

# Missed Monteggia fracture-dislocation in children: Pearls and Pitfalls of open reduction and Ulnar Osteotomy with Annular Ligament Reconstruction using Forearm Fascia.

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## Abstract

### Background

Missed radiocapitellar dislocation is a complication of Monteggia fracture. Children usually present with a swelling on the anterior aspect of the elbow. If left untreated they may present with limited elbow flexion and forearm rotation, progressive cubitus valgus, and pain. Surgical treatment is recommended to avoid such complications and to improve long-term function.

### Purpose

Pearls, pitfalls, and functional results of open reduction and ulnar osteotomy with annular ligament reconstruction using forearm fascia are presented.

### Patients and Methods

Ten children with chronic Monteggia lesions were treated with open reduction, annular ligament reconstruction with the fascia of the forearm, and ulnar osteotomy. The left elbow was involved in 6 patients, the right in 4 patients. Mean age at presentation was 6 years (range 3 years 7 months to 10 years), six cases were classified as Bado type I, four cases as Bado type III lesion. The interval between injury and surgery ranged from 3 months to 2 years (mean 8.5 months). Mean follow-up was 2 years 8 months.

### Results

The range of flexion was not affected in any case, range of extension improved in 2 cases and decreased by 15 degrees in one case who had postoperative radial head subluxation and was revised and corrected. Both pronation and supination were affected in 2 patients, they lost 10 and 20 degrees of pronation and 15 and 25 degrees of supination respectively. One patient had 15 degrees of supination loss with full pronation and 2 patients lost 10 and 20 degrees of supination with full pronation. All osteotomies united within 6 to 8 weeks. At the final follow-up, the radiocapitellar joint was reduced in all cases.

### Conclusion

Operative intervention is the treatment of choice in cases of missed Monteggia fracture-dislocation as cases treated conservatively, with late radial head excision has a high complication rate. Meticulous execution of open reduction, ulnar osteotomy with annular ligament reconstruction using forearm fascia with avoidance of pitfalls yields good results with a functional range of motion.

### Key Words

Neglected Monteggia, Missed Monteggia, annular ligament reconstruction.

## Introduction

Fracture of the ulnar shaft associated with an anterior dislocation of the radial head was described by Giovanni Battista Monteggia, in 1814.[1] Bado[2] classified these injuries based on the direction of the radial head dislocation and apex of the associated ulnar fracture. Despite the increased awareness of Monteggia fracture-dislocations, the diagnosis is often missed in the initial presentation leading to chronic Monteggia lesion in which the joint remains dislocated for 4 weeks after injury.[3]

Children with chronic Monteggia lesions may remain

symptomless for a long time. Sometimes the parents notice an asymptomatic bump on the anterior aspect of the elbow. In the past, it was suggested that neglected Monteggia lesions should be treated conservatively, with late radial head excision if the patient became symptomatic. This form of management carries a poor prognosis because of the risk of developing chronic pain, restricted range of motion, progressive cubitus valgus, and late ulnar nerve palsy.[4, 5]

Even though the authors agree that operative intervention is the best way of management, opinions differ regarding the best way to do it. Most authors agree that ulnar osteotomy is the mainstay of the operative

procedure; meanwhile, opinions differ regarding the need for reconstruction of the annular ligament.[6-8].

The aim of this study is to present pearls, pitfalls, and functional results of open reduction and ulnar osteotomy with annular ligament reconstruction using forearm fascia.

## Patients and Methods

Ten cases of chronic Monteggia lesions treated by the same surgeon from November 2010 to May 2019 were reviewed. All 10 patients underwent open reduction, ulnar osteotomy with annular ligament reconstruction using forearm fascia. The osteotomized ulna was fixed with intramedullary wires in all except 2 cases (cases number 2 and 10) who were fixed by a small DCP.

The left elbow was involved in 6 patients, the right in 4 cases. Mean age at presentation was 6 years (range 3 years 7 months to 10 years), six cases were classified as Bado type I, four cases as Bado type III lesion (fig. 1). The interval between injury and surgery ranged from 3 months to 2 years (mean 8.5 months).

At presentation all patients complained of swelling in front of the elbow, pain was reported by only 1 patient, a limited extension was reported by 2 patients, Valgus deformity of 24 and 30 degrees was found in 2 cases. Although limited forearm rotation was present in 4 patients it was not noticed by any of them.

## Surgical technique

The approach was performed with the patient in the lateral position with the affected limb hanging over-arm support assuring that the elbow can be flexed freely beyond 90 degrees.

