

## Management of Subacute Monteggia Fracture Dislocation in Children

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### ABSTRACT

**Background:** Although Monteggia fracture dislocation is a rare injury, representing less than 1% of pediatric forearm fractures, missed Monteggia injuries are common, representing up to 50% of the acute injury. Both the acute and the chronic Monteggia injuries have different treatment protocols. There is a gray zone between the acute and the chronic Monteggia fracture dislocation, which represents the period after 2 weeks of injury until the ulnar fracture union.

**Objective:** This study aimed to identify the treatment protocol for this gray zone between the acute and the chronic Monteggia fracture dislocation.

**Patients and Methods:** Sixteen subacute Monteggia fracture dislocation patients (10 boys and 6 girls) underwent either closed or open reduction of the ulnar fracture with internal fixation. The patient's mean age was 9 years. Inclusion criteria conditioned a patient with Monteggia fracture dislocation after two weeks of the injury and before the ulnar fracture union. **Results:** By the end of the follow-up, all patients resumed full elbow range of motion with no elbow pain or deformity. All radiological parameters, including the radiocapitellar line and the ulnar bow lines, were normal at the end of the follow-up, with no redislocation of the radial head.

**Conclusions:** Unlike the acute injury, there is no role for conservative treatment in the subacute Monteggia fracture dislocation. And contrary to chronic Monteggia, all patients didn't need open reduction of the radial head. Level of evidence: level IV.

**Keywords:** Monteggia fracture dislocation, Missed Monteggia, Treatment of Monteggia fracture.

### INTRODUCTION

By definition, the Monteggia fracture dislocation is a fracture of the proximal or middle ulna associated with dislocation of the radius head and proximal radioulnar dissociation. It is an uncommon injury, representing less than 1% of all pediatric forearm fractures [1,2].

Missed Monteggia fracture is not uncommon, it complicates up to 50% of acute injuries [3]. It can be missed by even a skilled radiologist, orthopedic surgeon, or emergency room physician particularly if the ulnar injury is in the form of plastic deformation. Prompt management of the acute Monteggia fracture dislocation gives excellent results and avoids the possible complications of the chronic Monteggia fracture dislocation. Even a few weeks delay in the management of acute injury can complicate the situation compared to early management [4].

Many authors agreed that Monteggia fracture dislocation is considered chronic if the ulnar fracture is united, mostly after 4-6 weeks from the onset of the injury [5-9]. The period from two weeks after the onset of the acute injury to before the union of the ulnar fracture is considered a gray zone between acute and chronic Monteggia injuries and could be called "subacute Monteggia fracture dislocation".

This study aimed to define the subacute Monteggia injury and to propose a suitable treatment protocol for this injury.

### PATIENTS AND METHODS

We conducted this study in the period between January 2019 and October 2022. Sixteen subacute Monteggia fracture dislocation patients (10 boys and 6

girls) underwent either closed or open reduction of the ulnar fracture with internal fixation. The patient's mean age was 9 (ranging from 6 to 12) years. According to the Bado classification system [10], nine fractures were Bado type I, two were Bado type II, and five were Bado type III. The mean follow-up period was 13 (ranging from 9 to 24) months.

**Inclusion criteria:** Patient with Monteggia fracture dislocation after two weeks of the injury and before the ulnar fracture union.

**Surgical technique:** With the patient in a supine position and under general anesthesia, sterilization and draping of the affected upper extremity were done. According to the ulnar fracture pattern, we faced one of two situations. The first was a length stable ulnar fracture (short oblique or transverse fracture) mostly in the middle part of the ulna. The second was a length unstable ulnar fracture (long oblique or comminuted metaphyseal fracture).

