of the ulna. Fortunately, there was no damage to the lateral ulnar collateral ligament, radial head, or cartilage, which can happen with significant axial loading. Type I variants are attributed to high-energy events and patients commonly present with polytrauma, both of which were seen in this case [2]. Energy from the ulnar fracture is transmitted via the interosseous membrane to contribute to the radial dislocation. More specifically, the mechanism behind the type I variant constitutes a posterior blow to the elbow, a force causing hyper-pronation on an outstretched arm, or a contracted bicep refraining from extension with impact [5]. Transverse humeral shaft fractures result from direct high-energy trauma with a force vector at the level of the fracture plane [19]. Capitellar fractures of the humerus occur due to axial loading of the humerus that is propagated from the radius. This energy transfer creates a shearing force that is responsible for the capitellar injury [20]. All three of these mechanical phenomena occurring simultaneously at the time of injury are less likely outside the context of high-energy trauma. In this case, the capitellar shear component was large enough and allowed recognition of the axial component. However, without a bony component, further damage to vital structures would have been difficult to anticipate. The clinical implication is that hypervigilance is warranted when evaluating patients with Monteggia Type I fractures in the setting of high-energy mechanisms. There may be an axial or rotational component, resulting in damage to vital structures of the elbow that may go undiagnosed.

The individual fixation methods do not necessarily benefit or further orthopedic standards of practice. Intramedullary nailing for the humerus is well established, as well as plate fixation and head compression screws for the ulna and capitellum, respectively. However, given that this injury has never been described, the presented fixation provides a viable option for similar injuries in the future. The patient would eventually need operative fixation of his humerus to aid with ambulation and early weight bearing, given the polytraumatic nature of his injuries. The decision for intramedullary nailing was made due to the patient's body habitus and to limit extensive violation of the soft tissues. Because a large posterior incision would have to be made for the fixation of the ulna and capitellum, avoiding further violation of the soft tissues for plate fixation would be ideal. Plate fixation of patients' ulna and headless compression screws are within the realm of standard practice given the irreducible Monteggia variant and significantly displaced capitellum. Postoperatively, our routine follow-up and rehabilitation protocols were the same: dvancing weight-bearing status in the forearm and elbow, with full weight bearing as tolerated in the humerus. For the Monteggia fracture, we typically splint for 5–7 days and start advancing the range of motion after removal, planning for full range of motion at the 6-week time frame. Unfortunately, in our patient's case, the COVID-19 pandemic delayed the postoperative care treatment, given his elbow stiffness postoperatively. As Fitzgerald et al.

described, delays resulted in significant morbidity in their patient population [21]. We were able to recognize this and implement a more home-based program with instructional exercise pamphlets, which allowed for functional improvement. A limitation to our case, however, is due to the number of patients we have treated with this same injury. Since this is the first patient we have treated with this injury, it is difficult to ascertain what is a normal recovery. Specifically, the delay in recovery of his range of motion and prolonged stiffness could have also been due to the severity of his injuries, rather than the pandemic. However, another benefit from this case is the realization that patients can improve regardless of dedicated therapy if given the right tools and motivation. Improper management, either with an operative plan or postoperative re-habilitation, can lead to permanent mechanical damage to the elbow. Data have shown that 100° of flexion–extension arc and at least 50° in both pronation and supination provide a functional range of motion in the elbow for most daily activities [22]. With the described operative plan and postoperative protocol, our patient not only met these standards but exceeded them.

4. Conclusions

Type I Monteggia lesions with ipsilateral capitellar and humeral diaphyseal fractures are an exceptionally rare elbow injury, especially in the adult population. The recognition of this fracture pattern is important clinically as it suggests an atypical mechanism of injury. A typical hyperextension mechanism with the addition of an axial vector force can cause more severe injuries that can be overlooked, and careful examination and vigilance are required. Appropriate surgical intervention and post operative rehabilitation are paramount to optimize patient outcomes. This case provides just one example describing this fracture pattern, atypical mechanism of injury, and successful surgical intervention, and further research is needed.

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