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Oblique sliding ulna osteotomy to treat paediatric neglected monteggia fracture dislocation

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Abstract

Introduction: There have been osteotomy methods that corrected or overcorrected the ulna deformity as part of surgical treatment for chronic radial head dislocation.

Methodology: We reported surgical technique and outcome of oblique sliding ulna osteotomy that created acute lengthening, deformity correction or both to assist open reduction of radiocapitellar joint in four patients with neglected Monteggia fracture dislocation.

Result: Patients aged 3–12 years old had trauma duration of 4 weeks to 3 years. Two patients had Bado type I injury, and the other two had Bado type III. There was no acute nerve injury. During the final follow-up, all patients achieved union, with the limitation of motion range in the rotation arch being less than 20°. The radial head had no recurrent dislocation.

Conclusion: This case series has shown sliding osteotomy safely, providing acute correction and lengthening of the ulna without requiring bone graft to facilitate stable reduction of the neglected Monteggia lesion.

Keywords

monteggia, neglected, oblique sliding osteotomy, open reduction, radiocapitellar joint

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Introduction

A late or missed Monteggia lesion is a fracture of the ulna with dislocation of the radial head presenting 4 weeks after the initial injury.[1]

Monteggia fracture dislocation is uncommon and frequently missed when the elbow radiograph is improperly interpreted during the first presentation. Delayed diagnosis is usually contributed by incomplete fracture or plastic deformation of the proximal ulna.[2]

The most used classification for Monteggia fracture dislocation is the Bado classification, which describes four types of proximal ulna fracture with the direction of radial head dislocation: type 1 has the anterior dislocation, type II has the posterior dislocation, type III has lateral dislocation of the radial head, and type IV is described as any direction of radial head dislocation with radius and ulnar bone fractures.[3] Type I injuries are the most common fracture

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dislocation pattern in children, representing 75% of acute pediatric Monteggia injuries and about 85% of pediatric Monteggia lesions in case series describing chronic missed injuries.[4]

Antebrachial osseous protuberance (Bado type I), various degrees of cubital valgus, and elbow rotation and flexion limitation are among the common findings in patients with neglected Monteggia. In the neglected Monteggia lesion, the ulna would heal and remodel immediately, adopting deformity that prevents radial head reduction. The annular ligament that provides stability to the radiocapitellar joint is usually torn or entrapped as it falls into the joint together with capsular structures.[4,5]

Several authors concur with the open reduction of the radial head and correction or overcorrection of ulnar angular deformity to achieve a stable reduction of the radial head. However, employing annular ligament reconstruction remains debatable.[6]

We reviewed our cases of neglected Monteggia treated with open reduction of radio-capitellar joint and oblique sliding ulna osteotomy, creating acute lengthening and correction or overcorrection of the deformity.

Patients and surgical technique

Two boys and two girls aged 3–12 years old had a neglected Monteggia, with duration of 4 weeks to 3 years (Table1). Two cases were Bado type I injury (Figure 5(a) and (d)), while the other two were Bado type III (Figure 5(b) and (c)). Patients with Bado type I (patient no. 1 and 4) had limitation mainly in elbow flexion until 90° (Table 1). They were treated with this approach between 2007 and 2023.

The surgery was done in a supine position, with the affected limb on the arm board under a sterile tourniquet. We used the Kocher approach to the posterolateral elbow. The skin incision was made from the lateral distal humeral ridge toward the posterior proximal ulnar ridge passing in between the tip of the olecranon on the medial and lateral humeral condyle on lateral measuring about 10 cm in length. Superficial dissection was made in between the anconeus muscle and the common extensor origin (Figure 1(a)). The posterior interosseous nerve (PIN) that might be displaced anteriorly in anterior radial head dislocation was identified and secured with a vessel loop. The lateral humeral condyle joint surface was identified. The contracted annular ligament and fibrous tissue inside the radio-capitellar joint were cleared until the radial head was visible (Figure 1(b)).