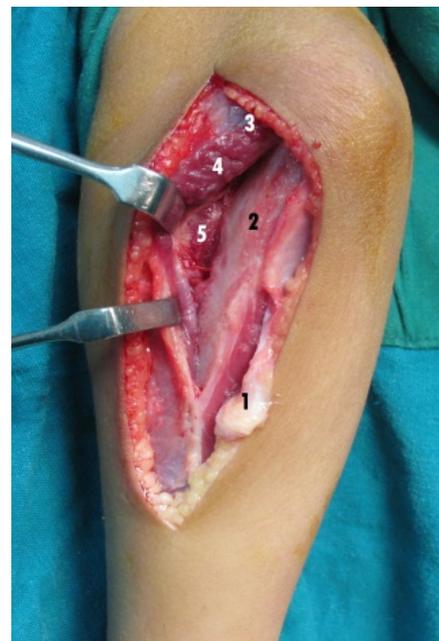
A straight dorsal incision was made, centered between the tip of the olecranon and lateral epicondyle. A strip of deep fascia with its lateral limb over the posterior border of the ulna of approximately 1 cm wide and 10 cm long was harvested from the posterior forearm, leaving its base attached proximally at the level of the radial neck (Fig. 1).

The anconeus and extensor carpi ulnaris were elevated extra-periosteal and retracted laterally allowing access to the proximal ulna, radiocapitellar, and proximal radioulnar joint capsule (Fig. 2). The capsule is opened and reflected laterally. Remnants of annular ligament and fibrous tissue were removed bringing the anteriorly dislocated head radius into view.



**Figure 1:** Strip of deep fascia 10x1 cm

If needed, the supinator fibers are sharply incised from their origin at the crista supinator exposing the lateral surface of the ulna. To protect the posterior interosseous nerve, the forearm is kept pronated and the supinator is directly dissected off the bone. In these cases the lateral ulnar collateral (LUCL) which is inserted in the supinator crest, should be dissected and isolated, and if cut, a stump is left inserted on the ulna for later repair at the end of the procedure to prevent posterior radio-capitellar subluxation (Fig. 3).



**Figure 2:** Extra-periosteal muscle retraction  
2: Periosteum over the lateral ulnar surface  
3: Anconeus  
4: Extensor carpi ulnaris  
5: Supinator



**Figure 3:** Incision of the radioulnar joint capsule and lateral ulnar collateral (LUCL) Tagged.

- 6: Capitellum
- 7: The capsule
- 8: LUCL

The level ulnar osteotomy was usually predetermined before the operation at the apex of the ulnar curve and was revised intra-operatively by laying a straight k-wire over the surface of the ulna, the site of osteotomy is where the ulna deviates away from the wire.

The periosteum was opened on the medial ulnar surface as a proximally based long rectangular flap extending 4 cm distal to the osteotomy site, then elevated circumferentially off the ulna at the osteotomy site. In cases where lengthening is needed at the osteotomy site, the periosteal flap was taken from the medial and lateral ulnar surfaces while the anterior periosteum is cut. The periosteal flap covers the osteotomy site to promote healing and to decrease the incidence of synostosis.

The ulna was osteotomized, one surface was weakened and fractured as a greenstick fracture, the osteotomy site was angulated and the radial head reduced without force (Fig. 4). In old cases where the dislocation occurred with plastic deformation of the ulna or if the ulna had straightened due to the remodeling power in children, the osteotomy was completed then some distraction, over angulation, and /or some rotation is usually needed to relocate the radial head.

