Acute Elbow Dislocation and Instability: Update on Diagnosis and Management

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ABSTRACT
Nonsurgical treatment is the most common approach for simple elbow dislocations. After reduction, careful clinical evaluation to identify injured stabilizers is essential. In selected cases, ligament repair or reconstruction is indicated. Outcomes are generally predictable, with restoration of a functional elbow and a low complication rate. The objective of this article is to provide an update on the diagnostic and therapeutic management of acute elbow dislocations.
Keywords: Elbow dislocation; elbow instability; elbow; medial instability; lateral instability; posterolateral rotatory instability.
Level of Evidence: V

Luxación e inestabilidad aguda de codo

RESUMEN
El tratamiento incruento es el más frecuente para la luxación simple de codo. Luego de la reducción de una luxación de codo, es importante la evaluación clínica y el diagnóstico de los estabilizadores lesionados. En algunos casos, se impone la cirugía de reparación o reconstrucción ligamentaria. Los resultados suelen ser previsibles, se logra un codo funcional y la tasa de complicaciones es baja. El objetivo de este artículo es presentar una puesta al día del manejo diagnóstico y terapéutico de las luxaciones agudas de codo.
Palabras clave: Luxación de codo; inestabilidad de codo; codo; inestabilidad medial; inestabilidad lateral; inestabilidad rotatoria posterolateral.
Nivel de Evidencia: V

INTRODUCTION

Elbow dislocations account for 20% of all joint dislocations and are the second most common in the upper limb after the glenohumeral joint. They are more frequent in males between 10 and 20 years of age.

Acute elbow instability (traumatic dislocations) and chronic instability are easier to understand—and therefore better treated—when the interaction among the joint's stabilizing structures is well known. For elbows that remain stable after reduction, nonoperative care is the accepted treatment. Nevertheless, there is ongoing controversy regarding the mechanisms of injury, duration of immobilization, and surgical techniques.

The aim of this article is to provide an update on the diagnostic and therapeutic management of acute elbow dislocations.

Elbow Range of Motion

The anatomic ("normal") flexion–extension arc ranges from 0° to 140° (±10°), taking 0° as full extension. The functional arc required for most activities of daily living is 30° to 130°.[1] Pronation and supination are normally about 75° and 85°, respectively; a functional arc of 50° in each direction is usually sufficient.

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Elbow Stability

Stability is provided by osseous, capsuloligamentous, and muscular components. Soft tissues and articular surfaces contribute in similar measure. [2]

The lateral collateral ligament complex (LCLC) maintains relatively uniform tension throughout the flexion–extension arc. The anterior bundle of the medial collateral ligament (ulnar collateral ligament, UCL) is commonly described as having anterior and posterior portions: the anterior portion tightens in extension, whereas the posterior portion tightens in flexion, so one or the other contributes to stability across the arc.

It is useful and didactic to compare the elbow's stabilizers to a fortress whose defenses must be breached to create instability, as proposed by O'Driscoll et al.[3]

Stabilizers are divided into primary, secondary, and dynamic. Primary stabilizers are the humeroulnar joint, the UCL, and the LCLC—particularly the lateral ulnar collateral ligament (LUCL). Secondary stabilizers are the radial head, the origins of the common flexor and common extensor muscles (medial and lateral), and the joint capsule. Dynamic stabilizers are the muscles crossing the elbow, which generate compressive forces.

An elbow is stable when all of these structures are intact. Injury to any stabilizer determines the pattern of instability and the compensatory role of remaining intact structures. For example, with a coronoid fracture, a primary stabilizer as part of the humeroulnar articulation, the radial head becomes especially important and should be preserved in the setting of a fracture-dislocation.

CLASSIFICATION OF ELBOW DISLOCATIONS

Several parameters have been proposed to classify them, such as:

1. Direction of displacement: varus, valgus, anterior, or posterolateral.
2. Degree of displacement: complete or incomplete (perched).
3. Chronicity: acute, chronic, or recurrent.
4. Associated fractures: simple or complex.

Two classifications guide treatment: simple vs complex (absence or presence of associated fractures) and complete vs incomplete (perched), the latter based on a true lateral radiograph showing the humerus entirely anterior or perched on the coronoid (Figure 1).

Common acute instability patterns, by region involved, include posterolateral rotatory instability (PLRI), valgus instability, and posteromedial rotatory instability (PMRI).

