The Recurrent Unstable Elbow: Diagnosis and Treatment

Anand M. Murthi, Jay D. Keener, April D. Armstrong and Charles L. Getz


This information is current as of August 3, 2010

Reprints and Permissions

Click here to order reprints or request permission to use material from this article, or locate the article citation on jbjs.org and click on the [Reprints and Permissions] link.

Publisher Information

The Journal of Bone and Joint Surgery
20 Pickering Street, Needham, MA 02492-3157
www.jbjs.org
Printed with permission of the American Academy of Orthopaedic Surgeons. This article, as well as other lectures presented at the Academy's Annual Meeting, will be available in February 2011 in Instructional Course Lectures, Volume 60. The complete volume can be ordered online at www.aaos.org, or by calling 800-626-6726 (8 a.m.-5 p.m., Central time).
The Recurrent Unstable Elbow: Diagnosis and Treatment

By Anand M. Murthi, MD, Jay D. Keener, MD, April D. Armstrong, MD, and Charles L. Getz, MD

An Instructional Course Lecture, American Academy of Orthopaedic Surgeons

The elbow has always been a difficult joint to manage because of the subtle nuances of pathology, examination, and treatment. Patients experiencing the sequelae of recurrent elbow instability can lose a substantial amount of function in the affected upper extremity. Elbow instability comprises a wide spectrum of disease ranging from valgus instability in the throwing athlete to traumatic recurrent rotatory instability to iatrogenic damage. Our goal in this article is to provide readers with information to guide them in the development of a systematic algorithm for the treatment of a variety of elbow instability problems. First, we will discuss basic elbow biomechanics and their alterations in the unstable elbow. Next, a thorough discussion of the history, physical examination, and imaging studies necessary to diagnose these injury patterns will be presented. Finally, we will discuss the nuances in the treatment of both medial/valgus elbow injuries and posterolateral rotatory instability of the elbow. Cutting-edge advances in surgical reconstruction of the unstable elbow will allow those caring for these difficult injuries to make the proper management decisions.

Biomechanics of Elbow Stability

The elbow joint is a stable articulation comprising the distal humeral, proximal ulnar, and proximal radial articular surfaces. The stabilizers of the elbow are classified as having primary or secondary roles. The primary stabilizers include the conformity of the articular surfaces (both the ulnohumeral and the radiocapitellar articulations), the anterior bundle of the medial ulnar collateral ligament, and the lateral collateral ligament complex. The articular conformity of the ulnohumeral joint arises from the mating of the trochlea of the distal part of the humerus to the greater sigmoid notch of the ulna. This articulation is augmented by the presence of a guiding ridge within the greater sigmoid notch that articulates with the trochlear sulcus. The anterior aspect of the ulnohumeral joint is supported by the coronoid process located at the distal aspect of the greater sigmoid notch. The relative contributions of the articular surfaces and the soft-tissue restraints about the elbow depend on the angle of elbow flexion and the type of force (varus or valgus) applied to the joint. Muscular forces augment osseous stability throughout all arcs of motion by generating joint compressive forces.

The lateral collateral ligament complex comprises the lateral ulnar collateral ligament, the radial collateral ligament, and the anular ligament. The
lateral ligaments provide varus stability to the elbow and are the primary restraint to posterolateral rotational forces at the ulnohumeral joint. These ligaments are not discrete anatomic and biomechanical structures, and they act in concert to provide stability to the elbow joint. The lateral ulnar collateral ligament and radial collateral ligament originate from the lateral epicondyle near the flexion-extension axis of the elbow. The radial collateral ligament is isometric; however, the lateral ulnar collateral ligament loosens in elbow extension and becomes more taut with increasing elbow flexion. Biomechanical studies of cadavers have shown that both the lateral ulnar collateral ligament and the radial collateral ligament must be injured to compromise the stability offered by the lateral collateral ligament complex.