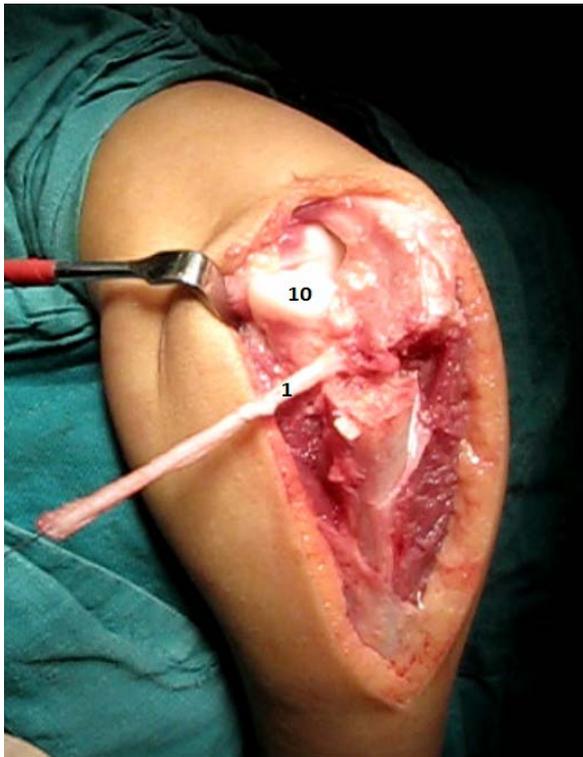


**Figure 4:** osteotomy, correcting lateral angulation and reducing the radial head

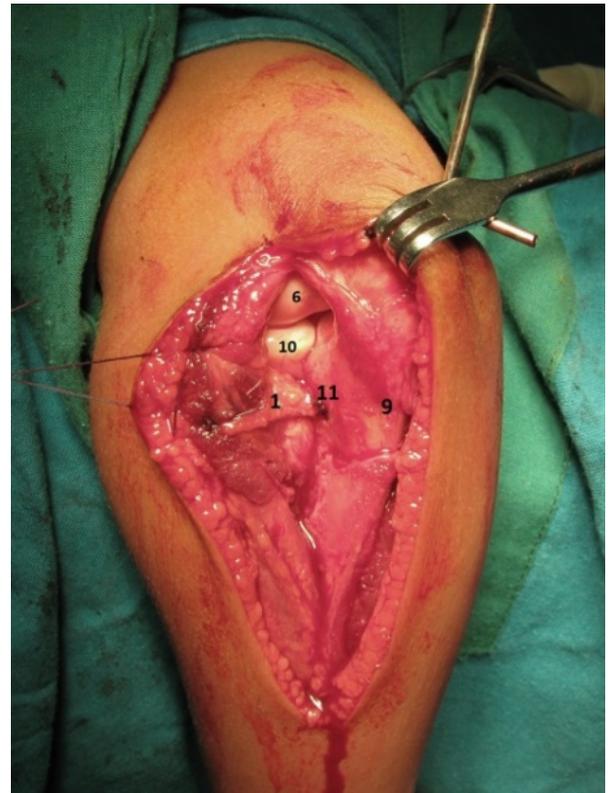
- 9: Osteotomy site.
- 10: Radial head

**Ligament reconstruction:** At the level of the radial neck a 3.5 to 4.5 mm drill hole was made in the ulna from the base of the fascial strip to just distal the anterior edge of the radial notch, the fascial strip is whip stitched and passed through the drill hole (Fig. 5). While the radial head is dislocated anteriorly, the fascial strip is held in the depth of the wound, the radial head is reduced and the fascial strip looped anterior to the radial neck (Fig. 6). Passing the fascial strip around the radial neck is much easier if the ulnar lateral collateral ligament was cut during exposure which allows the surgeon to sublunate and even dislocates the radial head posteriorly, if that occurs care must be taken to repair the ligament to prevent posterior subluxation of the elbow. The radial head was reduced and centralized, the osteotomy site is then fixed in the angle that provides the most radial head stability.

In some cases where over angulation is needed, a straight k-wire introduced from the tip of the olecranon will have poor purchase in the distal segment due to its proximity to the osteotomy site, in this situation, there is the tendency to fix the osteotomy site in an angle less than the predetermined angle to have better purchase in the distal segment and this may lead to postoperative subluxation. In these cases, a short plate may be a better choice for fixation.



**Figure 5:** Fascial strip is whip stitched and passed through the drill hole



**Figure 7:** The free edge of the fascial strip was inserted into a drill hole posterior to the radial head after ulnar osteotomy fixation.



