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# Lateral Elbow Instability: Nonoperative, Operative, and Postoperative Management

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**ABSTRACT**: The purpose of this article is to present a treatment approach that has been found to be effective in the early management of lateral elbow instability. Anatomy and joint mechanics related to stability of the elbow are reviewed. Operative and nonoperative treatment is outlined followed by a description of an innovative paradigm for the rehabilitation of elbow instability. Progression of the rehabilitation program as the elbow achieves greater stability is discussed. The authors hope that therapists and surgeons will find this method beneficial in beginning early range of motion for the unstable elbow, thus minimizing joint stiffness while preserving stability at the elbow joint.

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## ELBOW STABILITY

In the normal elbow, the highly congruent joint surfaces in combination with the ligaments and muscle tension provide stability.[1] Stability can further be viewed as having static and dynamic components. The muscles crossing the elbow joint contribute to the dynamic stability by creating a compressive force, while the ligaments, joint morphology, and joint capsule act as static stabilizers (Figure 1A). Tension in the biceps and brachialis resolves a component of a posterior force vector, which is counteracted by the coronoid and radial head creating a joint reaction force (Figure 1B). The ligaments are composed of two separate groups: the medial collateral ligament complex, including the anterior bundle, the posterior bundle, and the transverse bundle, and the lateral collateral ligament complex. The lateral ligament has been described as having four separate components: the lateral ulnar collateral ligament (LUCL), the radial collateral ligament, the annular ligament, and the accessory lateral collateral ligament (Figure 2)[2] Historically, much attention has been devoted to the role of the medial collateral ligament. In recent years, the lateral ligaments have received greater attention because of their role in resisting varus laxity and posterolateral instability.[1–9] Clinically important instability results when any of these structures are injured or disrupted (Figure 3).

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## ELBOW INSTABILITY

Elbow instability is a general term used to describe anything from a dislocation of the ulnohumeral joint to clinically important injury of the varus and/or valgus stabilizers of the elbow, and the radial head.[5,8] Lateral elbow instability can be viewed on a continuum from mild laxity to severe and recurrent dislocation. The soft tissue disruption progresses from lateral to medial and has been described in four stages by O'Driscoll et al.[10] In Stage I, only the LUCL is injured. This results in posterolateral ulnohumeral rotatory subluxation. In Stage II, both the anterior and posterior capsule fail, resulting in a rotatory instability with varus and valgus instability. In Stage IIIA, the injury progresses through the medial collateral ligament and a complete dislocation occurs. Finally, in Stage IIIB, complete disruption of the medial ligament creates a complex instability.[10] The mechanism of injury for elbow dislocation is often from a forceful fall on an outstretched hand. The impact drives the head of the radius into the capitellum of the humerus. This may result in radial head and coronoid process fracture, or medial collateral, posterolateral, and/or lateral collateral ligament disruption.[5,11]

## SURGICAL/MEDICAL MANAGEMENT

Simple dislocations, those without fracture, are usually treated without surgery. The elbow is immobilized in flexion but with protected and often supervised motion beginning within a few days of injury. Regardless of the severity of the dislocation,

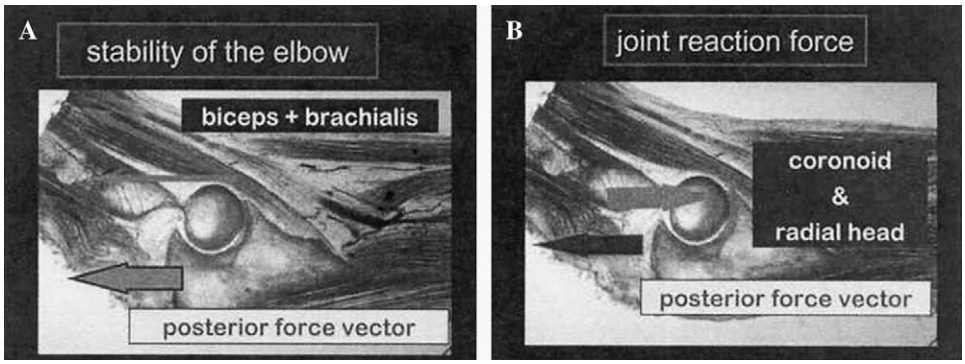


***FIGURE 1.*** *(**A**) Tension in the biceps and brachialis muscles creates a posterior vector force. (**B**) The posterior force vector is counteracted by the coronoid and radial head, creating a joint reaction force. (Reprinted with permission; from diagram of Robert N. Hotchkiss).*

our initial preferred immobilized position is in a thermoplastic posterior elbow immobilization splint with the elbow positioned in 90–120° of flexion and the forearm in pronation. The length of immobilization time will vary depending on the level of stability. This is described in detail in the postoperative management later in this article.

