



Difficult closed reduction of elbow dislocations: two case reports from a multicenter retrospective chart review



Fumihiko Isobe, MD^{a,*}, Koichi Nakamura, MD, PhD^a, Hiroshi Yamazaki, MD, PhD^b, Masanori Hayashi, MD, PhD^c, Toshiro Itsubo, MD, PhD^d, Masatoshi Komatsu, MD, PhD^e, Shigeharu Uchiyama, MD, PhD^f, Jun Takahashi, MD, PhD^c

^aDepartment of Orthopaedic Surgery, North Alps Medical Center Azumi Hospital, Ikeda, Nagano, Japan

^bDepartment of Orthopaedic Surgery, Aizawa Hospital, Matsumoto, Nagano, Japan

^cDepartment of Orthopaedic Surgery, Shinshu University School of Medicine, Matsumoto, Nagano, Japan

^dDepartment of Orthopaedic Surgery, Iida Municipal Hospital, Iida, Nagano, Japan

^eDepartment of Orthopaedic Surgery, Red Cross Society Suwa Hospital, Suwa, Nagano, Japan

^fDepartment of Orthopaedic Surgery, Okaya City Hospital, Okaya, Nagano, Japan

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Traumatic elbow dislocation is a common injury in both children and adults with an annual incidence of 6.1 per 100,000.³ Carlouz and Ablos¹ reported that 6 of 58 (10%) pediatric traumatic elbow dislocations required open reduction and cited the presence of intra-articular bone fragments, usually the medial humeral epicondyle, as the greatest impediment to manual reduction. In adults, traumatic elbow dislocation that cannot be manually reduced is extremely rare. There have been no comprehensive studies on traumatic elbow dislocation that use a high number of cases with a large body of data. Therefore, the type of dislocation that induces difficulty in reduction and requires additional anesthesia, sedation, or open reduction in the operating room remains unknown. The purpose of this multicenter study is to investigate the manual reduction of elbow dislocation and report the detailed results.

Materials and methods

Patients

This multicenter retrospective study involved 6 hospitals with hand surgeons. Cases of acute traumatic elbow dislocation were

retrieved from electronic medical records covering a 5-year period between April 2013 and March 2018 at each institution. Patients with a history of surgery or fracture of the elbow, complications of neurovascular injury, and open fractures were excluded. Patients with fractures of the olecranon and medial and lateral epicondyles of the humerus were excluded. Monteggia fracture-dislocation and transolecranon fracture-dislocation, which could be reduced but were often difficult to maintain reduction, were also excluded (Fig. 1). There were 92 elbows in 92 patients (52 males and 40 females) with a mean age of 39 years (7–87 years). This study was approved by the institutional review board of each institution (study no.: 30-07-01).

Approval for this study was received from North Alps Medical Center Azumi Hospital (# 30-07-01).
*Corresponding author: Fumihiko Isobe, MD, Department of Orthopaedic Surgery, North Alps Medical Center Azumi Hospital, 3207-1 Ikeda, Ikeda-Town, Nagano 399-8695, Japan.

E-mail address: flipflop700@gmail.com (F. Isobe).

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Outcome measures

In all cases, the presence or absence of fracture and the direction of dislocation were classified by the first author (F.I.) based on radiographs of the elbow joint at initial examination. Elbow dislocations were classified into anterior, posterior, posteromedial, posterolateral, medial/lateral, and divergent dislocations according to the relative position of the ulna to the humerus. In the lateral view, ulnar positions posterior to the trochlea were broadly defined as posterior dislocations, and ulnar positions anterior to trochlea were defined as anterior dislocations. When not dislocated in the anteroposterior direction, the dislocations were classified as lateral or medial. A medial transition with posterior dislocation of the ulna