The primary valgus stabilizer of the elbow is the medial ulnar collateral ligament complex. This ligament complex is divided into the anterior oblique ligament (the anterior bundle of the medial ulnar collateral ligament complex), the posterior oblique ligament, and the transverse ligament (Fig. 1). The anterior bundle of the medial ulnar collateral ligament complex arises from the deep anterior aspect of the medial epicondyle at the flexion-extension axis of the elbow and inserts near the sublime tubercle of the ulna at the base of the medial aspect of the coronoid process. The anterior bundle of the medial ulnar collateral ligament complex is the primary varus stabilizer of the elbow. This ligament is functionally divided into the anterior and posterior bands. The anterior band is taut for the first 60° of elbow flexion, and the posterior band is taut from 60° to 120° of flexion. This provides a reciprocal function of resisting valgus forces at various ranges of flexion and extension motion. Although it has been theorized that there is an isometric central band to the anterior portion of this ligament, injuries to the anterior bundle of the medial ulnar collateral ligament complex are primarily related to attritional stress from repetitive throwing. These stresses are greatest during the early acceleration phase of throwing, producing up to 64 Nm of valgus torque at the elbow, which is thought to exceed the ultimate tensile strength of the medial ulnar collateral ligament complex. These data highlight the importance of other joint stabilizers and dynamic muscular forces in buffering the large valgus moments that occur with throwing.

The secondary stabilizers of the elbow joint include the radial head, the anterior and posterior aspects of the capsule, and the muscular forces around the joint. The radial head is an important contributor to elbow stability. In light of the valgus angulation of the elbow, it is estimated that, in full extension, 60% of the joint reactive forces occur at the radiocapitellar articulation. The radial head augments valgus stability of the elbow, particularly in the presence of an incompetent medial ulnar collateral ligament complex. In addition, the radial head provides some restraint to posterolateral rotatory forces at the elbow. The anterior and posterior aspects of the capsule consist of relatively thin, weak tissue and play a smaller, but probably important, role in elbow stability. The anterior aspect of the capsule makes its greatest contribution to stability in terminal elbow extension; it provides the greatest resistance to distraction forces, and an equal contribution to valgus stability, as compared with the roles of the medial ulnar collateral ligament complex and the osseous anatomy.

Muscular forces across the elbow are important augmenters of elbow stability. Forces from the brachialis, biceps, and triceps muscles augment osseous stability through joint compression and increase varus and valgus stability independent of the position of the forearm. The common wrist extensors have imparted substantial stability to the lateral aspect of the elbow in cadaver testing. On the medial aspect of the joint, the flexor-pronator muscles, particularly the flexor carpi ulnaris and flexor digitorum superficialis, augment valgus stability at the elbow. These muscles are particularly important in throwers; the torque across the medial aspect of the elbow during the throwing motion is estimated to exceed the ultimate strength of the anterior band of the medial collateral ligament. Despite the theoretical benefit of flexor-pronator-mass muscle function,
activity in protecting the medial ulnar collateral ligament complex, some clinical electromyographic studies have failed to show compensatory activity of these muscles in throwing athletes. Injuries to the medial ulnar collateral ligament are usually attritional, and most often occur in overhead-throwing athletes. The anterior band of the medial ulnar collateral ligament is the primary restraint to valgus moments. It is supplemented by dynamic muscular support from the flexor-pronator mass. Injuries to the medial ulnar collateral ligament are thought to be the result of cumulative stress from repetitive throwing. Occasionally, the medial collateral ligament ruptures as a result of acute trauma producing a severe valgus moment to the joint. These injuries may or may not produce elbow dislocation and often occur in the context of avulsion of the flexor-pronator muscle mass and acute ulnar nerve symptoms.

### History and Physical Examination

Most patients with recurrent posterolateral elbow instability recall a distinct injury that may or may not have produced a complete dislocation. The chief symptom in patients with recurrent posterolateral instability is often subtle, consisting of position-dependent elbow pain or apprehension. Occasionally, clunking, popping, and shifting sensations are felt when the elbow is extended, especially when an axial load is applied to the limb. Provocative activities include those that require forced elbow extension, such as pushing up from a chair or pushing a heavy object with an extended arm. Some patients describe a history consistent with repeated self-reductions.

