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Techniques and Procedures

ELBOW DISLOCATIONS IN THE EMERGENCY DEPARTMENT: A REVIEW OF REDUCTION TECHNIQUES

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☐ **Abstract—Background: Elbow dislocations are one of the most common large joint dislocations and they require urgent reduction in the emergency department. Posterior dislocations are the most common type, with anterior dislocations occurring in rare cases. Discussion: Reduction techniques include traction–countertraction, patient-assisted countertraction, the leverage approach, and the modified Stimson technique. Complications can include nerve injury, vascular injury, and compartment syndrome. Conclusions: It is important for emergency physicians to be familiar with several different reduction techniques for elbow dislocations in case the initial reduction attempt is unsuccessful. This article reviews the current evidence for reduction of elbow dislocations and any variations on these approaches. © 2018 Elsevier Inc. All rights reserved.**

☐ **Keywords—dislocation; elbow; reduction; relocation**

INTRODUCTION

The elbow is one of the most common large joint dislocations in adults and the most common in children, responsible for 10% to 25% of all elbow injuries with a reported incidence ranging from 2.7 to 6.1 per 100,000 people (1–7). This injury affects men more frequently than women, typically occurring on the nondominant side, and is most common in the 30-year-old age group (8–17). Dislocations occur most frequently from falls, followed by sports, assault, and motor vehicle collisions (7,15–20). Wrestling, football, and gymnastics are the most common sports associated with this injury (7,15–20).

The elbow includes 3 articulations: the ulno-trochlear, the proximal radio-ulnar, and the radio-capitellar joints (19). The articular surfaces are highly congruent and, therefore, inherently stable (10,21–23). Further stability is provided by the static restraints, comprised of the medial collateral ligament (MCL), lateral collateral ligament (LCL), and the joint capsule. Muscles crossing the elbow joint provide additional dynamic stabilization (11–13,24,25).

Typically, elbow dislocations occur when falling on an outstretched arm. As the hand contacts an immobile surface, axial force is directed toward a flexed elbow in supination (20,21,25–29). The first stage of dislocation involves disruption of the LCL (2,24,30–33). Stage 2 involves subluxation of the coronoid over the trochlea (2,24,30–33). The final stage involves damage to the MCL, resulting in full dislocation of the radius and ulna (2,24,30–33).

A dislocation is considered complex when it is associated with a fracture and simple when no fractures are present (4). Between 50% and 80% of adult dislocations are simple, while the majority of pediatric elbow dislocations are complex (12,34–38). Dislocations are also classified by forearm location in relation to the humerus, with

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90% of dislocations occurring in a posterior or posterolateral direction and only 1% to 2% displacing anteriorly (1,12,33,37–40). Divergent dislocations are rare and occur when the humerus is forced between the radius and ulna (35,41). A complex dislocation with fractures of the coronoid process, radial head, and MCL is referred to as the "terrible triad" of the elbow because of frequent problems with instability, stiffness, and degenerative changes (31,42,43).

When dislocated, the elbow will appear deformed, with the forearm shortened and flexed at 45° degrees, and the olecranon will be prominent (24,25). The mechanism, time of injury, and hand dominance should be noted along with any lacerations. A detailed neurovascular and ipsilateral full extremity examination is warranted, as shoulder and wrist injuries may be found in up to 10% to 15% of cases (10,28,31–33).

DISCUSSION

Reduction Techniques

Before the reduction attempt, the forearm should be placed in a supinated position. This allows the coronoid process to disengage and relaxes the biceps tendon, thereby facilitating the reduction. There are several elbow reduction techniques that have been described in the literature.

The most commonly described technique is traction–countertraction. For this approach, 2 providers are often needed. One provider will apply longitudinal traction on the forearm, while a second provider applies countertraction at the distal humerus (Figure 1) (2,33,44,45). A folded bedsheet may be used to facilitate the countertraction (44). While providing traction with one arm, the other hand may be used to directly manipulate the olecranon to facilitate the reduction (2). When performing this technique, slow and steady pressure should be used to reduce muscle spasm and the risk of injury. Slight elbow flexion or downward flexion on the forearm may be necessary to disengage the coronoid process and facilitate the reduction. It is important to avoid applying pressure directly into the antecubital fossa because the nerves and vessels are more exposed in this area, which can increase the risk of iatrogenic injury. As a result, countertraction is best applied at the middle or distal humerus.