In the length stable ulnar fractures (10 cases), reduction of the ulnar fracture was performed by traction and counter-traction and by fracture manipulation. A suitable sized K-wire (or even 2 K-wires) was then introduced from the ulnar metaphysis through the fracture site to the distal ulna for fixation. The accuracy of reduction of the head radius was finally checked under the image intensifier (Figure 1). In four cases, there was slight subluxation of the radial head after adequate ulnar fracture reduction and fixation. We had to overcorrect the ulnar fracture angulation by slightly bending the fracture and the K-wire opposite to the direction of the radial head dislocation.



**Figure (1):** **A:** Eleven-years-old boy with a missed Monteggia fracture for 23 days (subacute injury). **B:** After the reduction and fixation of the ulnar fracture, the head radius regained its normal position. **C:** Post-operative plain X-ray showed a well-reduced subacute Monteggia fracture.

In the length unstable ulnar fracture (6 cases), open reduction of the ulnar fracture was performed.

A small dynamic compression plate (DCP) was used for fixation (Figure 2). Prebending of the plate from 10-15 degrees was used to overcorrect the ulnar fracture. Finally, the radius head reduction was checked under the image intensifier.

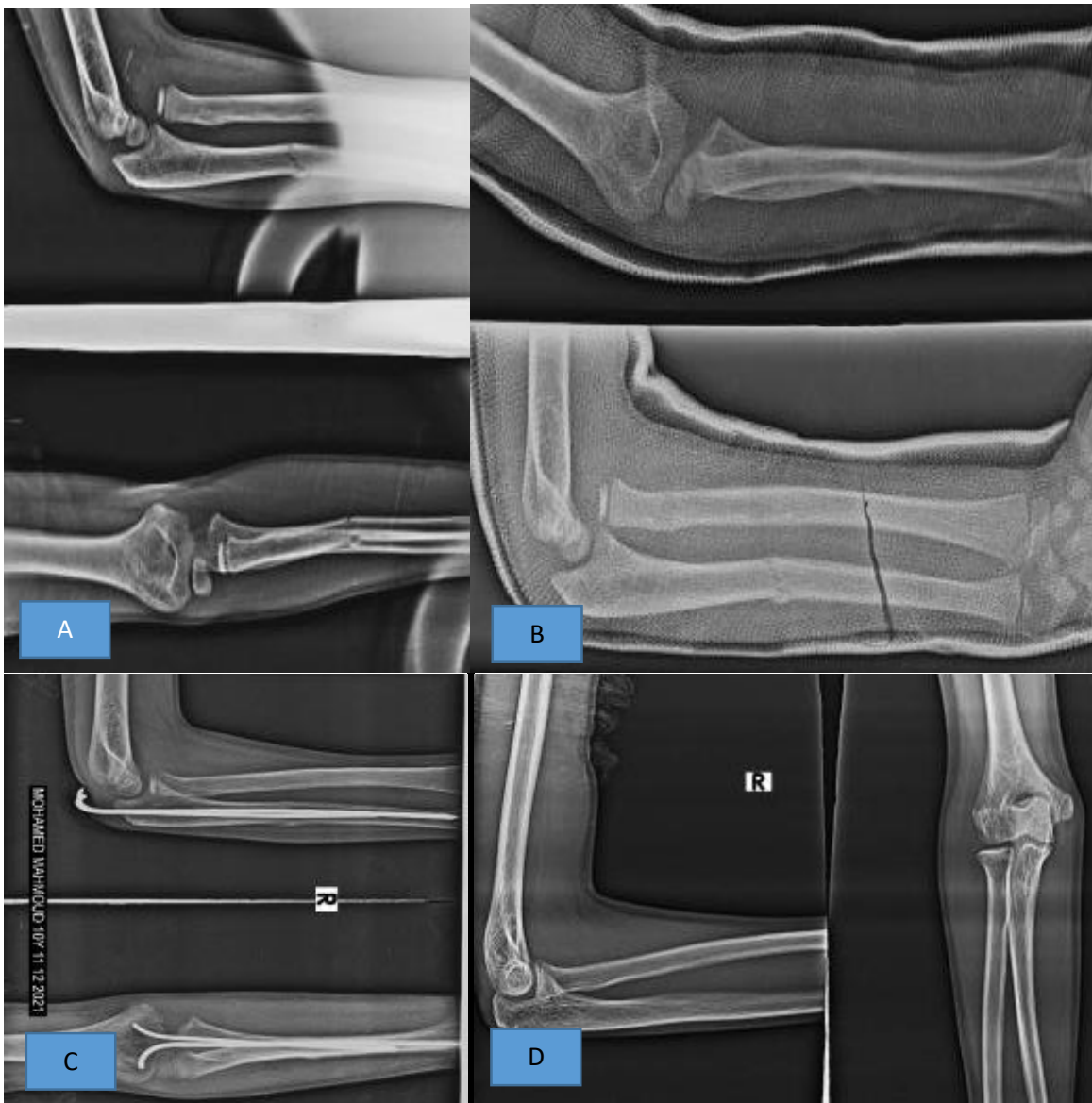
The wound was closed in layers. In both situations, an above elbow cast was placed at the end of the surgery.