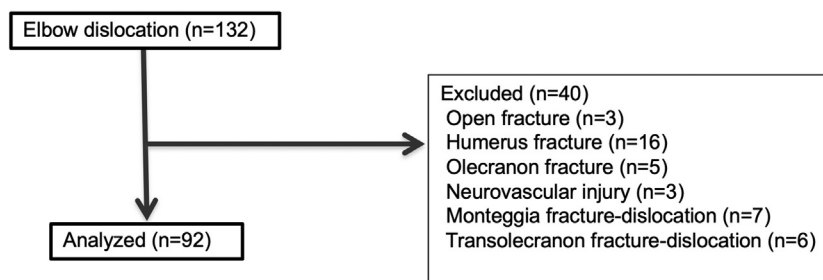


Figure 1 Patient recruitment flowchart.

was defined as a posteromedial dislocation of the elbow joint. A lateral transition with posterior dislocation of the ulna was defined as a posterolateral dislocation of the elbow joint. A divergent dislocation was defined as those with concomitant dislocation of the radius from the ulna (Fig. 2).

Whether manual reduction was difficult or not was determined by medical records. In this study, irreducible dislocation was defined as a case requiring open reduction. In order to clarify the characteristics of elbow dislocations that are difficult to reduce, we examined whether age, gender, the mechanism of injury, absence of sedation or anesthesia in reduction, and the type of dislocation affect the difficulty of manual reduction. The mechanism of injury was classified into three categories: low-energy trauma such as falls, moderate-energy trauma from sports injuries such as skiing and snowboarding, and high-energy trauma such as falls from heights and traffic accidents.

Results

The direction of dislocation was posterior in 34 cases (37%), posteromedial in 4 cases (4%), posterolateral in 48 cases (52%), lateral in 6 cases (7%), medial in 0 cases, anterior in 0 cases, and divergent in 0 cases. Fractures were observed in 25 (27%) elbows, including 6 radial head fractures and 23 coronoid process fractures. Reductions were performed without anesthesia and sedation in 73 patients (79%), with conduction anesthesia in 11 patients (12%), with sedation in 5 patients (5%), and with local intra-articular anesthesia in 3 patients (3%) (Table 1).

There was no irreducible dislocation requiring open reduction. In addition, there were no cases of difficult reduction due to intra-articular obstacles. However, there were two cases of difficult closed reduction that were transferred to the operation room for open reduction after a failed manual reduction under anesthesia in the outpatient department. The difficulties in reduction were due to an impingement of the coronoid on the trochlea. Fortunately, these cases were reduced in the operating room under sedation or brachial block using a fluoroscope without open reduction.

The two cases reduced in the operating room were both female and sustained a traumatic injury from snowboarding. These cases were posteromedial dislocations, complicated by a type I coronoid process fracture according to the Regan classification.⁸

Case 1 was a 40-year-old female who sustained an injury to her left elbow joint during a fall in snowboarding. Radiographs of the elbow showed a posteromedial dislocation and type I coronoid process fracture. Computed tomography (CT) showed no bone fragments in the joint, and the medial edge of the trochlea was riding on the coronoid process, indicating an impingement. Magnetic resonance imaging (MRI) showed no obvious intra-articular soft tissues or other factors that could inhibit reduction, and the brachial muscle was taut. MRI of the elbow in the dislocated position was difficult to accurately depict the collateral ligament

injury. Reduction was attempted 4 times under brachial plexus block with a 10-mL injection of 1% lidocaine. However, closed reduction was deemed difficult to achieve despite the absence of pain, and there was no varus-valgus stability of the elbow joint. The reduction procedure was more challenging than it was in typical cases; therefore, closed reduction was again attempted under general anesthesia in the operating room. Fortunately, we were able to manually reduce this dislocation in a two-step procedure. First, the posteromedial dislocation shifted into a medial dislocation by pushing the olecranon in the distal direction. In the second step, we pushed the olecranon from the medial side to the lateral side, which allowed us to reduce the dislocation (Fig. 3).