Figure 1. A. Lateral elbow radiograph. Complete dislocation. **B.** Lateral elbow radiograph. Incomplete or perched dislocation. **C.** Sagittal CT of the elbow. Detail of a perched (incomplete) dislocation.

According to several authors, posterolateral rotatory instability is the most common type,[4-6] and may present as dislocation, fracture–dislocation, or fracture–subluxation. Acute subluxations are often missed after trauma; a small flake from the coronoid tip may be the only clue. These fractures result from trochlear loading on the coronoid. If a coronoid fracture measures >2 cm on a lateral radiograph, CT should be obtained because such injuries can evolve to varus posteromedial rotatory instability, which is associated with early elbow osteoarthritis.

Acute valgus instability can follow trauma or chronic valgus overload. When traumatic, it involves the UCL and is often associated with a radial head fracture.

Varus posteromedial rotatory instability has been more recently described and represents the end stage of PLRI during axial loading with the elbow flexed. It is associated with lateral ligament injury and anteromedial facet fracture of the coronoid.

CLINICAL EVALUATION

In elbow dislocation, a thorough assessment of the affected limb (shoulder, elbow, forearm, wrist, and hand) is required to identify associated injuries, along with a neurovascular examination (median, ulnar, and radial nerves). Compare pulses with the contralateral side and examine soft tissues for abrasions and open wounds.

Standard AP and lateral elbow radiographs are generally sufficient initially. CT helps delineate fractures. MRI is seldom obtained in the acute phase; we reserve it for later, once treatment has begun, to characterize soft-tissue injuries (Figure 2).

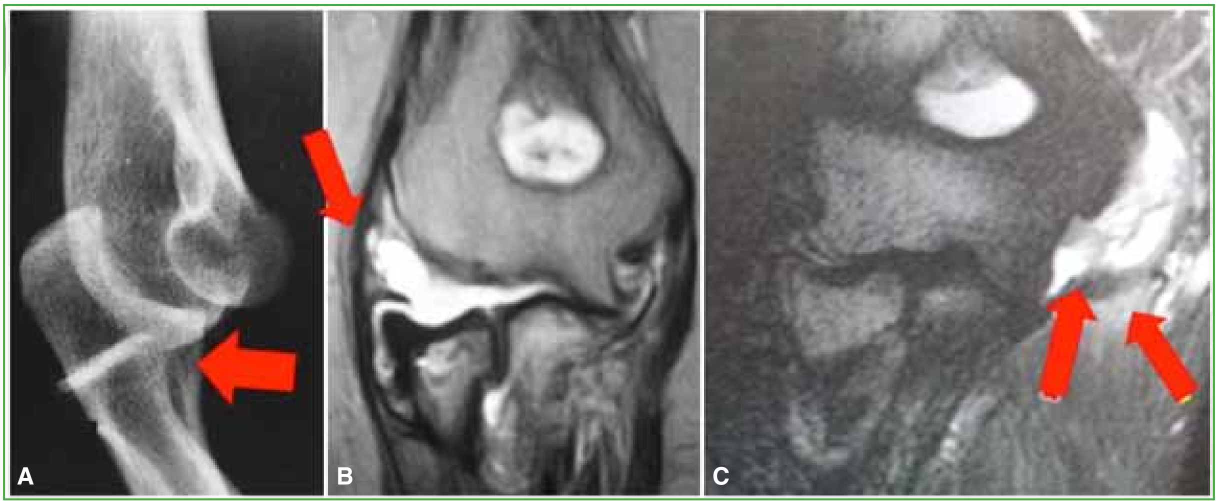

Figure 2. A. Lateral elbow radiograph showing the radial head positioned below the capitellum during a *pivot-shift* maneuver in PLRI. **B.** Coronal elbow MRI. Avulsion of the lateral ligament complex. **C.** Coronal MRI of the left elbow. Avulsion of the medial ligament complex.

MANAGEMENT OF ACUTE DISLOCATIONS

Following clinical and radiologic assessment, closed reduction is the primary goal and should be performed as atraumatically as possible. Reduction under anesthesia avoids certain complications.

The key maneuver is to disengage the coronoid from behind the trochlea, typically by combining forearm supination and elbow extension while applying anterior force to the olecranon. Fluoroscopic control is useful to confirm a concentric reduction and to assess for intra-articular fragments.

