Original Article

Outcome of Open Reduction and Internal Fixation of Monteggia Fracture-Dislocation by Small Dynamic Compression Plate (DCP) in Adult Patients

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Abstract

Monteggia fractures involve a break in the ulna along with a dislocation of the radial head. Proper and timely anatomical reduction and stable fixation management are critical for successful outcomes. This prospective, observational study was conducted in the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh, to assess the effectiveness of open reduction and internal fixation using a small dynamic compression plate (DCP) on the ulna, alongside the anatomical reduction of the radial head in adult patients with early-stage of Monteggia fracture-dislocation, between March 2017 and February 2020. A total of 30 patients with radiologically confirmed closed Monteggia fractures were included through purposive sampling. Outcomes were measured over 24 weeks following operation using the Quick DASH (shortened disabilities of the arm, shoulder, and hand questionnaire) score, visual analogue scale (VAS), and range of motion (ROM) for flexion-extension and supination-pronation and evaluated against Anderson criteria for functional outcomes. The average age of the patients was 36 years; a male predominance was observed (80%). The majority had Bado type I fractures (86.7%), with the remainder having type II. The average time from injury to surgery was approximately 10 days. Post-operative complications occurred in 13.3% of cases, including tourniquet palsy and wound infections. Functional outcomes rated 23.3% as excellent, 63.3% as good, 6.7% as fair, and 6.7% as poor. Overall, 86.7% of outcomes were satisfactory. Patients with Bado type II fractures and those with longer intervals between injury and surgery experienced worse outcomes ($p=0.004$ and $p=0.012$, respectively). Open reduction and internal fixation approach for Monteggia fractures leads to predominantly excellent to good outcomes. Factors such as fracture type and delay in surgical intervention significantly impact recovery, highlighting the importance of prompt treatment. Despite resource limitations, early surgical intervention is recommended to prevent complications and enhance recovery.

Keywords*: Monteggia fractures, open reduction and internal fixation (ORIF), dynamic compression plate (DCP)*

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INTRODUCTION

Monteggia fracture-dislocation is a significant orthopedic injury characterized by a fracture of the proximal third of the ulna and dislocation of the radial head. This condition involves the radial head being dislocated from the proximal radio-ulnar and radio-capitellar joint. Recently, the definition has expanded to include almost any ulna fracture associated with the radio-capitellar joint dislocation, such as trans olecranon fractures where the proximal radio-ulnar joint remains intact[1].

The first classic description of this injury was provided by Monteggia of Milan, Italy in 1814. However, as noted by Bado and Boyd, the strict definition of Monteggia fracture-dislocation accounts for only about 60% of ulnar fractures with associated dislocation of the radio-humeral articulation. The typical displacement involves the ulna angulating forwards and the radial head dislocating anteriorly, although reverse deformities are less common. In 1962, Bado classified Monteggia lesions into four types: Type I (60%), Type II (15%), Type III (20%), and Type IV (5%), with Type I being the most common[2].

The term "Monteggia fracture" has often been associated with the frustration of managing these injuries, as emphasized by Watson Jones in his 1943 text, where he stated, "No fracture presents so many problems; no injury is beset with greater difficulty; no treatment is characterized by more general failure" (Bruce et al., 1974). Various theories have been proposed regarding the mechanism of injury, including the direct force theory by Speed & Boyd in 1940[3], the hyperpronation theory by Mervyn Evan in 1947, and the hyperextension theory by Tompkins in 1971[4]. Monteggia fractures account for 0.7% of all elbow fractures and dislocations and 7% of fractures involving the radius and ulna[5]. With an improved understanding of elbow and forearm trauma, distinctions have been made between classical ulnar fracture dislocation and other injuries grouped under the term "Monteggia equivalents or variants." It has been observed that Monteggia lesions associated with radial head or neck fractures tend to have worse clinical outcomes than those with radial head dislocation alone[6]. Further subclassification of Type II lesions by Jupiter provides more detailed categorization: IIa involves the distal end of the olecranon and the coronoid process; IIb includes metaphyseal-diaphyseal fractures distal to the coronoid process; IIc refers to diaphyseal fractures of the ulna; and IId describes fractures halfway through the bone[7].