Patients with symptomatic insufficiency of the medial collateral ligament usually have a gradual onset of symptoms. Some throwers relate the onset of pain to a single throwing event, occasionally accompanied by a painful “pop” in the elbow. More commonly, there is a gradual onset of pain at the medial aspect of the elbow during the acceleration phase of throwing. Frequently, the throwing athlete will have noticed a loss of velocity and control with certain pitches before having symptoms of instability. Typically, patients with medial collateral ligament insufficiency have few or no symptoms with activities of daily living or nonthrowing sports activities.
The majority of patients with recurrent elbow instability have posterolateral instability. On physical examination, the range of motion of the elbow and forearm is normal, and varus and valgus stress tests are usually not provocative. A variety of special tests have been developed to assess for posterolateral instability of the elbow. The pivot-shift test is designed to replicate the rotatory instability characteristics of this disorder.

To perform this test, the examiner stands at the head of the patient, who is supine. The patient’s shoulder is flexed as the examiner braces the patient’s elbow laterally with one hand and the patient’s wrist with the other. The patient’s forearm is supinated, and a valgus moment is applied to the patient’s elbow. The examiner then slowly moves the patient’s elbow from flexion to extension. The test is considered positive when there is subluxation of the elbow at 20° to 30° of extension. A sudden rotatory shift is felt, and the radial head becomes more prominent. Flexion from that point reduces the elbow. Frequently, a patient will not allow subluxation to occur because of pain or apprehension. Alternatively, the clinician can perform this test with the patient sitting. The examiner imparts a posterolateral drawer and supination force to the proximal part of the patient’s forearm with the patient’s elbow slightly flexed and the humerus stabilized.

Several functional tasks serve as clinical indicators of posterolateral instability. These tests include pushing up from a chair, the tabletop test, and attempting a push-up with the forearm supinated. These tasks recreate apprehension or instability symptoms by simulating an axial load on the extending elbow with the forearm supinated. The test results are considered positive if the patient is reluctant to fully extend the loaded elbow. The diagnosis of posterolateral instability is sometimes based only on a clinical impression because the patient cannot tolerate the subluxation of the elbow. An examination performed with the patient under anesthesia will confirm the clinical suspicion of posterolateral instability and may be necessary before definitive treatment is initiated.

A careful physical examination of a throwing athlete with symptomatic insufficiency of the medial collateral ligament is important to facilitate decision-making and care. The flexor-pronator mass is examined for tenderness and pain with strength testing. A careful evaluation of the shoulder should be performed, with the examiner focusing on rotator cuff and scapular stabilizer strength, identifying a glenohumeral internal rotation deficit, and analyzing pitching mechanics. The medial aspect of the elbow is examined for localized tenderness directly over the origin of the flexor-pronator mass, the sublime tubercle, the medial aspect of the olecranon, and the cubital tunnel. The range of motion of the elbow is usually preserved. The ulnar nerve should be assessed during elbow motion to rule out subluxation. Pain and tenderness in the posteromedial aspect of the elbow with valgus force into terminal extension can indicate valgus extension overload, which is another common cause of medial elbow pain in throwers. Valgus stress testing is conducted with the elbow flexed to 20° to 30° (this unlocks the olecranon from the humerus) and the forearm pronated. Laxity is difficult to appreciate unless fluoroscopic images or stress radiographs are made, but the test is considered positive if the patient has pain with valgus stress. Medial ulnohumeral space opening of ≥3 mm compared with that of the contralateral elbow on valgus stress radiographs indicates medial collateral ligament insufficiency.

Two other tests for medial collateral ligament laxity are the milking maneuver and the moving valgus stress test. The milking maneuver is done by pulling on the patient’s thumb with the arm supinated and the elbow flexed beyond 90°, creating a valgus stress. For the moving valgus stress test, the arm is taken to maximal external rotation of the shoulder while the milking maneuver is done (Fig. 2). The elbow is then flexed and extended with the constant valgus torque, and the test is considered positive when the medial elbow pain is reproduced and is maximum between 70° and 120°.