Next, assess range of motion and perform stress testing to evaluate post-reduction stability. Document the extension angle at which the elbow tends to subluxate or redislocate; this defines the allowable extension limit during rehabilitation. If ≥90° of flexion is required to maintain reduction, the elbow is unstable and surgical repair is likely indicated.

Radiographs may show avulsions, capitellar impaction (the Osborne–Cotterill lesion),[7] and cubitohumeral subluxations. These injuries may occur after dislocation due to interposed soft tissue or bone, joint hematoma, or muscle atony or tear (e.g., brachialis).

An increased humeroulnar distance on a lateral radiograph (the *drop sign*) immediately post-reduction may indicate greater instability; in one series, 20% with this finding required ligament repair.[8]

Even if the elbow appears stable after reduction, we immobilize it and confirm maintenance of reduction on radiographs. If congruent, we continue immobilization (splint or cast). At 7–10 days, we re-evaluate. If the elbow subluxates in extension, a pronated position with a 30° extension block can be used; however, if >30–45° of extension block is needed to maintain a congruent reduction radiographically, surgical treatment should be considered. If stable, immobilization is continued for 3 weeks, followed by re-evaluation in the same fashion.

When stability is maintained in the acute phase, a shorter immobilization period improves prognosis.

The elbow is also examined for valgus, varus, and posterolateral rotatory instability. Valgus stress is tested with the forearm fully pronated and the elbow extended to avoid mistaking PLRI for valgus instability (medial soft tissues in pronation act as a hinge to prevent lateral dislocation). Varus stress is tested with the shoulder internally rotated and the elbow extended, then at 30° of flexion to unlock the olecranon from the fossa. *Pivot-shift* and posterolateral drawer tests are also useful.

When there are major soft-tissue injuries (ligaments, capsule, muscle masses), the elbow may remain dislocated even beyond 90° of flexion. In these markedly unstable cases in which reduction cannot be maintained, external fixation may be indicated. [9]

RESULTS OF NONOPERATIVE TREATMENT OF ACUTE DISLOCATIONS

For a stable elbow after reduction, nonoperative treatment remains the standard. Three weeks of immobilization followed by exercises generally yields functional results for most activities of daily living, with some moderate extension stiffness and a low instability rate (<2%). Some authors immobilize for one week instead.

Maripuri et al. reported better outcomes (higher MEPS, lower DASH scores, shorter therapy, and quicker return to work) using a sling and early motion compared with two weeks of immobilization. They concluded that prolonged immobilization correlates with greater stiffness and worse function. [12]

It is important to note that, after nonoperative care of simple dislocations (not fractures), the main complication is stiffness or restricted range of motion, not instability. To mitigate this, we favor early mobilization.

Complex Dislocations

A dislocation is complex when fractures are present. The forces causing dislocation also injure bone, most commonly the coronoid and the radial head. Given their key stabilizing roles, careful evaluation and appropriate treatment are essential.

Management depends on fragment size and displacement. For radial head fractures, options include nonoperative care, partial fragment excision in select cases, screw or plate fixation, and prosthetic replacement. Complete radial head excision is contraindicated in the presence of instability because it worsens instability.

For coronoid fractures, options include nonoperative care; anterograde or retrograde fixation for large fragments; bone grafting for irreparable defects; and anterior capsular plication onto a raw coronoid surface when only small fragments are present.

Surgical Treatment of Acute Dislocations

After reduction, the rate of instability is low in simple dislocations (2%).[13,14]

Indications for surgery include: instability after reduction with/without associated fractures; recurrent subluxation or dislocation unless prevented by forced flexion; recurrent instability after immobilization; open dislocations; and vascular injury.

Surgical Technique

Lateral Approach

The patient is supine with regional anesthesia (or combined with general). Prepare and drape sterilely; if reconstruction is anticipated, prepare the graft harvest site. Fluoroscopy is helpful: assess for medial joint opening with valgus stress in forearm supination and lateral opening with varus stress. On dynamic lateral fluoroscopy, progressively extend to the point of dislocation and assess lateral ligament insufficiency. In our experience and that of many authors, most patients require lateral repair; fewer need medial repair. Apply a tourniquet after exsanguination. A lateral skin incision is made beginning 2–3 cm proximal to the lateral epicondyle and extend distally and obliquely toward the subcutaneous border of the proximal ulna. The Kocher interval between the posterior ulnar (*extensor carpi ulnaris)* and the anconeus muscle is then identified. The fascia over the interval is incised with a scalpel. The anconeus is elevated from the lateral collateral ligament at the distal interval to differentiate the muscle from the ligament complex, which in chronic cases may be thinned or attenuated. Next, the anconeus is reflected posteriorly to expose the proximal ulna at the level of the supinator crest. The anterior ulnar muscle is detached and reflected anteriorly from the lateral ligament complex. Once the ligament is exposed, an assessment is made as to whether ligament repair or reconstruction will be performed. In general, when the fascia is opened, avulsion of the lateral ligament complex of the lateral epicondyle is observed to varying degrees. Tears of the epicondylar muscles may also be seen. Tear of the insertion from the ulna is rare (Figure 3).