After clearing the joint, we performed an approximately 45 to 60° oblique osteotomy of the proximal ulna at the metadiaphyseal region. The angle was related to chronicity of the problem as a bigger angle of obliquity allows a longer sliding while maintaining the bone contact. It was also decided based on estimated lengthening based on pre operative radiograph. In patients with Bado type I, the oblique osteotomy was done in the sagittal plane (medial to lateral obliquity) (Figure 2(a)–(b) and 4(a) and (b))). In cases of Bado type III, the oblique osteotomy was performed in the coronal plane (anterior to posterior obliquity) (Figure 3(a) and (b)). Location of the osteotomy was at the visible center of rotation angulation (CORA) in early neglected cases. In a prolong neglected cases without visible deformity due to remodel, the osteotomy was done at meta-diaphyseal area where the proximal ulna segment able to accommodate at least two screws for plate fixation. The decision was made to allow stability of plate fixation and allowing good sliding as well as angular correction while maintaining bone contact.

Then, the radial head was reduced and temporarily fixed to the capitellum using a transfixing Kirschner wire (Figure 4(a)). Upon reducing the radial head, the osteotomized ulna slides (lengthened) and angulates (Figure 2(c) and (d), 3(c)–(d), and 4(a)). The overlap bone ends were clamped with bone holder on that position and plate were pre-bent accordingly (Figure 4(a)). The osteotomized ulna was then fixed in situ with a pre-bent plate and screws in lengthened and corrected or overcorrected position

Table 1. Demographic data and outcome.

Patient/ gender	Bado type	Age at surgery (years)	Period of neglect	Preoperative ROM	ROM at final follow-up	Period of follow-up
1/Boy	I	4	9 months	F 90°; E 0^0 S 90^0; P 60^0	F 130^0;E 0^0 S 90^0; P70^0	10 years
2/Girl	III	12	3 years	F 135^0;E 5^0 S 90^0;P 90^0	F 135^0;E 0^0 S 90^0;P 90^0	6 years
3/Girl	III	7	4 weeks	NA	F 145^0 E 0^0 S 90^0;P 90^0	2 years
4/Boy	I	8	2 months	F 90^0;E 0^0 S 90^0; P 90^0	F 130^0; E 0^0 S 90^0;P 80^0	12 months

ROM, Range of motion; F, flexion; E, extension; S, supination; P, Pronation; NA, not available.

