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Outcome of Missed Monteggia Fracture Dislocation by Corrective Ulnar Surgery with Plate and Screw and Radiocapitellar Stabilization in Children

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ABSTRACT ***Background:*** Monteggia fracture is a rare injury in children that combines a proximal ulnar fracture with radial head dislocation. Missed cases can result in chronic deformity, restricted motion, valgus instability, and long-term functional disability. Surgical management remains debatable, although corrective ulnar osteotomy with plate fixation and radiocapitellar stabilization has emerged as a reliable option. ***Objective:*** To evaluate the functional and radiological outcomes of corrective ulnar osteotomy with plate and screw fixation plus radiocapitellar stabilization in children with missed Monteggia fracture dislocations. ***Methodology:*** This quasi-experimental study was conducted at NITOR and Health & Hope Hospital, Dhaka, from January 2022 to December 2023. A total of 22 children (aged 3–18 years) with missed Monteggia fracture dislocations (>4 weeks post-injury) were enrolled. All underwent corrective ulnar osteotomy with plate and screw fixation along with radiocapitellar stabilization. Patients were followed for 24 weeks. Functional outcomes were assessed using the Mayo Elbow Performance Score (MEPS), radiological outcomes by union and alignment, and complications were recorded. Statistical analysis was performed using SPSS v26; $p < 0.05$ was considered statistically significant. ***Results:*** The mean age was 9.6 ± 2.6 years, with male predominance (72.7%). The mean injury-to-surgery interval was 9.2 ± 5.1 months. Pain improved significantly, with 31.8% of patients being pain-free post-operatively compared to none pre-operatively. MEPS scores improved from a mean of 62.0 ± 7.5 to 81.4 ± 6.9 ($p < 0.001$). Final outcomes were rated excellent in 22.7%, good in 72.7%, and fair in 4.5% of cases. Complications occurred in 40.9%, most commonly cubitus valgus deformity (27.3%) and stiffness (13.6%). ***Conclusion:*** Corrective ulnar osteotomy with plate and screw fixation and radiocapitellar stabilization is an effective procedure for missed Monteggia fracture dislocations in children. It ensures reliable union, restores stability, and significantly improves function. Early surgical intervention within six months of injury provides the best outcomes.

Keywords: Missed Monteggia Fracture, Outcome, Ulnar Osteotomy.

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INTRODUCTION

An upper extremity injury involving a proximal ulnar fracture with associated radial head dislocation was first described by Giovanni Battista Monteggia in 1814 [1]. Monteggia fractures are rare in children, accounting for 1–2% of forearm fractures [2,3]. When diagnosed early, most pediatric Monteggia fractures can be managed successfully with closed reduction and cast immobilization [2]. However, in cases with irreducible radial head dislocation or unstable ulnar fractures, surgical management is often required [2]. Although rare, missed Monteggia fractures carry significant clinical implications. The initial diagnosis may be overlooked in up to 50% of cases, leading to chronic Monteggia fractures (CMFs), defined as cases in which the interval between injury and diagnosis exceeds four weeks [3,4]. Untreated cases may result in chronic pain, valgus deformity, restricted range of motion, and long-term functional disability [5].

The reported global incidence of Monteggia fractures is less than 2% of pediatric forearm injuries [2], although prevalence varies regionally. In an Indian study, the prevalence was reported as 6.1% among pediatric trauma cases [6]. Given the large pediatric population, these injuries contribute significantly to the overall trauma burden in South Asia. Surgical strategies for neglected or chronic Monteggia lesions include ulnar osteotomy, open reduction of the radial head, annular ligament reconstruction, and gradual reduction using external fixation [7–10]. Among these, corrective ulnar osteotomy with stable plate fixation and radiocapitellar stabilization has demonstrated consistent outcomes in restoring biomechanics, maintaining reduction, and improving functional recovery [9–11]. This study aimed to evaluate the functional and radiological outcomes of corrective ulnar osteotomy with plate and screw fixation along with radiocapitellar stabilization in children with missed Monteggia fracture dislocations.

MATERIALS AND METHODS

This quasi-experimental study was conducted at the National Institute of Traumatology & Orthopedic Rehabilitation (NITOR) and Health & Hope Hospital, Dhaka, Bangladesh, between January 2022 and December 2023. The study population comprised children aged 3 to 18 years who presented with radiologically confirmed closed Monteggia fracture-dislocation that had remained untreated for more than four weeks, thereby classified as missed Monteggia fractures.