Ligament repair. In acute injuries with suitable tissue, we reinsert the capsuloligamentous complex and extensor origin to the distal humerus using strong sutures, typically with one or two double-loaded suture anchors. Tie sutures with the forearm in pronation and the elbow in valgus. Multiple high-strength sutures are passed to capture the collateral ligament, capsule, and extensor mass as needed. Transosseous sutures to the distal humerus are an alternative. Place anchors at the isometric point or slightly anterior/proximal; posterior/distal placement may facilitate instability (most evident in extension). After repair, reassess stability through the arc. For simple dislocations that remain unstable, lateral repair alone is usually sufficient. If medial instability persists, repair the medial side via a separate approach with ulnar nerve protection (see Medial repair and reconstruction). Identify and reattach the anterior band of the UCL with the flexor–pronator origin as indicated.

Ligament reconstruction. Some recommend reconstruction even acutely; we reserve it for chronic cases or insufficient tissue. After exposure, debride the epicondylar footprint and elevate a portion of the common extensor and triceps origins to expose the distal humerus for tunnel creation.

Many surgeons leave remaining capsuloligamentous tissue interposed between graft and joint; others resect it.

Graft options include palmaris longus, semitendinosus, or allograft flexor tendons. Prepare the ends with high-strength Krackow sutures.