Case 2 was a 30-year-old female who sustained an injury to her left elbow joint during a fall in snowboarding. She had a posteromedial dislocation and Regan type I coronoid process fracture. Manual reduction was performed under local intra-articular anesthesia without success. CT and MRI showed no intra-articular bone fragments or soft tissue and showed impingement of the trochlea and coronoid process. The patient was taken to the operating room with the possibility of open reduction. Under brachial plexus block, closed reduction was first attempted. The elbow was placed in hyperextension to release the impingement and allow for noninvasive reduction. No valgus instability of the elbow joint was observed; however, there was significant varus instability, and the lateral collateral ligament was surgically repaired.

Discussion

In most cases, acute traumatic elbow dislocations are easily reduced. In rare but difficult cases, open reduction is recommended because of the possible need for nerve or vascular intervention.^{6,16} Structures that have been reported to inhibit the reduction of elbow dislocation include medial epicondyle, lateral epicondyle, collateral ligament, anconeus, brachialis, biceps tendon, flexor muscles, capsule, median nerve, ulnar nerve, and brachial artery.^{2,4-6,14-16} Our study revealed that there were no cases of difficult reduction due to obstacles. In our two cases of elbow dislocation, the reduction was prevented by the impingement of the coronoid on the trochlea. To the best of our knowledge, there are no previous reports on impingement as an inhibiting factor in the reduction of dislocation. We hypothesize that the reason for their difficult closed reduction of dislocations was that they were young and their bones were strong enough to avoid fracture, but the moderate external forces (moderate-energy mechanism) led to the dislocation and the trochlea impinging on the coronoid.

Posterior and posterolateral dislocation of the elbow are common^{9,14}; however, there is no consensus on their exact mechanism of injury. Varus posteromedial rotatory instability and posterolateral rotatory instability are known as posterior dislocation mechanisms of the elbow.⁷ In this study, posterior dislocation and posterolateral dislocation accounted for 89% of the cases, while the



Figure 2 Classification of elbow dislocation.

Table 1

Demographic information.	
Sex	
Male	52
Female	40
Mean age in years	39
Injury energy	
Low	29
Moderate	35
High	28
Irreducible dislocation	
Yes	0
No	92
Type of dislocation	
Anterior	0
Posterior	34
Posteromedial	4
Posterolateral	48
Medial	0
Lateral	6
Divergent	0
Fracture	
Yes	25
No	67
Fracture type	
Radial head	6
Coronoid	23
Type I	14
Type II	5
Type III	4
Reduction with	
Anesthesia	14
Sedation	5

Low energy: eg, fall. Moderate energy: eg, sport injury. High energy: eg, crash, traffic injury. Coronoid fractures are classified into three types, according to the degree of involvement of the coronoid process²: type I, avulsion; type II, involvement of 50% or less of the coronoid process; type III, involvement of more than 50% of the coronoid process.

incidence of posteromedial dislocation was as low as 4%. The mechanism of posteromedial dislocation is assumed to be that the elbow joint was slightly flexed, and the dislocation was caused by

the addition of axial compression, supination, and varus, causing a lateral collateral ligament complex injury.

In this study, coronoid process fractures occurred in all cases of posteromedial dislocation. Furthermore, cases with impingement showed type I coronoid process fractures without capitellum fractures in posteromedial dislocation. Moreover, cases without impingement showed type I coronoid process fractures with capitellum fractures or type II coronoid process fractures. Impingement of the humeral trochlea and coronoid process was considered as an inhibiting factor for reduction in cases of difficult closed reduction. In a posteromedial dislocation with a type I coronoid process fracture, it is assumed that the reduction of dislocation may be difficult because of the remaining coronoid process of enough size to cause impingement and less damage to the medial collateral ligament and anterior capsule. Impingement does not occur when posteromedial dislocation is combined with type II or III coronoid process fractures or a capitellum fracture, which is likely due to the significant instability of the elbow joint. The impingement caused by a posteromedial dislocation could be diagnosed with an accurate evaluation by CT and MRI. As a treatment strategy for closed reduction, if there is no valgus instability in the stress test, it may be difficult to shift a posteromedial dislocation into posterior dislocation; thus, we recommend to first reduce the dislocation in the anterior-posterior direction. Under painless conditions with conduction anesthesia or general anesthesia, the posteromedial dislocation should first be shifted into a medial dislocation by hyperextending the elbow or pushing the olecranon distally. After the posteromedial dislocation is manipulated into a simpler dislocation pattern, the resulting medial dislocation can be further reduced by pushing the olecranon from the medial to lateral side. If reduction of the medial dislocation is not possible, open reduction should be considered.

