Traumatic Elbow Instability

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Trauma can render the elbow unstable via a combination of bone and ligament injuries. Some of these injuries feature subluxation rather than dislocation of the elbow. Effective treatment centers on restoring enough of the bony and ligamentous structures to keep the elbow in joint so that recovery can proceed as for a simple elbow dislocation. Recognition of distinct patterns of injury can help determine the structures injured and the best methods for repairing them. *(J Hand Surg 2010;35A:1220–1225. © 2010 Published by Elsevier Inc. on behalf of the American Society for Surgery of the Hand.)*

Key words Traumatic elbow instability, elbow fracture dislocation, radial head fracture, coronoid fracture, collateral ligament injury.

POSTEROLATERAL ROTATORY INSTABILITY, posteromedial varus instability, and olecranon fracture dislocations of the elbow are patterns of traumatic elbow instability that present as a continuum of injuries from stable simple elbow dislocations to chronic subluxation or dislocation. Each injury mechanism corresponds to specific injured structures, treatment strategies, pitfalls, and prognosis.

ANATOMY OF ELBOW STABILITY

The elbow is an inherently stable joint. The nearly 180° capture of the trochlea in the trochlear notch is tilted somewhat posterior, thereby increasing the anterior buttress of the coronoid process. The trochlea is wide and has a central groove that interdigitates with a ridge in the center of the trochlear notch. The contacts between (1) the anteromedial coronoid facet and the medial lip of the trochlea, and (2) the radial head and capitellum represent the most important stabilizing columns of the elbow.

This inherent bony stability is reinforced by capsuloligamentous structures. The medial collateral ligament (MCL) has been emphasized as the primary stabilizer of the elbow,[1,2] but this is only true for valgus stress, as in throwing athletes.[3] The importance of the MCL may be emphasized because its contribution to elbow stability is much easier to isolate in cadavers.[2,4] Injury to the lateral collateral ligament (LCL) is a consistent feature of traumatic elbow instability, and problems related the LCL are responsible for a large proportion of residual subluxation or recurrent dislocation.[5,6] The LCL and MCL are often referred to as complexes, to emphasize that their contributions to elbow stability are enhanced by adjacent capsuloligamentous, fascial, and musculotendinous structures.[4] The anterior capsule also makes a substantial contribution to elbow stability.[2] Dynamic forces from the muscles that cross the elbow joint provide an important element of stability when other stabilizing structures have been injured.[7,8]

SIMPLE POSTERIOR DISLOCATION (NO ASSOCIATED FRACTURES)

Most posterior dislocations occur through a posterolateral rotatory mechanism. In the act of falling onto an outstretched arm, the hand makes contact with the ground, the elbow flexes slightly, and the body rotates

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internally, causing external rotation of the radius and ulna with respect to the distal humerus. A valgus and axial force is produced on a supinated and externally rotated arm, initiating a cascade of soft tissue injury from lateral (avulsion of the origin of the LCL) to medial both anterior and posterior, with the last structure injured being the anterior band of the MCL. The elbow can dislocate with the anterior band of the MCL still intact, but in most injuries a complete capsuloligamentous disruption occurs with a variable degree of injury to the common flexor and extensor muscles crossing the elbow.[5,9]

EDUCATIONAL OBJECTIVES

- Discuss the anatomy of elbow stability
- State the mechanism leading to elbow dislocations
- Explain the technique of reduction for a simple elbow dislocation
- Define the terrible triad following elbow dislocation
- State the hallmark x-ray finding after varus posteromedial injury
- Describe the drop sign following elbow dislocation and its clinical significance

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Some simple elbow dislocations may occur through a distinct varus posteromedial injury mechanism tearing the soft tissue structures from medial to lateral. A small anteromedial facet coronoid fracture can be a hallmark of this injury mechanism. Based on clinical experience, we speculate that elbow dislocations that occur from medial to lateral may be less stable after manipulative reduction than those that occur from lateral to medial (Fig. 1).

Acute simple elbow dislocations can be reduced under local anesthesia, conscious sedation, or general anesthesia. Manipulative reduction should be accomplished in some flexion because extension risks entrapment of neurovascular structures. Medial or lateral displacement is usually corrected first, and then the elbow is brought forward by pulling the olecranon process toward the trochlea. Varus-valgus stability testing after reduction will not influence management—one expects everything to be torn. The elbow is immobilized as briefly as possible after relocation, definitely no longer than 2 weeks. A slight sagging of the joint (sometimes referred to as the "drop sign")[10] can often be addressed with confident active flexion exercises and avoidance of shoulder abduction (varus stress on the elbow)[11] (Fig. 2). If the elbow redislocates after reduction and splint immobilization, nonsurgical treatment is unlikely to succeed.

Recurrent dislocation of the elbow after manipulative reduction can sometimes be treated reattaching the lateral collateral ligament complex, and sometimes both the lateral and medial collateral ligament complexes, but a static or hinged external fixator or even cross-pinning of the joint (particularly in older, infirm patients) can also be effective. The key is to hold the elbow reduced for about 3 weeks while the soft tissues begin to heal.

DISLOCATION OF THE ELBOW WITH ASSOCIATED FRACTURE

Fracture-dislocation of the elbow is most commonly defined as a dislocation of the elbow with one or more intra-articular fractures. Typically, this refers to dislocation with fracture of the radial head or with fractures of both the radial head and the coronoid process (the so-called terrible triad), but dislocation with fracture of the capitellum and trochlea and with fracture of the olecranon are also seen. Most anteromedial facet coronoid fractures and complex proximal ulna fractures (olecranon fracture-dislocations) feature subluxation, but not complete dislocation of the elbow, and therefore do not fit this traditional definition of a fracture-dislocation.

Some useful principles can help conceptualize the management of fracture-dislocations: (1) Fracture-dislocations should be converted to simple dislocations by repairing or reconstructing the bony stabilizers of the elbow; (2) the initial treatment is important because it can be difficult to salvage subacute and chronic elbow subluxation with damage to the articular surfaces[12]; (3) restoration of motion results from restoration of a congruent stable joint.

ELBOW DISLOCATION WITH FRACTURE OF THE RADIAL HEAD

The studies of Josefson and colleagues and Broberg and Morrey documented that elbow dislocation with fracture of the radial head is associated with a stable elbow in most patients, even if the radial head is excised or not specifically treated.[13,14] Furthermore, patients casted for a month were able to regain functional ulnohumeral motion in most cases, although secondary radial head resection was often needed to restore forearm rotation.

Nonetheless, we usually recommend surgical treatment consisting of repair or replacing the radial head and reattaching the origin of the lateral collateral ligament complex to the lateral epicondyle. Surgical treatment limits later problems related to the radial head