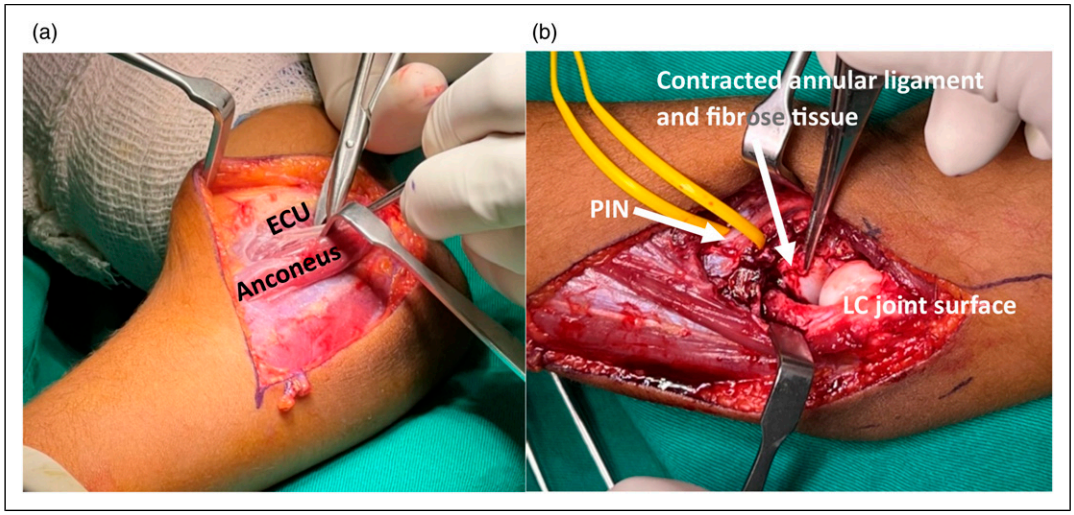

Figure 1. (a) Superficial dissection between the ECU and anconeus muscle, (b) Clearing the radiocapitellar joint from contracted annular ligament and fibrose tissue. ECU, Extensor carpi radialis muscle; PIN, Posterior interosseous nerve; LC, lateral humeral condyle.

(Figure 4(b)). The transfixing Kirschner wire was later removed, and the reduction's stability was tested. Upon confirmation of stable radial head reduction, the wound was washed and closed. The limb was immobilized with a long arm cast. The magnitude of sliding and angular creation depended on the position of the osteotomised ends fall in contact when temporarily transfixed the radial head in reduced position. Radial shortening was not required as long as the ulna ostetomised ends were in contact for at least 5 mm. There was no patient requiring radial osteotomy in our series.

Result

There was neither peripheral nerve palsy nor dislocation or subluxation following the surgery, except for patient no.1, who had early dislocation due to immobilization of less than 90° flexion. He required revision surgery and was held with temporary transfixing Kirschner wire for 3 weeks. All patients achieved nearly full range of motion at 1 year after the surgery (Table 1 and Figure 5).

Discussion

Surgical approaches for neglected Monteggia lesions include single or dual incisions, but most authors advocated a single incision using the Boyd or Kocher approach to reach the radio-capitellar joint and proximal ulna.[4] We opted for single incision which is a more extensive approach compared to the other but the muscles are easily mobilised and will not cause stretching to the skin. However, the patient will have a longer scar. Anatomically, the position of the Posterior interosseous nerve (PIN) is more to the anterolateral aspect of the radial neck; hence, the Kocher approach poses a higher injury risk to the anterior incision than the Boyd approach. However, surgeons must be careful of the PIN's displacement in chronic radial head dislocation.

Until this article was written, we planned the surgery based only on plain radiograph. The location and obliquity of osteotomy could be decided easily when the apex of deformity is visible on plain radiograph before complete remodel of the bone. The amount of angular correction and lengthening would be finally decided after the head reduction. Wintges et al in 2024 recommend CT scan for injury of more than 12 months duration.[7] In future, we would propose for planning of osteotomy to be done based on 3D printing of CT Scan image to precisely decide on the location of the osteotomy, amount of sliding and degree of correction needed.

Previously, Lloyd-Roberts and Bucknill recognized in the early developments of missed Monteggia lesions treatment that adequate debridement of interposed capsuloligamentous tissue from the radio-capitellar joint is needed in joint reduction.[8] A systematic review of 600 patients revealed that proximal ulnar osteotomies were the significant predictors for maintaining radial head reduction in pediatric neglected Monteggia fracture dislocation.[9] Nakamura et al. used transverse proximal ulna osteotomy with corticocacellous iliac crest bone graft to correct and lengthen the ulna in all their patients and found two cases of delayed union at the osteotomy site that needed surgical intervention.[10] Exner GU et al. performed ulnar corticotomy and distraction osteogenesis using an external fixator without open reduction of the radial head.[11] In our series, we had patients with wide range of neglected period, from 4 weeks to 3 years. Angular correction and