For more complex dislocations with fracture, surgical treatment may be needed, including primary repair of the posterolateral ligament, open reduction internal fixation to the radial head, titanium radial head replacement, and open reduction internal fixation of the coronoid and proximal ulna.[5,12] Radial head excision versus radial head replacement is dictated by the degree of comminution, the experience of the surgeon, and the perceived need for immediate load-sharing at the radiocapitellar joint.[13–16] The titanium head replacement has been used effectively to assist in restoration of stability after excision of a comminuted radial head fracture.[6,15,17] In this situation, the lateral ligament complex is also repaired. The location of the ligament tear is usually at the humeral insertion. In most cases, a strong, nonabsorbable locking, running suture can be passed through drill holes in the humerus after securing the distal portion of the ligament. This suture is then secured down to bone, making certain that the tension is optimal. The anterior capsule, especially distally, is then imbricated to the reattached posterior ligament complex.

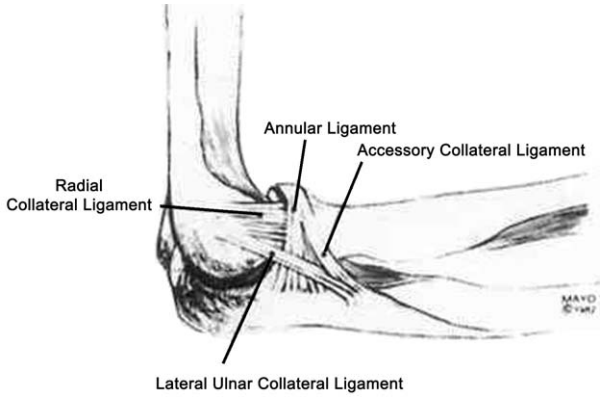


***FIGURE 2.*** *The lateral ligament complex of the elbow (Reprinted, with permission of the Mayo Foundation, from Morrey BF. The Elbow and Its Disorders. 2nd ed. Philadelphia, PA: WB Saunders, 1993).*

## THERAPIST'S MANAGEMENT

The treatment guidelines discussed in this section can be applied to both surgically and nonsurgically managed unstable elbows. Our guide for progressing treatment is based on the stability of the elbow. This is determined by the expected sequence of physiological healing of the repaired or injured structures. Early treatment is directed at maintaining stability and achieving a limited arc of motion, while the injured structures are healing. Protected range of motion (ROM) exercises are performed to prevent joint stiffness and augment healing. It is well documented that early motion nourishes the cartilage and enhances soft tissue healing.[18] ROM is gradually progressed avoiding any subluxation or instability. Strengthening exercises commence once stability and motion have been achieved.

## PHASE I: INFLAMMATION/ PROTECTION (WEEKS 0–3)

The challenge facing surgeons and therapists in the rehabilitation process is, How do we successfully initiate early ROM to avoid joint stiffness without jeopardizing the stability of the elbow joint? Traditionally, the unstable elbow was immobilized until adequate stability had been achieved at four to five weeks postinjury, and ROM exercises commenced at that point. In our experience, this resulted in significant limitations in both forearm supination and elbow extension. We have developed a treatment plan, which allows for early motion while protecting the stability of the joint. Postoperative management