**Imaging**

Standard radiographic images of patients with recurrent elbow instability include anteroposterior, lateral, and internal and external rotation oblique views. By definition, simple dislocations occur without associated elbow fractures. Occasionally, calcification or ossification is seen along the lateral epicondyle and within the substance of the ol-
the lateral collateral ligaments or, in throwing athletes, the anterior band of the medical collateral ligament, but these are nonspecific findings. After an acute simple elbow dislocation has been reduced, the ulnohumeral joint is carefully inspected to confirm a concentric reduction. The presence of a “drop sign” after acute dislocation indicates an elbow with ligamentous and soft-tissue injury and an increased risk of recurrent instability. A drop sign is a widening of the ulnohumeral joint and represents a subtle resting subluxation of the elbow joint. Radiographs should be inspected for avulsion fractures of the medial collateral ligament at the base of the medial epicondyle or the sublime tubercle. Stress radiographs or fluoroscopy are useful for patients with suspected medial collateral ligament insufficiency. Stress radiographs of patients with posterolateral instability are less reliable because of difficulty in reproducing the positions of instability and because of the onset of pain while the imaging study is conducted. Posterolateral instability can be assessed with fluoroscopy during an examination with the patient under anesthesia.

Magnetic resonance imaging is indicated after an acute simple dislocation when a nonconcentric reduction is present and no cause for the persistent subluxation can be seen on a plain radiograph. Incarcerated cartilage fragments or soft tissue can be seen on the scan. Magnetic resonance imaging may also help in the evaluation of a patient who has elbow pain without an obvious cause, but it is not routinely performed in cases of suspected posterolateral instability because the lateral collateral ligament is a poorly defined structure.

Magnetic resonance imaging may help the clinician to diagnose medial collateral ligament injuries. Disruption of the medial collateral ligament can be seen at the origin, at the insertion, or within the midsubstance of the tendon. Intra-articular contrast medium improves the accuracy of detecting partial articular-sided tears of the medial collateral ligament. In addition, magnetic resonance imaging identifies associated injuries to the radial head, capitellum, and flexor-pronator mass; stress fractures within the olecranon; and the presence of loose bodies and osteophytes. Dynamic ultrasonography is also used to evaluate the medial collateral ligament and can detect increased laxity with valgus instability.

**Medial Collateral Ligament Insufficiency of the Elbow**

**Background and Anatomy**

The anterior and posterior bands of the medial ulnar collateral ligament complex tighten in a reciprocal fashion so that the anterior band is lax in extremes of flexion and the posterior band is lax in elbow extension. The existence of a distinct central isometric band remains a point of controversy. In one biomechanical study, a single 3-mm central band of the anterior bundle was sufficient to provide elbow stability (Fig. 3). This band is nearly mechanically isometric, and its origin lies very close to the anatomic axis of rotation of the elbow. This concept becomes important clinically when the surgeon is considering single-point tunnel fixation on the ulna and medial epicondyly. To decrease tension in a medial collateral ligament reconstruction, the medial epicondyle drill hole should be located at the anatomic axis of rotation of the elbow.

Long-term studies of chronic elbow instability due to a traumatic medial collateral ligament injury suggest that symptomatic arthritic changes develop over time in up to 50% of cases, and there is a 15% to 35% prevalence of symptomatic valgus instability. Therefore, although it is known that many patients who do not participate in activities that require valgus loading of the elbow can live with an insufficient medial collateral ligament, the sequelae of this injury may not be as benign as was once thought.