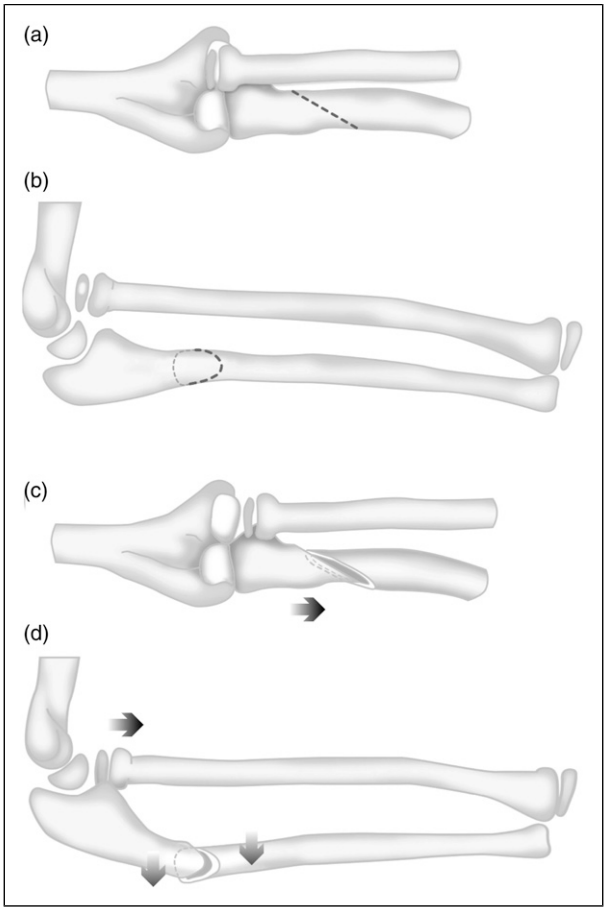

Figure 2. Neglected Monteggia Bado type I illustration. The frontal view (a) of the radial head overlapping the lateral condyle, and the lateral view (b) of the anterior dislocation of the radial head before surgery with proposed sagittal obliquity plane osteotomy. The frontal view (c) with angular overcorrection to reduce radial head reduction, and the lateral view (d) after osteotomy with sliding of osteotomy ends and radial head reduction.

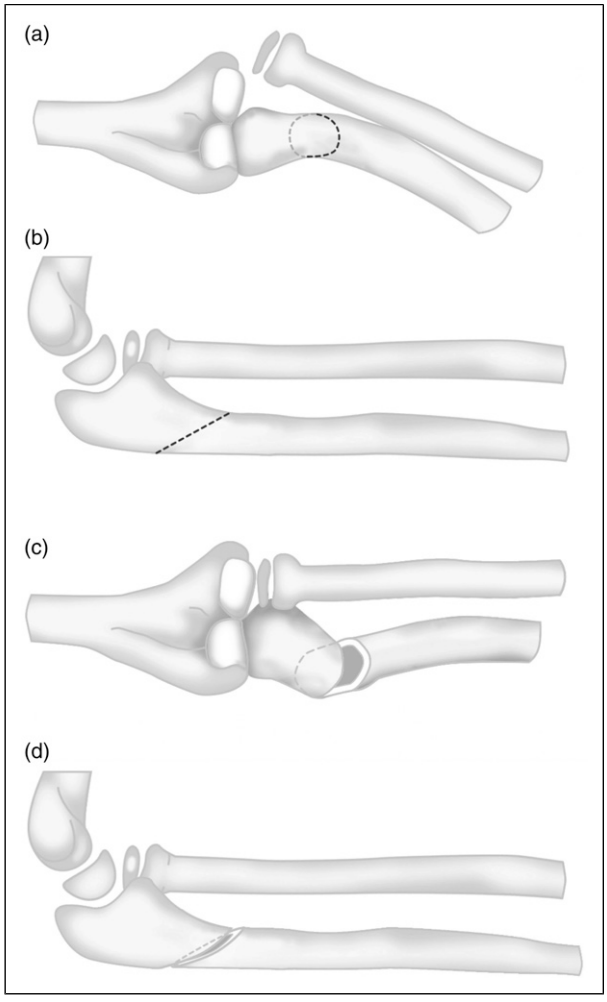

Figure 3. Neglected Monteggia Bado type III illustration. Frontal (a) and lateral views (b) before osteotomy with proposed coronal obliquity plane osteotomy. Frontal (c) and lateral views (d) after osteotomy with angular correction to suit radial head reduction. Lateral view (d) after osteotomy with minimal sliding.

lengthening were required for those neglected for more than 2 months because the ulna bone had remodeled to become more straight and shorter. Patient no.3 with shorter period of neglect required only deformity correction and automatically regain the length.