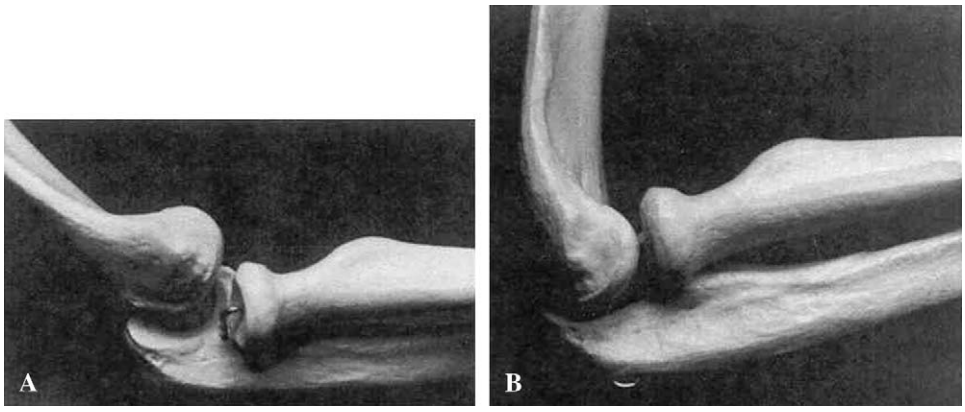


***FIGURE 3.*** *Lateral photograph of the elbow skeleton. In cases of posterolateral rotatory instability, the radial head lies posterior to the capitellum and the lateral aspect of the ulnohumeral articulation is widened. Supination, valgus, and compressive force applied to the elbow in extension will cause this pattern of subluxation following injury to the lateral ulnar collateral ligament (**A**). Gradual flexion of the joint will result in reduction of the radius and ulna onto the humerus (**B**) (Reprinted from Hunter, et al. Rehabilitation of the Hand and Upper Extermity, Vol. 1, 5th ed, Philadelphia, PA: Elsevier, 2002.)*

begins as early as two days following surgery and involves splint fabrication and protected ROM exercises. The treatment goals during this phase are twofold: 1) maintain stability of the elbow and 2) begin early protected motion in a safe overhead position to avoid joint stiffness. Nonoperative management begins as soon as the joint is immobilized in a stable position. The position of immobilization and the protected ROM exercises are the same for both operative and nonoperative treatment; therefore, there is no distinction made in the therapeutic intervention discussed in this article.

## SPLINT FABRICATION AND MANAGEMENT

The treatment plan begins with fabrication of a custom thermoplastic posterior elbow splint with the elbow positioned in 120° or more of flexion and the forearm in full pronation (Figure 4). In this position, the radial head is approximated against the coronoid and is more stable. The pronated position of the forearm protects the lateral ligament from stress. The wrist is included and splinted in neutral to relax the proximal wrist muscular attachments and to increase patient comfort. In larger framed and obese individuals, it may be difficult to achieve and maintain the elbow in the desired degree of flexion. A figure-eight strap may be added to stabilize the elbow within the splint (Figure 5) . Another option is to add thermoplastic or Velcro struts to the proximal and distal portions of the splint. The splint is worn at all times and removed three to five times daily for protected exercises. The elbow must be in 120° or more of flexion to ensure approximation of the radial head. If this is not achieved, an instability may occur (Figure 6). An alternative to the thermoplastic splint, and a preference of some surgeons, is a Bledsoe brace (Bledsoe Brace Systems, Grand Prairie, TX) or the Mayo elbow universal brace (Aircast, Summit, NJ). The brace is locked in 120° of elbow flexion with the forearm in pronation. A prefabricated neoprene forearm pronation/supination splint is worn with the splint to position the forearm in pronation in the brace. The

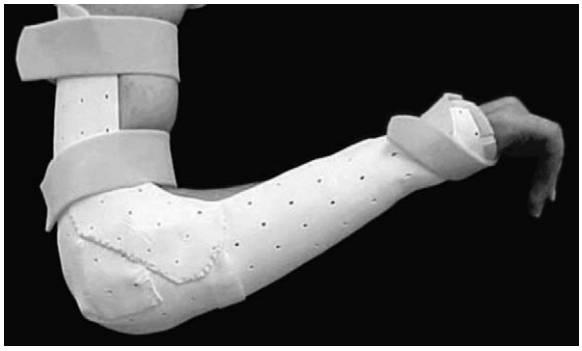

***FIGURE 4.*** *Posterior splint—position of stability.*

***FIGURE 5.*** *Figure-eight strap to secure elbow in splint.*

***FIGURE 6.*** *Radial head subluxes posteriorly if joint is not approximated.*

brace is worn at all times, and exercises are performed within a protected range with the brace on. Some surgeons immobilize the elbow in 90° of flexion if adequate stability was achieved intraoperatively.

## THERAPEUTIC EXERCISES

Usually, by the second postoperative day, the patient is instructed in two exercises. Early protected ROM exercises are performed in a supine overhead position with the shoulder flexed to 90° to decrease the effects of gravity by minimizing posterior vector forces at the elbow. This places the elbow in a stable position while allowing early motion to avoid joint stiffness (Figure 7). In this position, the triceps can function as an elbow stabilizer. It is extremely important for the patient to be instructed in the proper

***FIGURE 7.*** *Overhead stable position for radial head.*

position for this exercise. When coming into the overhead position, the shoulder is held in adduction and neutral to external rotation. The arm should not be allowed to cross midline. Internal rotation and abduction of the shoulder places varus stress on the repaired or injured lateral ligament and increases the risk of redislocation. In the supine position with the shoulder in 90° of forward flexion and forearm maintained in pronation (forearm resting on forehead), gentle active assisted supination and pronation is performed (Figure 8). The second exercise is performed in the same position. The shoulder is placed in 90° of forward flexion and the elbow in 90° or more of flexion. The forearm is held in full pronation. Gentle active and active assisted elbow flexion to full range and elbow extension is performed as tolerated not to exceed 30° (Figure 9). It is important to recognize that the exercises and treatment are custom tailored to the individual injury based on the level of instability. An elbow that is considered to be stable may be permitted to extend beyond 30°. Conversely, an elbow that is very unstable may be allowed less than 30° extension.