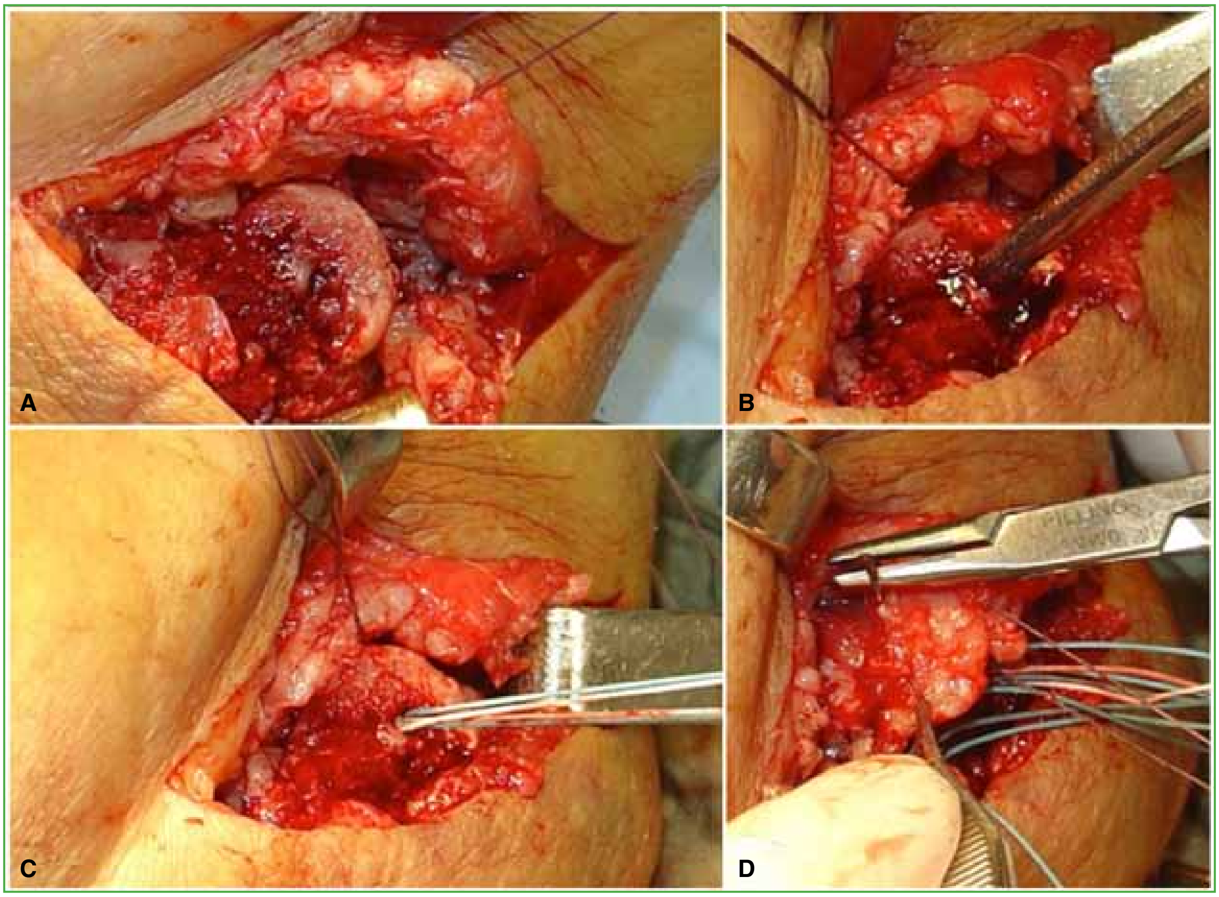

Figure 3. Lateral repair for complete tear/avulsion. **A.** Denuded distal humerus. **B.** Placement of a lateral suture anchor. **C.** Detail of double high-strength sutures. **D.** Reinsertion of the lateral ligament complex.

Drill two ulnar tunnels (3.5 mm burr): one at the proximal supinator crest or radial neck region, and a second 1–2 cm proximal to the first near the base of the annular ligament. Maintain at least a 1 cm bone bridge to avoid fracture.

Connect the tunnels with a curette. In the humerus, drill a 4.5 mm tunnel at the isometric point (near the capitellar center of rotation at the tip of the lateral epicondyle; slightly anterior/proximal placement can help maintain tension).

Create two additional 2 mm tunnels anterior and posterior to the superior epicondyle and connect them to the main anterior tunnel, again preserving a 1 cm bone bridge.

Use a suture passer to shuttle the graft through the ulnar tunnels. Seat both graft limbs into the humeral anterior tunnel and retrieve the traction sutures posteriorly through the two small tunnels; tie the sutures with the elbow at 90° flexion, maximal pronation, and slight valgus. Check graft tension in extension; side-to-side sutures between the graft limbs can increase tension (Figure 4).

Release the tourniquet, achieve hemostasis, and close in layers.

Immobilize in a posterior splint at 90° flexion and full pronation. Alternatives include hinged braces with extension limits or external fixation.