Our proximal oblique sliding ulna osteotomy technique immediately provides lengthening and angulation to stabilize the radial head reduction without requiring a bone graft. The oblique direction osteotomy in the coronal or sagittal plane will depends on the type of the proximal ulna's deformity.

A few authors overcorrect the ulna to ensure the stability of reduction. However, overcorrection has been reported to cause posterior dislocation of the radial head.[12] Transfixating the radio-capitellar joint has not been recommended as it is associated with early recurrence dislocation, pain, and osteoarthritic remodeling.[9,13] We used temporary radio-capitellum transfixation before fixing the ulna osteotomy to allow adequate lengthening and deformity correction and avoid excessive overcorrection. This temporary radio-capitellar transfixation is similar to the recommendation by Soni et al.[14] External fixator can be an alternative to transfixing Kirschner wire for stabilization of the radial head reduction.

The necessity of reconstructing the annular ligament varies. A study that directly compared similar surgery techniques with and without annular ligament reconstruction reported similar functional outcomes in both groups,[15] especially in Bado type I injury, concluding that annular ligament reconstruction did not guarantee radial-head stability.[9,13]

We are aware that experience on four patients with 4 weeks, 8 weeks, 9 months and 3 years make it difficult to

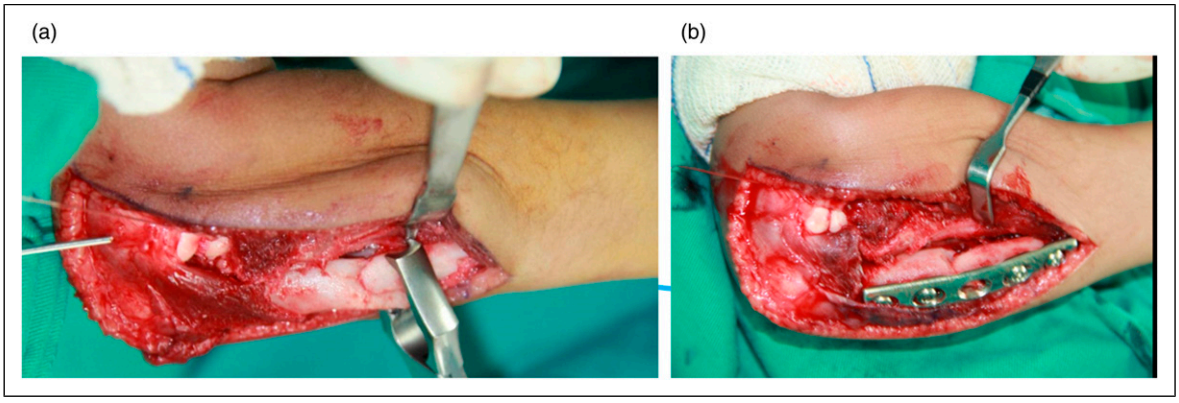

Figure 4. Surgical photo of patient no.4. Temporary transfixation of the radio-capitellar joint with Kirschner wire, allowing the osteotomized site to slide into obtaining the additional length and correct or overcorrect the ulna at the stable position of radial head (a). The ulna was fixed in the required position using the pre-bend DCP plate (b).