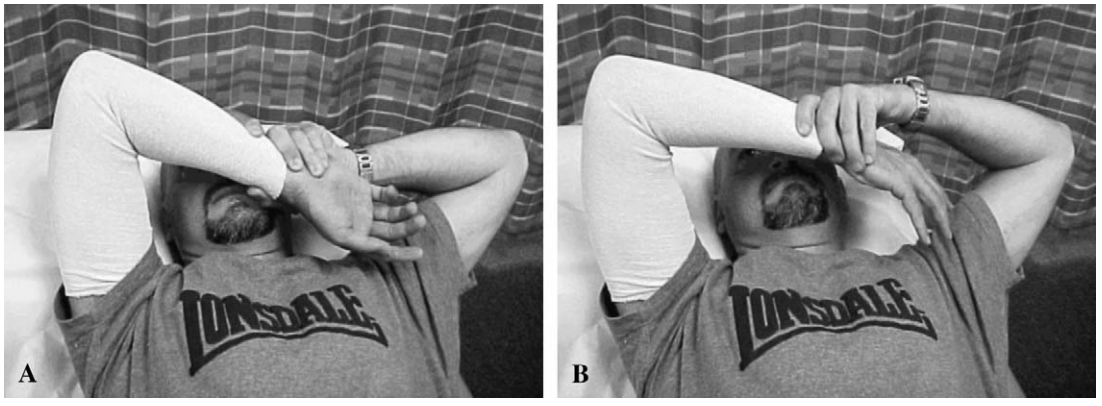


***FIGURE 8.*** *Supine overhead protected forearm pronation (**A**) and supination (**B**).*

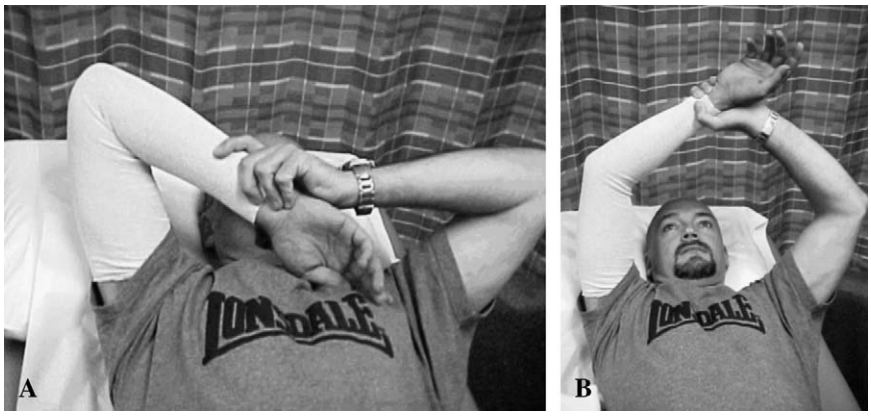

***FIGURE 9.*** *Supine overhead protected elbow flexion (**A**) and extension (**B**).*

Elbow stiffness is common after elbow trauma. Maintaining the balance between mobility and stability is a constant challenge during this phase. Successful treatment of this injury requires diligence, expertise, skill, and ongoing communication with the referring surgeon. Compliance and accuracy with the home program are paramount to achieving good results. In rare instances, the joint may be unstable even in the overhead position. When this occurs, the surgeon and therapist determine together how to proceed. In some situations, motion may be delayed until some degree of stability is achieved. We have found that even in highly unstable elbows, a small arc of motion performed passively in the clinic by the therapist several times a week is necessary to prevent significant ROM loss. Surgically applied dynamic hinged fixation may be indicated in cases of extreme instability.