The strength of this study was its multicenter design that comprised hospitals with hand surgeons, which enabled closed or open reduction of a higher quality for elbow joint dislocation. However, in our region, there are no anesthesiologists in the outpatient department or emergency room. Thus, we may reduce elbow dislocations without sedation if the simple elbow dislocation

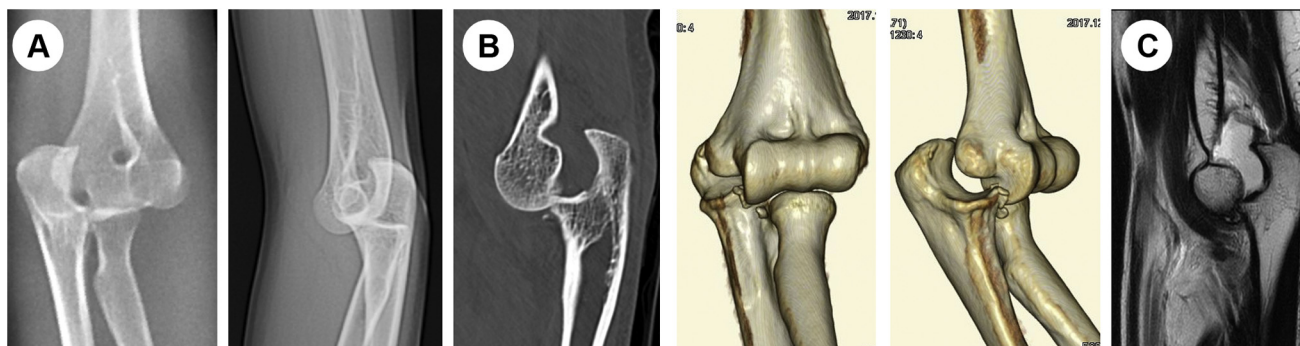


Figure 3 Case 1. A 40-year-old female presented with a posteromedial elbow dislocation. (A) Radiographs of the elbow; (B) computed tomography images of the coronoid fracture with tip avulsion; (C) magnetic resonance imaging shows no bone fragment or soft tissue in the elbow joint.

is acute. Although dislocations with fractures can be reduced under sedation or anesthesia, the use of sedation has been reported to result in higher costs, longer stay in the emergency room, and more complications, such as nausea, vomiting, central nervous system depression, and respiratory depression.^{10–13} For this reason, unsedated dislocation reduction is performed in our region. In cases of elbow dislocation that are difficult to reduce, open reduction may be necessary. In this study, half the posteromedial dislocations were difficult to reduce but could be finally corrected by closed reduction. CT and MRI images that show presence or absence of impingement of the humeral trochlea and coronoid process could allow us to predict the difficulty of closed reduction as a method of reducing posteromedial dislocations. These cases can be reduced manually without open reduction if they are well sedated or receiving analgesics.

There were several limitations in our study. First, there have been no cases of irreducible reduction due to intra-articular obstacles. Although obstruction of reduction due to obstacles has been reported, the body of literature is scarce with a small number of cases. Second, as this study was a retrospective study, the methods for dislocation reduction and anesthesia were not standardized. Normally, sedation should be performed in the outpatient department or emergency room. However, in our region, sedation was not always possible because of staffing constraints. The two cases in this study may have achieved reduction in the emergency room if they were sedated.

Conclusions

We presented two cases of posteromedial dislocation of the elbow joint that were difficult to reduce. In both cases, the dislocated coronoid process caused an impingement with the humeral trochlea.

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