Eligibility was determined using predefined criteria. Children with missed Monteggia fracture dislocation, aged between 3 and 18 years, presenting with closed fractures without neurological deficits, and with injury duration of at least four weeks were included. Patients were excluded if they had open fractures, pathological fractures, or established non-union. Based on prevalence data and the availability of patients during the study period, a total of 22 cases were enrolled using purposive sampling. Data collection included demographic and clinical variables such as age, sex, mechanism of injury, side affected, and time interval between injury and surgery. Functional outcomes were assessed using the Mayo Elbow Performance Score (MEPS), while radiological evaluation involved assessment of maximum ulnar bow (MUB), union status, and radiocapitellar alignment. Postoperative follow-up was carried out at 3, 6, 12, and 24 weeks.

All patients underwent corrective ulnar osteotomy stabilized with a plate and screws, along with radiocapitellar stabilization. Following surgery, immobilization was applied, and a structured rehabilitation program with gradual physiotherapy was instituted to restore motion and function. Data analysis was performed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical data were summarized as frequencies and percentages. Comparative analyses were carried out using paired *t*-tests for continuous variables and chi-square tests for categorical data, with a significance level set at $p < 0.05$.

RESULTS

Table 1. Distribution of Study Population According to Age and Sex (n=22)

Age group	Number	Percentage
3–10 years	15	68.2
10–18 years	07	31.8
Mean ± SD (years)	9.64 ± 2.65	Range 3-18 years

Gender		
Male	16	72.7
Female	06	27.3
male-female ratio	2.67:1.	

Among the 22 patients, the majority (68.2%) were aged 3–10 years, with the remaining 31.8% in the 10–18 years age group. The mean age was 9.64 ± 2.65 years (range 3–18 years). Males predominated (72.7%) compared to females (27.3%), resulting in a male-to-female ratio of 2.67:1.

Table 2: Duration from Injury to Operation and Duration of Hospital Stay (n=22)

Duration (months)	Number	Percentage
2–6 months	10	45.4
7–10 months	02	9.10
11–14 months	06	27.3
≥15 months	04	18.2
Mean ± SD	9.23 ±5.11	
Mean duration of hospital stay (in days)	18.64±3.87	Range 12 to 25 days

Table 2 shows the interval between injury and surgical intervention as well as the duration of hospital stay among the study patients. The mean interval from injury to operation was 9.23 ± 5.11 months, with the majority of cases (45.4%) undergoing surgery between 2 and 6 months after injury. A smaller proportion (9.1%) had surgery within 7–10 months, while 27.3% presented after 11–14 months, and 18.2% after 15 months or more. The mean duration of hospital stay was 18.64 ± 3.87 days, ranging from 12 to 25 days.

Table 3: Pain Status Before and After Surgery (n=22)

Pain level	Pre-operative (%)	Post-operative (%)	p value
No pain	0 (0.0)	7 (31.8)	0.004
Mild pain	18 (81.8)	15 (68.2)	0.303
Moderate pain	4 (18.2)	0 (0.0)	0.03

Table demonstrates the changes in pain status before and after surgery among the study participants. Preoperatively, none of the children were pain-free, with the majority experiencing mild pain (81.8%) and a smaller proportion reporting moderate pain (18.2%). At final follow-up, a significant improvement was observed: 31.8% of patients were completely pain-free (p = 0.004), while 68.2% reported only mild pain. Importantly, no patient experienced moderate pain postoperatively (p = 0.03). These findings indicate that corrective ulnar osteotomy with radiocapitellar stabilization effectively reduced pain in children with missed Monteggia fractures.

Table 4: Functional Evaluation According to MEPS (n=22)

MEPS score	Pre-operative (%)	Post-operative (%)	p value
<60 (Poor)	5 (22.73)	0	0.01
60–74 (Fair)	17 (77.27)	1 (4.55)	<0.001
75–89 (Good)	0	16 (72.73)	
≥90 (Excellent)	0	5 (22.73)	
Mean ± SD	62.04 ± 7.51	81.36 ± 6.93	p <0.001

Table 4 presents the functional outcomes assessed using the Mayo Elbow Performance Score (MEPS). Preoperatively, the majority of patients (77.3%) were classified as having fair function, while 22.7% were rated poor. None achieved good or excellent scores prior to surgery. Following corrective ulnar osteotomy with radiocapitellar stabilization, there was a marked improvement in functional status: 72.7% of patients achieved good results and 22.7% reached excellent outcomes, while only one patient (4.5%) remained in the fair category. The mean MEPS improved significantly from 62.04 ± 7.51 preoperatively to 81.36 ± 6.93 postoperatively ($p < 0.001$). These findings indicate that the surgical technique resulted in substantial functional recovery in the majority of cases.