Kumar and Ahmed have suggested that countertraction may be effectively performed by the patient, reducing the risk of muscle spasm or the need for an assistant (46). With this approach, the provider places the supine patient's arm across the chest toward the opposite side, so that the olecranon points upward (Figure 2). The provider then applies in-line traction on the forearm with one hand while the other hand manipulates the olecranon process. The patient's chest wall maintains the flexed position of the elbow joint, while traction is performed.

The leverage technique is an alternate, single-provider approach first described by Hankin in 1984 (47). This technique involves using the provider's forearm as a fulcrum to assist with the reduction in a slow, controlled manner (Figure 3) (44,47). The provider begins by gently supinating the patient's forearm. Then, the provider interlocks his or her fingers with the patient's fingers in a clasping grip. Next, the provider places his or her elbow against the distal portion of the patient's biceps muscle. The provider slowly draws the patient's wrist into flexion using the provider's elbow as a fulcrum. If the patient has a longer forearm length, the provider may grasp the patient's wrist instead of the fingers. During this technique, the provider can use his or her other hand to apply lateral or medial pressure for medial or lateral reductions, respectively. One small

Figure 1. Traction–countertraction technique.

Figure 2. Patient-assisted countertraction technique.

Figure 3. Leverage technique.

Figure 4. Modified Stimson technique.

study found that this technique was more successful than the traction–countertraction technique among 16 patients (44). No complications were identified with either reduction technique (44).

A fourth technique involves a modification of the Simson technique for shoulder and hip dislocations (48–51). For this approach, the patient should be placed in the prone position with the affected upper arm abducted and the forearm placed over the side of the bed (Figure 4). The provider then applies a slow, downward force along the long axis of the forearm, while manipulating the olecranon process with the provider's opposite hand to achieve reduction. This may be performed with 1 or 2 providers. In the latter case, one provider applies downward traction, while a second provider manipulates the olecranon process. One disadvantage of this technique is if procedural sedation is required; this position may limit the provider's ability to monitor the patient's airway and breathing.

Anterior elbow dislocations are much less common than other types of dislocations and require a modification of the technique used for posterior dislocations. For anterior dislocations, the reduction is performed by flexing the elbow and applying a downward force on the proximal forearm instead of the distal humerus (52).

Potential Complications

Many important structures may be affected by elbow dislocation. Associated nerve injury has been noted in 1.4% to 29% of dislocations, most commonly involving the ulnar nerve (2–4,53–56). However, injury to the median and radial nerves has also been reported (2–4,53–56). Most often, the injury is a simple neuropraxia that results from stretching of the nerve, and function returns after the elbow is reduced (3,4,56). It is important to avoid hyperextension during the reduction attempt, because this has been associated with a higher risk of median nerve entrapment (57–59).

Vascular involvement has also been described, most often because of a brachial artery spasm (60–62). Direct injury causing thrombosis or rupture is much less common (60–62). These injuries occur most frequently with open or complex dislocations, reported in <1% of simple dislocations (60–62). Recognition may be difficult because collateral circulation can obscure overt signs of ischemia (61–65). In fact, 10% to 25% of vascular injuries in elbow dislocation retain a radial pulse, so clinicians should remain vigilant and prompt vascular imaging should be obtained if this injury is suspected (61–65).

Compartment syndrome can occur in rare cases and is more common in higher-energy injuries, divergent dislocations, or in association with vascular injuries (10,28,33,65). Fractures in adults typically involve the coronoid, radius, or humeral epicondyles, while the medial condyle is the most common fracture in children (2,4,66).