#### Post-operative care and follow-up:

A post-operative neurovascular evaluation was performed. The cast and the K-wire were removed after the radiological union. In the cases of plate fixation, the cast was removed after four weeks, and plate extraction was after one year. A plain radiograph of the affected forearm, including the elbow anteroposterior and lateral views, was done in the immediate postoperative period to evaluate the reduction of both the ulnar fracture and the radiocapitellar joint. Then it was done every two weeks till the ulnar fracture union, then every 3 months till the final follow-up (Figures 2 and 3).



**Figure (2):** Plain X-ray elbow anteroposterior and lateral views. **A:** 7 years old boy with subacute Monteggia 17 days after the initial injury. **B:** Open reduction and fixation of the comminuted metaphyseal fracture with a small DCP with bending nearly 10 degrees. **C, D:** Follow-up X-ray showed a well-reduced radial head.



**Figure (3):** **A:** Ten years old boy with a Monteggia fracture dislocation was seen by a junior orthopedic surgeon, who missed the dislocated head radius. **B:** Follow-up x-ray showed a missed Monteggia fracture dislocation. **C:** The patient underwent closed reduction and percutaneous pinning with 2 K-wires. **D:** Follow-up X-ray after the ulnar fracture union and the extractions of the K-wires showed a well-reduced subacute Monteggia fracture.

**Ethical approval:**

The study was approved by the Ethics Board of Zagazig University and an informed written consent was taken from each participant or their parents in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

**RESULTS**

The mean time for the ulnar fracture union was 4.5 (ranging from 4 to 6) weeks. Clinical evaluation at the end of the follow-up was based on Bruce *et al.*'s [11] criteria [Table 1]. At the final follow-up, all patients resumed full elbow range of motion with no elbow pain or deformity. All radiological parameters, including the radiocapitellar line and the ulnar bow lines were normal at the end of the follow-up with no radial head redislocation. There were no nonunion or malunion complications. There were 4 cases of pin tract infection that were resolved after the K-wire extraction. Also, there was one case complicated by tourniquet paralysis that was resolved spontaneously after 5 weeks.

**Table (1):** Criteria for clinical assessment of Monteggia fracture dislocation [11].

<b>Criteria for Assessing Monteggia Treatment as Described by Bruce <i>et al.</i> [11]</b>	
Range of motion	60 points: % impairment 0.6 (% impairment calculated on the basis of the American Medical Association guides for calculation of upper extremity impairment)
Activities of daily living	20 points: function equal to opposite arm 15 points: no more than 2 activities affected 10 points: unable to perform 3 activities 5 points: unable to perform 4 or more activities
Pain	15 points: no pain 13 points: pain that does not interfere with daily activities 10 points: pain interfering with activity 5 points: pain preventing activities 0 points: pain causing outcries
Anatomy	5 points maximum (1 point for each) Acceptable cosmetic appearance No angulation No displacement No change of carrying angle Radiographic union