The successful management of Monteggia fractures in adults' hinges on accurate classification and stable anatomical reduction. While surgical outcomes for chronic injuries are often less reliable, early intervention can lead to good or excellent results[8]. The primary aim of treatment is to restore a functional limb as early as possible, ensuring a sound bony union. Factors critical to successful outcomes include early accurate diagnosis, anatomical reduction of the dislocated radial head, stable internal fixation of the ulna, and early mobilization. Various operative treatments are available for Monteggia fracture-dislocations, including small Dynamic Compression Plates (DCP), Limited Contact-Dynamic Compression Plates (LC-DCP), 3.5 mm reconstruction plates, K-wires, Rush nails, and tubular plates. Early cases, defined as those within three weeks of injury, are typically treated with open reduction and internal fixation of the ulna using small DCP, followed by anatomical reduction of the radial head. However, Monteggia fracture-dislocations are complex injuries that pose significant challenges. Successful management requires precise diagnosis, appropriate classification, and early, stable intervention to achieve the best functional outcomes

METHODS

This prospective, observational study was conducted in the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, between March 2017 and February 2020. The study aims to evaluate patients with radiologically confirmed closed Monteggia fracture-dislocation admitted to various orthopedic units within NITOR hospital. Due to time constraints and the limited availability of suitable patients, a total of 33 cases were initially selected. However, three patients were dropped from the study due to non-cooperation, resulting in a final sample size of 30 patients for evaluation. The inclusion criteria specified patients aged between 20 and 60 years with closed fractures, presenting within three weeks of injury, irrespective of sex or side of injury. Exclusion criteria included patients outside the specified age range (below 20 and above 60 years), those with open fractures, active or latent infections, medically unfit cases (e.g., uncontrolled diabetes mellitus, chronic renal failure, chronic obstructive

pulmonary disease with an ASA score greater than 4), individuals unwilling to undergo surgery, and injuries older than three weeks. This structured approach ensured a focused evaluation of early closed Monteggia fracture dislocations, aiming to provide insights into the management and outcomes of this specific patient group within the constraints of the study period.

Data collection involved a prescribed data sheet with a pre-tested structured questionnaire covering the patient's hospital profile, injury profile, operation details, post-operation management, complications, rehabilitation, and follow-up. Outcomes were evaluated according to Anderson's criteria[9]. Detailed patient histories were taken, focusing on the injury mechanism, timing, and patient age, followed by thorough systemic and local examinations for proper assessment.

Radiological Examinations included antero-posterior and lateral views of the affected forearm, including the elbow, were taken to confidently assess the ulna fracture and dislocation of the radial head. The patient was followed up at regular intervals (2, 6, 12, and 24 weeks) to assess the final outcome. During these follow-up sessions, the range of motion was tested, x-rays were taken, and visual analogue scale (VAS) scores for pain, Quick DASH (shortened disabilities of the arm, shoulder, and hand questionnaire) score, and functional outcomes according to Anderson criteria were measured (VAS score, motion range not shown here). Late complications were assessed, and improvement was noted.

Surgical technique involved internal fixation of the ulna and anatomical reduction of the radial head. The radial head dislocation was first reduced by applying traction on the forearm and counter-traction on the arm, followed by elbow flexion to 120°. An incision was then made along the subcutaneous border of the ulna to expose the fracture. The fracture ends were cleaned, aligned, and fixed using a dynamic compression plate (small DCP) and 3.5 mm cortical screws. A 6 or 7-hole plate was placed over the posteromedial surface of the ulna after periosteal elevation and removal of soft tissue interposition. The plate was held with a Luman's clamp while drill holes were made, starting from the most distal hole and moving towards the fracture site, where the screws were fixed. Compression was applied to the fracture site, the muscles were allowed to fall into place, hemostasis was ensured, and the wound was closed in layers. Finally, a long arm cast was applied with the elbow at 90° flexion and the forearm supinated.

Following operation, active movements of the fingers were started in the evening after the patient recovered from anesthesia. The limb was elevated and checked for early signs of compartment syndrome frequently. Adequate analgesia was administered at regular intervals. After 2 weeks the cast was removed, and sutures were cut maintaining the elbow in the same position of flexion and supination. The long arm back slab was reapplied. After 6 weeks that cast was also removed, and active exercises of the elbow and forearm were advised. A radiological checkup of the elbow and forearm was advised. From then time to time check x-rays were done and the prognosis was noted.

Statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS) version 25.0 for Windows. The study findings were presented in tables by frequency and percentage. Means and standard deviations were used for continuous variables, while frequency distributions described categorical variables. Associations of categorical data were assessed using Fisher's Exact test, with $p<0.05$ considered significant.

The study was approved by the Ethical Review Committee of the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh.

RESULTS

The study included 30 patients with Monteggia fractures. The age distribution showed that 11 (36.7%) patients were in the 20-29 years age group, 6 (20.0%) were in the 30-39 years age group, 8 (26.7%) were in the 40-49 years age group, and 5 (16.7%) were in the 50-55 years age group. The mean age was 35.96±11.48 years, with a range from 20 to 55 years (Table-I). Among the patients, occupations varied: 10 (33.3%) were service holders, 5 (16.7%) were housewives, 4 (13.3%) were cultivators, 4 (13.3%) were businessmen, 3 (10.0%) were students, 2 (6.7%) were transport workers, and 2 (6.7%) were in other occupations (Table-I). 36.67% fractures caused by physical assault, 33.33% by road traffic accidents (RTA), and 30% due to fall. Out of the 30 patients, 12 (40.0%) presented with right-sided fractures, and 18 (60.0%) had left-

sided fractures. According to the Bado classification, 26 (86.7%) had Type I fractures, and 4 (13.3%) had Type II fractures. The time interval between injury and surgery was examined, showing that 19 (63.3%) patients had surgery within 10 days of the injury, while 11 (36.7%) had surgery within 11-21 days. The mean time interval between injury and surgery was 10.13±3.86 days, ranging from 5 to 20 days. Post-operative complications were noted in 4 (13.3%) patients, with complications such as tourniquet palsy (2 patients, 6.7%) and wound infection (2 patients, 6.7%). The remaining 26 (86.7%) patients did not experience any complications (Table-II). The union status at the last follow-up revealed that 28 (93.33%) patients achieved union (as seen in Fig. 1), while 2 (6.67%) patients did not show any signs of union up to 24 weeks of follow-up. The final outcomes were assessed using the Anderson criteria, showing that 7 (23.3%) patients had excellent outcomes, 19 (63.3%) had good outcomes, 2 (6.7%) had fair outcomes, and 2 (6.7%) had poor outcomes. The final outcome was satisfactory (excellent and good) in 26 (86.7%) patients and unsatisfactory (fair and poor) in 4 (13.3%) patients (Table-II). Six weeks after surgery, the mean Quick DASH score was 54.2%±5.11%. At 12 weeks, it decreased to 34.4%±7.71%. Furthermore, at the last follow-up, it significantly decreased to 16.6%±10.08% (Fig. 2).

Table-I: *Characteristics of patients (n=30)*

Variables	Frequency	Percentage
Age group (in years)		
20-29	11	36.7
30-39	6	20.0
40-49	8	26.7
50-59	5	16.7
Mean±SD	35.96±11.48 years	
Range (min-max)	20-55 years	
Occupation		
Service holder	10	33.3
Housewife	5	16.7
Cultivator	4	13.3
Businessman	4	13.3
Student	3	10.0
Transport worker	2	6.7
Others	2	6.7

Table-II: *Clinical characteristics of the patients (n=30)*

Variables	Frequency	Percentage
Causes of injury		
Physical assault	11	36.67
RTA	10	33.33
Fall	9	30.0
Affected limb		
Right	12	40
Left	18	60
Bado classification of Monteggia fracture		
Type I	26	86.7
Type II	4	13.3
Interval between injury and surgery		
≤10 days	19	63.3
11-21 days	11	36.7
Mean±SD	10.13±3.86 days	
Range (min-max)	5-20 days	
Postoperative complications		
Yes	4	13.3
No	26	86.7
Union status		
Union	28	93.33
Non-union	2	6.67
Final outcome according to Anderson criteria		
Excellent		23.3
Good		63.3
Fair		6.7
Poor		6.7
Final outcome		
Satisfactory	24	86.7
Unsatisfactory	6	13.3

Fig. 1: *X-ray of the forearm including the elbow: preoperative (left), and during final follow-up (at 24 weeks after operation) showing excellent union (right).*