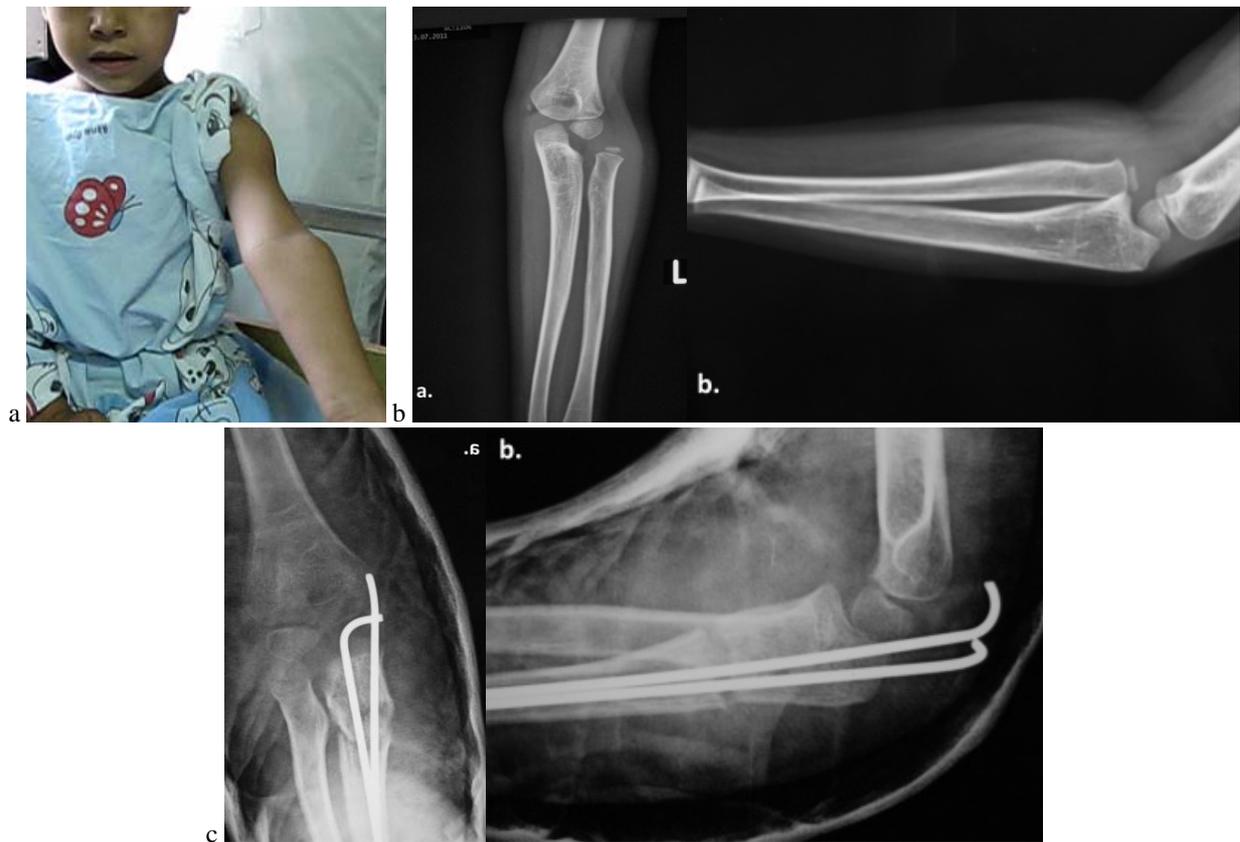
**Figure 6:** Fascial strip looped anterior to the radial neck

While the joint is centralized an intraoperative radiograph was taken and recorded. Finally, the free edge of the fascial strip is sutured to itself, to the ulnar periosteum, or inserted into a drill hole posterior to the radial head (Fig. 7).

All patients were immobilized in above-elbow casts for 6-8 weeks with the elbow in 90° flexion and forearm in full supination until the union of osteotomy, cast, and wires were removed and the patient was allowed to use the arm as tolerated. Home exercises in the form of active flexion, extension, and forearm rotation were taught to the child, the parents were instructed to encourage and supervise the child while doing these exercises 3 times daily.

## Results

The mean follow-up period was 2 years 8 months (range 12 months to 4 years). The range of flexion was not affected in any of our patients preoperatively or postoperatively. Limited extension of 20 and 25 degrees was observed in 2 patients at presentation, at the last follow up extension lag improved to 10 degrees and 5 degrees respectively. One case lost 15 degrees of extension postoperatively. Both pronation and supination were affected in 2 patients, they lost 10 and 20 degrees of pronation and 15 and 25 degrees of supination respectively. One patient had 15 degrees of supination loss with full pronation and 2 patients lost 10 and 20 degrees of supination with full pronation. All osteotomies united within 6 to 8 weeks.



**Figure 8:** case example.

- Patient female 7 years old. complained of swelling at the anterolateral elbow, history of fracture ulna treated by cast 11 months earlier
- Plain x-ray shows missed Monteggia fracture, Bado type III.
- After open reduction, ulnar osteotomy with annular ligament reconstruction using forearm fascia. Note the correction of lateral ulnar angulation.