## PHASE II: FIBROPLASTIC/EARLY REMODELING (WEEKS 3–6)

Phase II of therapy commences as soon as joint stability is achieved. This is often achieved by the third or fourth week in both operative and nonoperative dislocations. The stability of the joint is assessed and determined by the referring surgeon. The splint is remolded to a position of 90° of flexion and neutral forearm rotation. The protected (supine-overhead) ROM exercises are replaced by active and active assisted elbow and forearm ROM in sitting or standing within the safe prescribed arc. This will differ in each patient depending on the level of instability. Elbow flexion and extension are performed with the shoulder resting on a towel roll against a wall, and the forearm positioned in neutral rotation. The shoulder is positioned in slight external rotation to avoid stress on the lateral ligament. Forearm ROM is performed with the arm at the side and the elbow flexed to 90°. Combined elbow extension and supination is the unstable position, and is therefore avoided until clearance is received from the physician. Likewise, passive elbow extension and passive forearm supination are avoided. Scar management in the form of scar massage and silicone gel sheets is added once the incision is fully closed and sutures or staples have been removed. Manual edema mobilization[19] and soft tissue mobilization[19] techniques are effective in reducing elbow edema. Gentle wrist strengthening (1–2 lb) and grip strengthening begin at four weeks. Specific strengthening activities include weight well, putty, and hand helper exercises.

Elbow stiffness continues to be a challenge during this phase. Specific treatment strategies are discussed in the article addressing contracture release. Occasionally, instability persists postsurgery for longer than the usual three to four weeks. In those situations, the progression of treatment is modified and/or delayed until further instructions from the physician.

## PHASE III: SCAR MATURATION (WEEKS 6–12)

The goals in this phase are to achieve maximum ROM, increase strength and endurance, and resume normal activity. There are no longer precautions that limit motion. If stiffness persists, capsular stretching, soft tissue mobilization, joint mobilization, and low-load prolonged stretch via static progressive splints are used. Graded strengthening begins when the elbow joint is stable and the soft tissue is healed. Isometric exercises are progressed to progressive resistive exercises: elastic bands, pulleys, and free weights. Functional retraining and work conditioning are performed in this phase. Full upper extremity and core stabilization strengthening exercises are used (if needed). Proximal shoulder strengthening, particularly external rotation, exercises are important to avoid posturing in internal rotation and abduction, thus adding stress to the lateral ligament complex.

Persistent pain that does not respond to conservative treatment may be indicative of a more serious complication, particularly when accompanied by loss of motion. Any unusual symptoms are reported to the physician. Complications associated with radial head dislocations have been reported in the literature and include infection, redislocation, and prosthetic failure.[20,21]

## CONCLUSIONS

Elbow instability is a complex pathology that remains a challenge for both surgeon and therapist. With vigilance, ongoing monitoring, and constant communication between surgeon, therapist, and patient, these injuries can be managed to restore sufficient stability to allow early motion and enhance functional outcome. Several studies review functional outcomes in patients with unstable elbow fractures. Harrington et al.[21] reported the long-term results of 20 patients with metallic radial head implants for the treatment of radial head fractures associated with gross instability of the elbow. They report excellent to good results using a modified Mayo Clinic functional rating index system.[22] The average follow-up was 12 years.[21] Pugh et al.[23] reviewed results in 36 elbows with an elbow dislocation and an associated radial head and coronoid fracture. The injuries were managed with standard surgical protocol to provide sufficient stability, and motion was allowed at seven to ten days postoperatively. The mean follow-up was three years. They report a Mayo Elbow Performance Score mean of 88 points, which corresponds to good to excellent.[23,24] It appears that elbow dislocations can be and have been treated successfully with proper reduction and surgery and supervised early motion. Further studies are required to establish outcomes for specific rehabilitation techniques.

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## Quiz: Article #031

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#1. Posterolateral stability/instability of the elbow is controlled primarily by the:
   a. annular ligament
   b. LUCL
   c. anterior capsule
   d. muscle–tendon units crossing the joint

#2. Following "simple dislocation" of the elbow:
   a. plaster immobilization is indicated for four weeks
   b. strengthening is the focus of therapy
   c. early motion is contraindicated
   d. early motion is indicated

#3. Following surgical repair of a complex elbow dislocation, therapy:
   a. includes plaster immobilization for four weeks
   b. includes early strengthening
   c. focuses on protected ROM
   d. includes end-range dynamic splinting starting at 14 days post-op

#4. Splinting following surgical repair of a complex elbow dislocation should position the elbow in about:
   a. 120° with full forearm supination
   b. 120° with full forearm pronation
   c. 90° with the forearm in neutral rotation
   d. 40° with the forearm in neutral rotation

#5. In the third to sixth week post-op period following surgical repair of the unstable elbow, active range of motion is performed:
   a. with the patient sitting or standing
   b. with the patient prone
   c. in proprioceptive neuromuscular facilitation (PNF) patterns
   d. with gravity eliminated

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