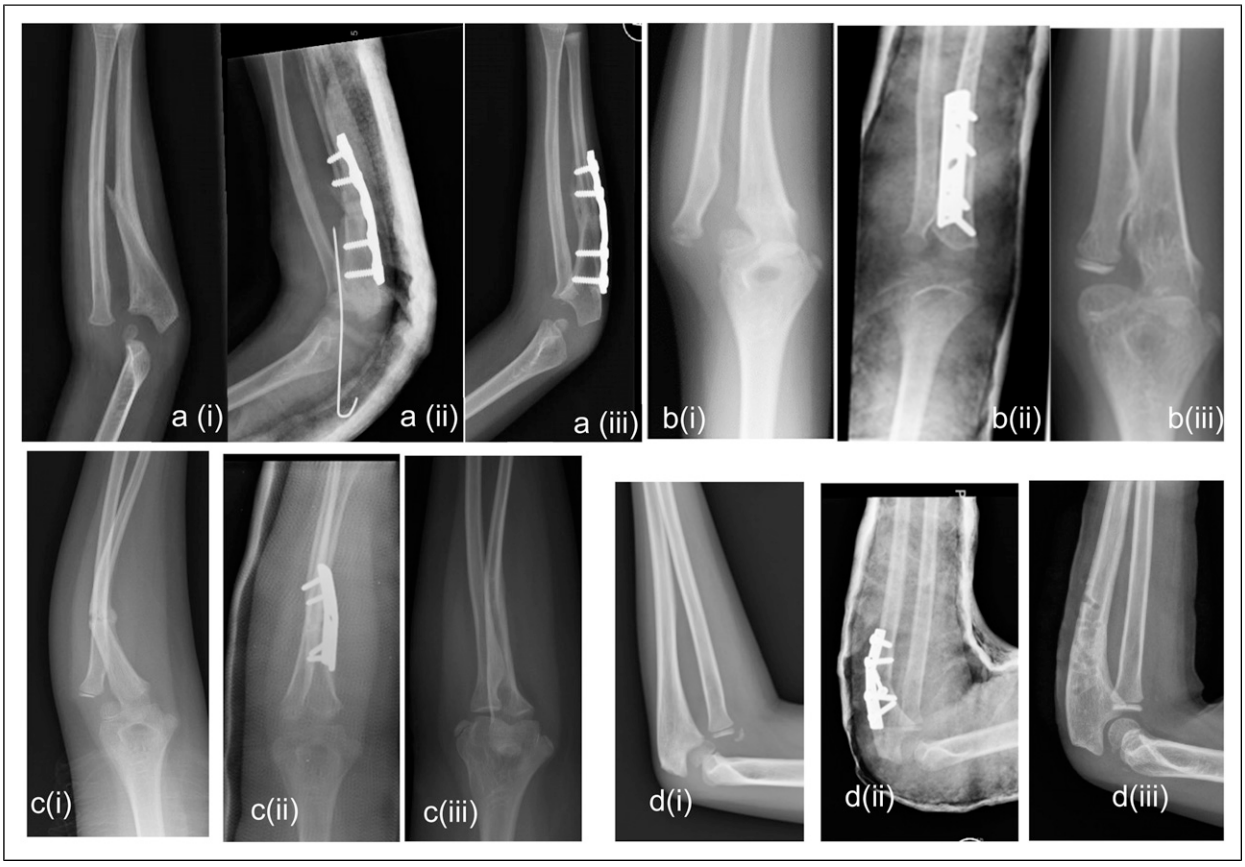

Figure 5. The plain radiograph view of all our patients; patient no1(a), patient no2(b), patient no3(c) and patient no4(d). The radiograph showed initial radiograph at presentation (i), post operative in POP (ii) and radiograph at latest follow up (iii). Note in radiograph a(ii) presence of radio-capitellar Kirschner wire as the immediate post operative radiograph.

make a strong conclusion on the real period of neglect that necessitate open reduction and ulnar ostetomy. Thus we can understand reason other authors recommendation on open reduction only if closed reduction fails.[2,7,16,17] We think this approach is worth to be considered in short period of neglect before complete remodel of ulnar takes place.

In conclusion, this case series showed the ability of oblique ulna sliding osteotomy to provide immediate ulnar angular

correction and lengthening without requiring bone graft as a safe approach to facilitate open reduction of neglected Monteggia fracture dislocation and prevent it from recurring.

Declaration of conflicting interests

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