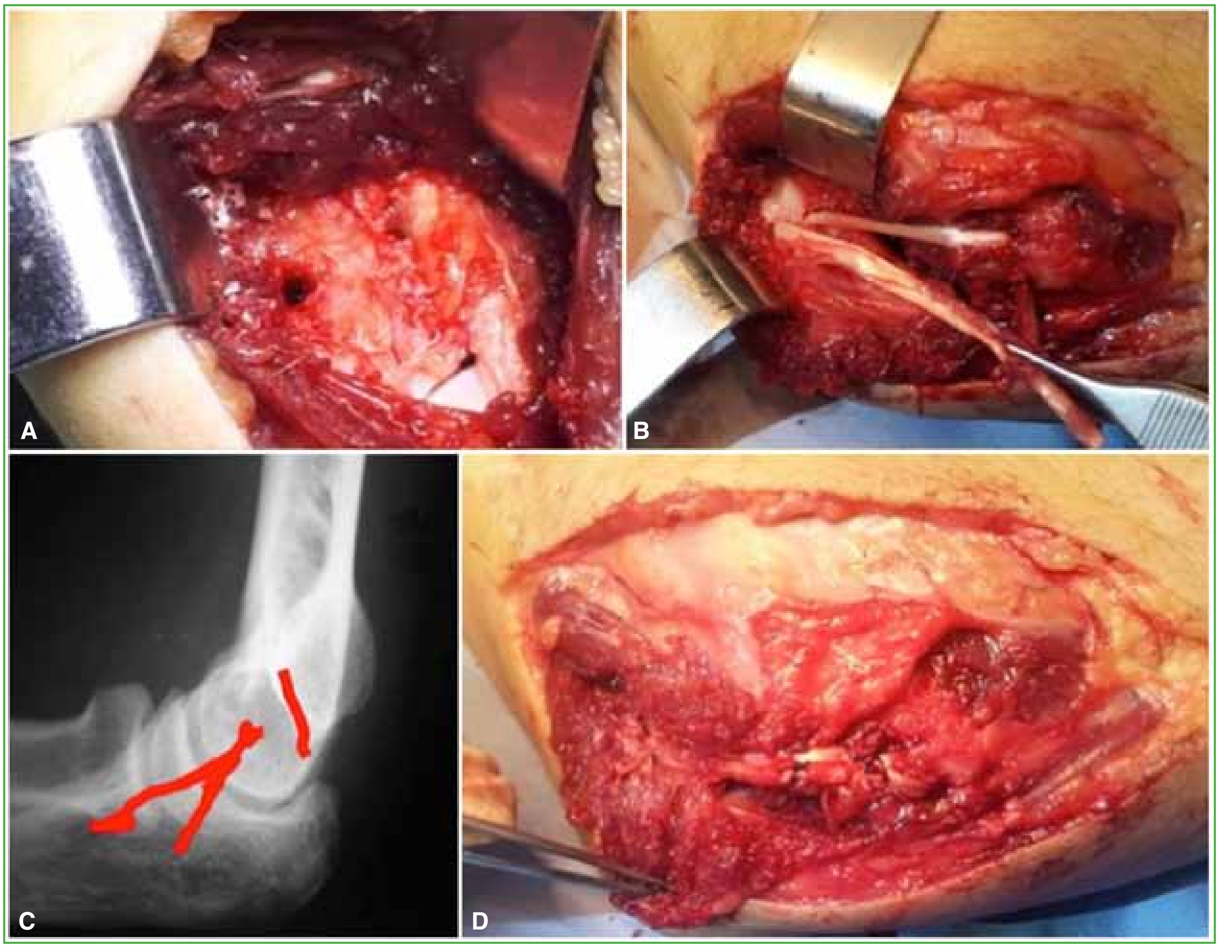

Figure 4. Lateral reconstruction. **A.** Transosseous tunnels. **B.** Passage of the tendon graft through ulnar tunnels. **C.** Passage of the graft through the distal humerus (red lines represent the graft). **D.** Final suture of the lateral reconstruction.

Postoperative Management

Immobilize in a splint or brace at 90° flexion and pronation for 2 weeks. Begin flexion–extension while maintaining pronation; limit extension to 30° initially and progress to full extension by 4 weeks. Flexion is not restricted. At 2 weeks, start forearm rotation with the elbow at 90°; avoid supination in extension until 6 weeks. Discontinue immobilization at 6–8 weeks (often converting the splint at 2 weeks) when full motion is allowed. Resistive/strengthening exercises begin at 12 weeks. Unrestricted activity is permitted at 6–9 months.

Medial Repair and Reconstruction

If reconstruction is planned, confirm the presence of a palmaris longus (have the patient oppose thumb and little finger while flexing the wrist against resistance). If absent, options include the contralateral palmaris or semitendinosus; we have also used flexor tendon allografts. Anesthesia may depend on graft choice. Position supine with the shoulder abducted and externally rotated. Make a curved medial incision centered at the elbow. Identify the medial antebrachial cutaneous nerve and protect it within the skin flap.

Identify the ulnar nerve proximally, releasing the cubital tunnel (epitrochlear–olecranon groove) distally. Distal to the tunnel, incise fascia over the two heads of the flexor carpi ulnaris (FCU); the ulnar nerve lies between them. Harvest autograft first if used.

Expose the distal medial UCL insertion on the proximal ulna by elevating FCU from the medial epicondyle to ~5 cm distal to the sublime tubercle. Assess tissue quality and lesion type. In acute injuries with good tissue, reattach the capsuloligamentous complex to the medial distal humerus with suture anchors; reattach the flexor–pronator origin if avulsed.

For reconstruction, drill two convergent 3.5 mm tunnels just distal to the margins of the sublime tubercle, separated by 1 cm, and connect with a curette. Pass the graft through the ulnar tunnel.