**Treatment**

Initial treatment for chronic medial collateral ligament insufficiency (especially in athletes) focuses first on rest and anti-inflammatory drugs, and then there is gradual progression into an...
interval throwing program. Early acute rehabilitation should focus on stretching and strengthening of the flexor-pronator mass, the rotator cuff, and the scapular stabilizers. Therapy then progresses to a comprehensive program involving normalization of the glenohumeral arc of motion through posterior shoulder stretching. The focus should be on improving strength and endurance of the flexor-pronator muscles and also on addressing core stability and lower-extremity strength and flexibility. Strengthening of the core musculature and the lower extremities plays an important role in transferring energy from the lower extremity to the upper extremity. The athlete then progresses into an interval throwing program. The Youth Baseball Athletes USA Baseball Medical & Safety Advisory Committee provides guidelines for specific pitch counts and rest periods. Close to half of all patients with a medial collateral ligament injury return to their sport within approximately six months following the initiation of nonoperative treatment. It is not possible to predict who will require surgery; therefore, a three to six-month directed rehabilitative program is recommended. If nonoperative treatment fails to control pain and allow a return to participation in sports, surgical reconstruction of the anterior bundle of the medial collateral ligament is recommended. Medial collateral ligament reconstruction is either single-stranded or two-stranded. The first two-strand reconstruction, a figure-of-eight reconstruction, was described in 1986. The exposure required release of the flexor-pronator group with an ulnar nerve transposition. It consisted of three drill holes in the medial epicondyle and two drill holes in the ulna, and the tendon graft was passed in a figure-of-eight fashion and sewn to itself. Approximately two-thirds of patients returned to their sport after this procedure, but there was a 21% prevalence of ulnar nerve injury. A late modification split the flexor-pronator mass and transposed the ulnar nerve only if clinically indicated. This modified approach was reported to result in a higher return to sports participation (74% to 81%) than the original method and only a 5% prevalence of ulnar nerve injury.

Another flexor-pronator-mass-splitting technique involves use of a single drill hole in the medial epicondyle at the elbow’s axis of rotation. Sutures are passed through two separate, smaller exit tunnels superiorly and anteriorly and are tied over an osseous bridge. This is called a “docking” method (Fig. 4). The two drill holes in the ulna are the same as those originally described. The return-to-sports rate after this procedure has been reported to be 92% to 95%.

Single-strand reconstruction has been shown to restore normal kinematics to the elbow. A number of fixation techniques have been described for single-strand reconstructions, including the use of interference screws, EndoButtons (Smith and Nephew, Memphis, Tennessee), and no additional hardware. The interference construct provides stability similar to that of a native elbow. A biomechanical study comparing four different reconstruction techniques showed that, with cyclic loading to failure, an EndoButton reconstruction technique was equivalent to the two-strand reconstructions and had a higher load to failure than an interference construct and the traditional figure-of-eight reconstruction. The only other technique reported clinically (for single-strand reconstruction) is the DANE TJ hybrid technique, which involves placing an interference screw in the ulna with a docking procedure at the medial epicondyle. An 85% return-to-sports rate has been reported following that procedure.

Graft choices for any of these reconstructions are at the surgeon’s discretion. Palmaris longus, gracilis, plantaris, toe extensor, and Achilles autografts; allografts; and GraftJacket (Wright Medical Technology, Arlington, Tennessee), an acellular dermal allograft, have all been used.

**Specific Surgical Technique**

We recommend the flexor-pronator-mass-splitting approach. In this technique, the flexor-pronator mass is split along its anterior two-thirds and posterior one-third. There is a palpable raphe...
that can be used to find the anterior bundle of the medial collateral ligament. An incision slightly posterior to the plane of the medial epicondyle helps to protect the medial cutaneous nerves. The sublime tubercle is identified for placement of the ulnar drill holes. For a two-strand technique, drill holes are placed anterior and posterior to the sublime tubercle with a 1-cm bone bridge. For a single-strand reconstruction, a single drill hole is created directly over the sublime tubercle. The elbow should be kept extended while the 4 or 5-mm holes are drilled into the ulna so that the ulnar nerve falls away from the drill-bit. The drill is aimed away from the articular cartilage. The drill hole in the humerus should be at the anteroinferior aspect of the medial epicondyle, close to the trochlea, at the anatomic axis of rotation of the humerus. Two smaller drill holes exit the far cortex of the medial epicondyle to create a bone bridge to tie the suture to the anatomic axis of rotation of the humerus. After surgery, the elbow is placed in a soft cast, flexed to 90° with the forearm in supination. At one week, the soft cast is removed and the elbow is placed in a static removable splint with the forearm in supination, as forearm supination is the position of stability for the medial collateral ligament. Active motion and muscular contraction provide compressive stability to the elbow. Thus, it is important that the patient actively move the elbow during therapy to provide the least stress on the medial collateral ligament reconstruction. Active-assisted range-of-motion exercises to full flexion and extension with the forearm in supination are begun and are continued for five weeks. Active forearm pronation and supination are allowed with the elbow at 90°. At six weeks, the patient is weaned off of the static splint and a full active range of motion of the elbow is initiated. The patient starts a gradual strengthening program at three months and an interval throwing program at nine to twelve months. With the possibility of the patient returning to competitive throwing, careful emphasis should be placed on body and throwing mechanics.