Figure shows post-operative complications, most patients (59.1%) did not experience any complications. Elbow stiffness was noted in 13.6% of cases, while cubitus valgus deformity occurred in 27.3% of patients, indicating that deformity was the most common complication among those affected.

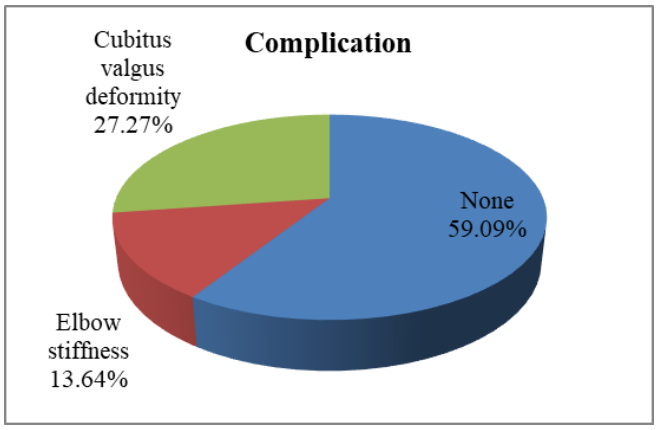

Figure 1: Post-operative complications (n=22)

DISCUSSION

Missed Monteggia fractures in children remain a challenging clinical entity due to delayed diagnosis, adaptive changes in the ulna, and difficulties in restoring radiocapitellar congruity. This study demonstrates that corrective ulnar osteotomy with plate and screw fixation combined with radiocapitellar stabilization results in excellent union rates, significant functional improvement, and acceptable complication rates. The mean age of affected children in this study was 9.6 years, consistent with Xu *et al*., who reported a mean age of 6.7 years. Male predominance (72.7%) was also observed, similar to findings from Langenberg *et al.*, [12, 13]. The most common mechanism of injury was fall from height, aligning with previous studies in South Asia where such mechanisms predominate due to childhood activity patterns.

Functional recovery was substantial, with mean MEPS improving from 62.0 to 81.3, reflecting significant enhancement in pain, stability, and range of motion. This is in line with Najd Mazhar *et al*., who documented excellent outcomes in 85% of cases treated with similar methods. In the series of He, *et al*., & Delpont, *et al*., it was found that, the mean MEPS at last follow up was 92.1±9.3 & 94±10 point respectively [14-16].

Complication rates in this series were 40.9%, primarily cubitus valgus deformity and stiffness. Comparable studies report complication rates ranging from 20–40%. Although these complications can impact long-term function, none of the patients in this study experienced redislocation or nonunion, indicating the reliability of the chosen surgical technique. In a previous study in Egypt, no case of instability was found at last follow up Megahed *et al*., reported out of 22 cases, 9 (40.9%) cases had complications [17]. Among them, 3 (13.6%) had elbow stiffness and 6 (27.3%) had cubitus valgus deformity. No patients experienced associated vascular & nerve injuries.

The interval between injury and surgery significantly influenced outcomes: patients operated within 6 months had better functional recovery compared to those with longer delays. This finding emphasizes the importance of early surgical intervention, as supported by Di Gennaro *et al*., and Stragier *et al*., who reported

poorer outcomes with prolonged delays [9,18]. Clinically, the study confirms that corrective ulnar osteotomy with stable plate fixation provides reliable correction, ensuring stable reduction of the radial head and preventing recurrence. However, residual deformities and stiffness highlight the need for long-term follow-up and rehabilitation.

CONCLUSION

Corrective ulnar osteotomy with plate and screw fixation combined with radiocapitellar stabilization is an effective surgical procedure for managing missed Monteggia fracture dislocation in children. It ensures reliable union, restores radiocapitellar congruity, and significantly improves functional outcomes. Early surgical intervention (within six months of injury) yields the best results. Despite a moderate rate of complications, most patients achieve excellent to good functional recovery. Further multicenter studies with larger cohorts and longer follow-up are needed to refine surgical techniques and minimize complications.

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