Long-term sequelae include heterotopic ossification, arthritis, chronic instability, and joint stiffness. The incidence of heterotopic ossification ranges from 3% in simple dislocations to 80% in high-energy polytrauma, but typically does not cause significant symptoms (67–72). Mild chronic instability occurs in ≤50% of cases, but symptomatic instability is rare (4,29,73,74). Osteoarthritis occurs in ≤80% of patients, most commonly in complex dislocations (10,21,37). The likelihood of long-term joint stiffness correlates with the degree of damage and is more common than joint laxity with an average loss of 10° to 15° of extension (4,15,71,73,75).

Long-term outcomes for elbow dislocations are often reported as good-to-excellent, for both children and adults, when using various scoring systems (2,15,74,76). However, 56% to 81% of patients report joint stiffness, 63% report chronic pain, and 8% report elbow instability, while only 19% report no symptoms (2,15,37,74). Ultimately, 2.3% of these cases will require further surgery for chronic instability (8,19,77).

Immobilization and Follow-Up

Upon successful closed reduction, one must repeat a neurovascular examination and obtain radiographs to confirm joint congruency. One should also perform varus and valgus stress testing and assess the joint through a full range of motion with the forearm in the neutral position. For valgus stress testing, the affected elbow should begin in 20° of flexion, with the humerus externally rotated, and the forearm in the neutral position. The provider should palpate the medial joint line. Then, the provider should apply a valgus force (i.e., forearm directed laterally) to the elbow. The varus stress test is performed similarly, but with a medially directed force to the forearm. For both examinations, excessive laxity compared with the contralateral side is considered a positive test.

If gross instability is noted, repeat testing should be performed with the forearm in pronation. Valgus instability suggests MCL injury and may benefit from immobilization with the forearm in supination, while varus instability suggests LCL injury and may benefit from immobilization with the forearm pronated. Elbows with instability at 30° to 45° of flexion, open or complex dislocations, neurovascular injuries, or incomplete reductions require orthopedic consultation for operative repair (11–16,76,78–82). Lateral plain films may show widening of the ulno-humoral space. When the ulnohumeral space is >4 mm wide, this signifies an increased chance for instability and has been termed “the drop sign” (19,83–86). Occasionally, ligaments or bony fragments may prevent reduction and patients will require operative repair (81,87,88). Simple dislocations that remain reduced with minimal or no instability are treated conservatively (33,73–75,89,90).

Traditionally, the arm would be placed in a plaster splint with the elbow at 90° and the forearm in a neutral position for several weeks. Immobilization is important to treat ligamentous damage, reduce pain, and prevent redislocation. However, prolonged splinting may lead to joint fibrosis, stiffness, and disability (32,66–68,90–95).

As a result, recent studies have evaluated early mobilization for elbow dislocations (93–97). Many versions of early or immediate motion therapy, made possible by the inherent stability of the elbow, have been proposed after closed reduction. If the elbow remains completely stabile, some authors have suggested that the arm may be placed in a sling for comfort, and the patient can start immediate range of motion exercises (8,24,93–97). However, others have proposed that all simple elbow dislocations are unstable in the acute setting because the LCL and MCL complexes have been disrupted and, therefore, recommend full splinting (78).

The decision to initiate early mobilization should be made in conjunction with an orthopedic surgeon because joint instability can be subtle (66). Most cases will be splinted at 90° and advised to follow up with an orthopedic surgeon within 72 h (66–68,74,89–95). Splinting for extended periods of time results in increased or prolonged disability, therefore close follow-up is essential (31–34,74,89–93).

CONCLUSIONS

Elbow dislocations are a common upper extremity dislocation that require urgent reduction in the emergency department. While all the above reduction strategies have been used for elbow dislocations, none has been demonstrated to have superior efficacy when compared with the others. Consequently, determining which technique should be performed first depends upon the patient and provider preference. If the first attempt is unsuccessful, the provider should attempt a different technique on the subsequent reduction attempt. Therefore, it is essential that emergency physicians be familiar with several reduction techniques to ensure the best likelihood of successful reduction.

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