At the humeral origin of the anterior band of the UCL, drill the larger anterior tunnel to receive both graft limbs. Connect it to two posterior tunnels in a Y-configuration. Assess tension with the forearm in supination and trim excess graft. Pass both limbs (Krackow traction sutures) into the anterior tunnel and retrieve each limb through a posterior tunnel (docking technique).[15]

Repair residual capsule/tendon over the graft. Tension by pulling across the posterior bone bridge and tie the sutures together. Release the tourniquet, achieve hemostasis, and close in layers (Figure 5).

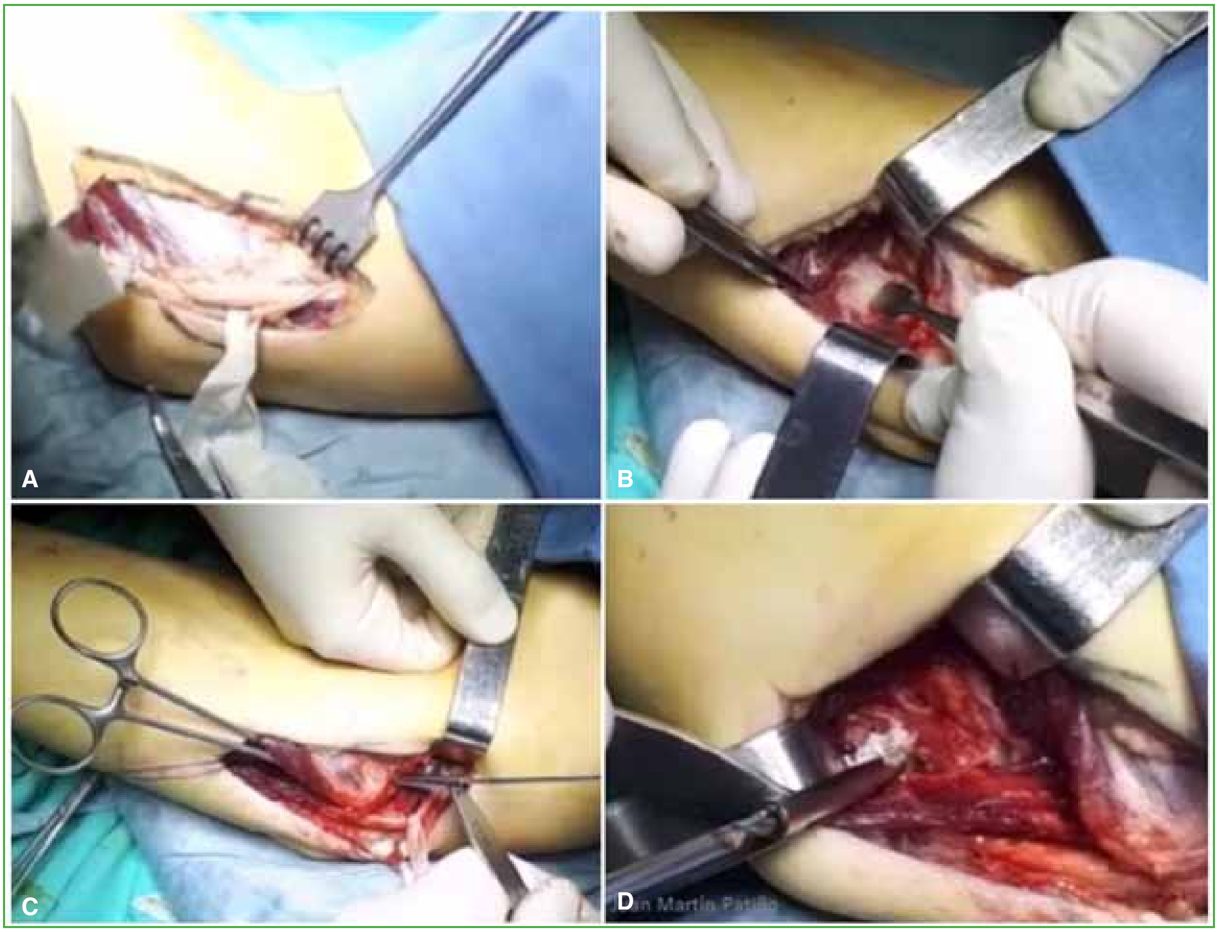

Figure 5. Medial ligament reconstruction. **A.** Identification and protection of the ulnar nerve. **B.** Curettage of the proximal ulna before drilling. **C.** Bone tunnel drilling in the distal humerus. **D.** Bone tunnel drilling in the proximal ulna.