**DISCUSSION**

Missed Monteggia fracture dislocation in children is one of the difficult situations facing the pediatric orthopedic surgeon. Many complications can result from the chronic Monteggia fracture, such as chronic pain, restricted elbow range of motion, and upper extremity deformity [4, 15]. **Fahey** [13] stated that although persistent head dislocation can do well with short term follow-up, complications arise over time. **Kalamchi** [14] reported pain, restricted motion, elbow deformity from the dislocated radial head, cubitus valgus, and tardy nerve palsy. To avoid these complications from a missed Monteggia fracture, careful evaluation of the radial head position in any patient with proximal or middle ulnar fracture is crucial, with special attention to the radio-capitellar line and the ulnar bow.

The treatment of the Monteggia fracture dislocation depends on whether the injury is acute or chronic and also on the ulnar fracture pattern. Acute Monteggia fractures were either treated conservatively by closed reduction and casting [12, 16, 17], or by operative fixation [15, 18, 19, 20]. **Ramski *et al.*** [20], and **Ring and Waters** [18] had proposed a treatment strategy for the acute Monteggia fracture. The length stable incomplete ulnar fractures (green stick or plastic deformation) were treated conservatively with above elbow cast. However, length stable complete ulnar fractures were treated by closed reduction and intramedullary fixation. The length unstable ulnar fractures were treated with open fracture and plate fixation.

**Foran and his colleagues** [17] proposed a more conservative strategy for acute Monteggia fractures, they tried closed reduction and an above elbow cast for all patients with acute Monteggia fracture dislocation, whether the ulnar fracture was length stable or unstable. They had 83% successful conservative treatment, with only 7.4% of the cases had lost their reduction during the first 3 weeks after the closed reduction. They recommended this protocol of treatment to avoid unnecessary surgery for acute Monteggia fractures.

The most acceptable treatment approach for chronic Monteggia injuries is ulnar osteotomy, and open reduction of the radial head with or without annular ligament reconstruction [21-25].

Most authors agreed that chronic Monteggia started after the union of the ulnar fracture, nearly 4-6 weeks after the initial injury [5-9]. **Ramski *et al.*** [20] and **Foran *et al.*** [17], considered patients with a Monteggia fracture within the first 2 weeks of the injury as inclusion criteria for their study to treat acute Monteggia. This means that their treatment protocol is not applied to the subacute injury after two weeks of onset of the trauma.

In our study, we defined the period after the first two weeks of injury till the ulnar fracture union as subacute Monteggia fracture dislocation. It has a different treatment protocol. Unlike acute Monteggia

fractures, patients with subacute injuries are not candidates for conservative treatment. Whether the ulnar fracture pattern is length stable or length unstable, all subacute Monteggia fractures are treated with surgical fixation. We noticed in this study that, after the release of the traction, the fracture deformity returned. This may be attributed to the soft callus formation that prevents maintenance of the fracture reduction after the traction release.

The treatment of the subacute Monteggia fracture differs from the treatment of chronic injuries in that the radial head reduction occurs spontaneously after the ulnar fracture reduction. In this study, we didn't have to open to reduce the radial head.

In this study, sometimes overcorrection of the ulnar fracture was needed. This was when the radiocapitellar joint was not perfectly reduced after the ulnar fracture reduction. Overcorrection of the ulnar fracture was done in the opposite direction to the subluxated head radius. This was achieved by bending the small DCP plate or by bending the K-wire inside the ulna after fixation.

In this study, all patients had full elbow range of motion without any extremity deformity and returned to pre-fracture elbow activity. The overall results of a subacute Monteggia fracture greatly resemble those of an acute injury.

#### Limitations of this study:

This study was conducted on only 16 patients who are considered relatively a small sample. Also there was no control group to compare our results with it. Further studies with larger sample size and a control group are recommended.

#### CONCLUSION

The subacute Monteggia fracture dislocation has a different treatment protocol compared to the acute and chronic Monteggia fractures.

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**Competing interests:** Nil.

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