## Complications

Postoperative anterior subluxation of the radial head was noted in one case; in that case, the problem was that the ulnar osteotomy was straightened by the intramedullary wires. Under anesthesia the wires were removed, the ulna angulated and the radial head relocated, new wires were inserted under the C-arm. A plate fixation would have been a better choice in that case.

Posterior subluxation of the radial head occurred in one case, the cause was most probably due to failure to appreciate the importance of the LUCL repair at the end of the procedure. The radial head was reduced and a trans-capitellar wire was inserted. At the last follow up the radial head was contained, there was an extension lag of 15 degrees with a loss of 20 and 25 degrees of pronation supination respectively.

## Discussion

Monteggia fracture, especially with plastic deforma-

tion of the ulna may pass unnoticed, especially in a young child.[9] As the initial period of acute injury passes, the subtleness of the symptoms (only a small swelling on the anterior elbow in 7 of our cases) may lead to the chronicity of the lesion. Pain, deformity, instability, limitation of motion, and late neuropathy are expected to appear later on once the child's activities demand more strength.[10]

According to many authors, ulnar osteotomy and angulation play the main role in achieving and maintaining radial head reduction and ALR is not necessary after the osteotomy.[9, 11] On the other hand, other authors stated that some of their cases did not require any osteotomy to achieve reduction and only ALR was done.[8, 12] If reconstruction was done using the annular ligament reconstruction without osteotomy excessive tension of the reconstructed ligament may lead to notching, osteolysis of the radial neck, or late subluxation due to stretch of the reconstructed ligament.[13-15]

In this series, it was not possible to reduce the radial head before ulnar osteotomy, angulation, and some-

times lengthening and rotation. It was found that after fixation of the osteotomy the radial head remained reduced but when stressed or rotated it showed some anteroposterior and mediolateral translation. This mild instability is managed by some authors by inserting a trans-capitellar wire, which may be a factor that postoperative forearm rotation arc decreases.[16] It is our impression following many authors that ulnar osteotomy was the key for successful management and that annular ligament reconstruction consolidated the anatomical relationship of the proximal radioulnar joint, eliminated that translation, and improved stability.

Loss of fixation, union problems, radioulnar synostosis were the reported complications related to ulnar osteotomy.[3, 17] In this series there were no complications related to the union or radioulnar synostosis, harvesting a proximally based periosteal flap to cover the osteotomy site may be a factor. Intramedullary wire purchase in the distal fragment was not strong enough when ulnar angulation was high and when the osteotomy was far distal with over angulation, in these cases care must be taken to achieve stable fixation, and if possible a plate can be used. At the same time temptation to decrease the angle of the ulnar osteotomy to achieve better intramedullary fixation must be resisted as this may lead to increased stretch over the reconstructed ligament and eventually subluxation of the radial head. To avoid this problem make sure that the osteotomy is adequately fixed in a position that gives the maximum stability to the radial head before final tensioning of the reconstructed annular ligament.

Interpretation of the postoperative x-rays may be difficult. In young children, an eccentric radiocapitellar line leads to a lot of confusion especially in a case known to have a neglected Monteggia injury and was just repaired, of course, the postoperative cast and the flexed position adds to the confusion. The radiocapitellar line (RCL) is most commonly described as a line drawn along the radius that should intercept the center of the capitellum in a normal elbow. Ramirez and colleagues[18] found that a line drawn along the radial shaft misses the capitellum completely in 8.6% of radiographs of normal elbows. Likewise, Miles[19] recommends caution in using the RCL as he identified 5 normal pediatric elbows in which this line did not intersect the capitellum. He recommends limiting the use of the RCL to the lateral radiograph. In an MRI study, Fader and colleagues[20] concluded that the RCL line does not reliably intersect the central third of the ossified capitellum until ages 10 years in girls and 11 years in boys in the sagittal plane due to eccentric ossification of the capitellum. To eliminate confusion resulting from an eccentric RCL line, using the image intensifier, an intraoperative radiograph

was taken and recorded while the joint is centralized and the elbow in the position of the postoperative cast.

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## Conclusion

Operative intervention is the treatment of choice in cases of Missed Monteggia fracture-dislocation as cases treated conservatively, with late radial head excision has a high complication rate as chronic pain, restricted range of motion, progressive cubitus valgus, and late ulnar nerve palsy. Meticulous execution of open reduction, ulnar osteotomy with annular ligament reconstruction using forearm fascia with avoidance of pitfalls yields good results with a functional range of motion.

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