Postoperative Management

Apply a posterior splint with the elbow at 90° flexion and the forearm supinated. At 14 days, begin flexion–extension while limiting varus–valgus stress and maintaining supination. Initiate full range of motion at 6–8 weeks. Begin strengthening at 12 weeks. Graduated return to sport occurs between 4 and 6 months, once a functional arc and adequate strength are achieved.

Results of Surgical Treatment

In one series, 13 patients underwent primary repair for subluxation after reduction with an incongruent joint requiring a 45° extension block to maintain reduction. One had isolated medial repair, two had isolated lateral repair, and ten had combined repairs. Mean MEPS was 93.5 (range 70–100); all elbows were stable with a mean 13° flexion contracture and 15° loss of extension.[16]

In another evaluation of 21 patients treated via a lateral approach (only four also had medial repair if instability persisted), immobilization lasted one week; mean follow-up was 15 months. All elbows were considered stable, with mean flexion 121°, mean extension loss 6.8°, and mean MEPS 91.[17]

In a further series of open lateral repairs (sutures or anchors) after acute PLRI, all elbows were stable with mean flexion 120°, extension loss 13°, and mean MEPS 86.9. Eighteen results were good/excellent and one fair; two patients had signs of instability with moderate pain.[9]

Some authors report that repair alone may be insufficient due to a 42% recurrence rate, and have used hinged external fixation, transarticular pins, or hinged braces limiting extension.[11]

Arthroscopic techniques are an option: in a series of 14 athletes treated arthroscopically after acute/subacute dislocation with suture anchors, all were satisfied with a return to preinjury level, achieving a flexion–extension arc of 3° to 130° and a mean MEPS of 99.6.[18]

Recently, augmentation of repairs—so-called internal bracing—has been proposed to increase construct strength, enable early rehabilitation, and expedite return to activity.[19]

Residual Instability After Medial and Lateral Repair

Persistent instability after both medial and lateral repair is uncommon. In such cases, external fixation with a static or hinged brace may be used. Hinged frames are less available in our setting, but they allow early elbow motion within a safe range. Typically, the brace is removed at 2–4 weeks, transitioning to a splint to protect the range of motion. An alternative is a transarticular pin as a stabilizer/protector in residual instability. In a comparative study, functional outcomes and scores were similar between methods, but transarticular pins had more complications.[20]

Post-dislocation and Postoperative Complications (Lateral and Medial)

Fractures between the tunnels have been reported; therefore, it is important to maintain adequate bone bridges to avoid this complication.

Recurrent instability: about 2% in older patients and associated with difficult reductions. Close follow-up after reduction is essential to detect recurrent instability, redislocation, severe stiffness, soft-tissue injury, or neurologic sequelae. The most challenging issues are chronic instability and chronic dislocations.

Nerve injuries: in the acute stage, they are rare; in simple dislocations, about 1% require surgery. Ulnar nerve irritation/palsy has been reported after surgery; routine release affords visualization and protection. If the nerve's position conflicts with tunnel creation, anterior transposition can be performed. Avoid knot stacks adjacent to the nerve.

Vascular injury: uncommon. In a series of 634 simple dislocations, brachial artery injury occurred in 3 (0.47%).[21] In these cases, arterial repair or *bypass* was required.

Stiffness: common after immobilization and increases with longer immobilization. [11]

Osteoarthritis: chondral injuries may be occult at the time of dislocation. Symptomatic osteoarthritis requiring surgery has been reported at low rates (7 of 5000 in long-term follow-up).[13]

FINAL CONSIDERATIONS

Simple elbow dislocations are common. Associated injuries must be identified, and reduction should be early and atraumatic. After reduction, evaluate stability under fluoroscopy with stress testing through the flexion–extension arc; this guides the indication for surgery.

When the elbow remains stable after reduction, 7–10 days of immobilization followed by motion within the stable arc reduces the risk of residual stiffness. For a stable elbow, nonoperative treatment is standard.

The mechanism of dislocation remains debated; injuries may begin laterally or medially.[22] Medial onset appears to be less common.

Isolated lateral repair is often sufficient, even when there is medial ligament injury. Neurologic and vascular complications are rare. Complications such as instability, stiffness, and osteoarthritis infrequently require surgery.

Most cases do not require operative repair, but when indicated, outcomes are generally good.

Conflict of interest: The author declare no conflicts of interest.

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