Fig. 2: *Distribution of patients according to Quick DASH score (n=30)*

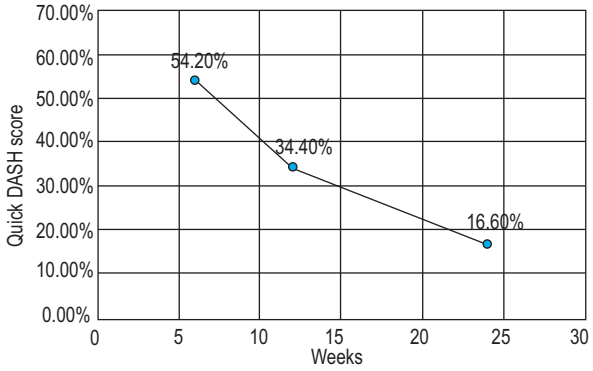

Fig. 2: *Distribution of patients according to Quick DASH score (n=30)*

DISCUSSION

Monteggia lesion, characterized by an associated fracture of the ulna with radial head dislocation, is a severe injury. The majority of our patients were aged between 20 and 39 years, with a mean age of 35 years, which is consistent with the findings from a retrospective study done in India by Reddy & Prasad[10]. Males constituted 80% of the study population; this finding is aligning with some other previous studies.[7-8,10] The predominance of males can be attributed to the nature of the injuries, which often occur due to highway accidents or physical aggression. Monteggia fractures typically result from a fall on an outstretched arm with forced pronation or a direct injury[11]. The present study identified physical assault, road traffic accidents (RTA), and falls from height as common causes of injury. One-third of our patients underwent surgery within 11-21 days, with a mean interval of 10.13±3.86 days between injury and surgery. Delays were primarily due to patients coming from outside Dhaka city, where surgical facilities and implants are scarce. Patients were initially treated with a back slab until the swelling subsided, followed by surgery.

Postoperative complications included tourniquet palsy in 6.7% of patients, a lower incidence compared to the 14% reported by Bruce, Harvey & Wilson[5], likely due to the absence of pre-existing nerve palsies in the present study cohort. Two patients experienced wound infections, managed with culture-specific antibiotics and regular dressings. No patient required revision surgery, reflecting the efficacy of using 3.5 mm DCP for stable fixation of ulnar fractures, which reduces the likelihood of reoperation and improves functional outcomes[7].

Functional outcomes were assessed using the Quick DASH score, which improved significantly from 54.2%±5.11% at six weeks to 16.6%±10.08% at the final follow-up, aligning with scores observed in other previous studies[12,13]. The range of motion (ROM) for elbow flexion-extension improved from 121.66°±7.58° at the first follow-up to 132.83°±5.82° at the last follow-up, similar to findings of Henle et al.[13]. Similarly, the ROM for supination-pronation improved from 79°±6.99° to 120.83°±15.26°, comparable to the results of the study done by Gill et al.[12].

According to Anderson criteria, most patients achieved good to excellent functional outcomes, with only two patients having poor outcomes due to nonunion. The study found that patients with timely surgery had better outcomes, as delayed surgery increases the risk of joint stiffness and soft tissue fibrosis. This finding is aligned with the findings of Konrad et al.[8] and Reckling[14], which interpreted that timely intervention is crucial for a better prognosis. However, patients with Bado type II fractures had less satisfactory outcomes, likely due to the complexity of these fractures involving the direction of radial head dislocation and proximal ulnar fracture type[10]. Overall, the study underscores the importance of early surgical intervention and stable fixation to optimize functional recovery in Monteggia lesions.

Our study has several limitations, including a small sample size and a short study period, which prevented the analysis of long-term outcomes or failure-related data. Additionally, the research was not recommended to conduct a long-term randomized study with an extended follow-up duration and to include a multicenter approach with a larger series of participants to enhance the reliability and generalizability of the findings.

CONCLUSION

The study indicates that operative treatment of Monteggia fracture dislocation with the selected implant typically results in excellent to good radiological and functional outcomes, with most patients experiencing uncomplicated recovery. However, delayed surgery and Bado type II fractures are linked to poorer outcomes, highlighting the importance of early surgical intervention despite limited facilities.

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