A systematic review of the treatment of medial collateral ligament injuries identified no prospective cohort or randomized controlled trials comparing reconstruction techniques. The rate of return to sports was 83%, with the time until the return to sports ranging from 9.8 to 26.4 months. The complication rate was 10%, with ulnar nerve injury being the most common postoperative complication, occurring in 6% of cases. The muscle-splitting approaches have a lower complication rate. Compared with previous methods, the docking technique has been shown to result in a higher rate of return to sports and a lower complication rate. In summary, medial collateral ligament reconstruction is an effective treatment for valgus elbow instability in the throwing athlete. Future research and education should emphasize prevention, considering that the incidence in athletes seems to be increasing.

**Posterolateral Rotatory Instability of the Elbow**

The radial head receives most of the attention in discussions of posterolateral rotatory instability because it is often easier to see malalignment between the radial head and the capitellum than it is to see malalignment of the ulnohumeral joint on plain radiographs. However, the primary cause of the instability is supination of the ulna away from the distal part of the humerus, and the lateral ulnar collateral ligament is the primary stabilizer preventing this instability. Therefore, treatment is aimed at restoring the integrity of the ulnohumeral stabilizers.

The radial head does play a role in rotatory stability, as the lateral ulnar collateral ligament courses around the radial head on its way to the ulna. This results in a mechanical block to the radial head, and the radial head helps to create tension in the lateral ulnar collateral ligament. Posterolateral rotational laxity increases by 145% after radial head excision. Hall and McKee identified a series of patients with posterolateral rotatory instability after a radial head resection. It is unclear whether the instability was due to an unrecognized or iatrogenic lateral collateral ligament injury. In an experimental model, stability after isolated lateral collateral ligament reconstruction was found to be similar to that after lateral collateral ligament reconstruction with radial head replacement.

**Nonoperative Management**

Little has been written about the efficacy of nonoperative treatment of patients with posterolateral rotatory instability. Treatment strategies include educating the patient about avoiding the most unstable positions of the upper extremity. Bracing can be used to stabilize the elbow and possibly to limit motion, preventing the position of provocation. Physical therapy can strengthen the dynamic stabilizers and help the patient with coping strategies.

**Operative Techniques**

Operative treatment is focused on restoring rotational stability of the ulnohumeral joint by reconstructing the lateral ulnar collateral ligament. In cases of chronic recurrent posterolateral rotatory instability, grafting of the lateral ulnar collateral ligament has produced more reproducible results than has use of local tissue. A native palmaris or plantaris graft, or allograft, is used. Novel techniques for arthroscopic imbrication and repair of the lateral collateral ligament complex are being developed.

The patient is positioned supine with the arm on a hand-table, and a nonsterile tourniquet is applied. A lateral approach over the lateral epicondyle that is sufficient to expose from the supinator crest to the lateral column of the humerus, while sparing the large cutaneous nerves, is used. The antebrachial fascia is then incised just posterior to the lateral collateral ligament at the rolled edge of the extensor carpi ulnaris and the anconeus. The lateral collateral ligament is deep and anterior to the thickened rolled edge of the extensor carpi ulnaris. If the lateral collateral ligament has been previously...
avulsed, scarring might be present in the area. The lateral collateral ligament is incised parallel to the radial head and along the axis of the radial neck to allow visualization of the joint. The anconeus is swept posteriorly to allow placement of the ulnar tunnels. A hole is made with a 4-mm high-speed burr at the proximal portion of the supinator crest, a second hole is made more proximally and posteriorly at the insertion of the anular ligament with a bone bridge of at least 1 cm, and the graft is passed through the ulnar tunnel (Fig. 5).

The humeral attachment of the lateral collateral ligament is at the isometric point of the lateral epicondyle. Although neither the native nor the reconstructed setting has a true isometric point, this so-called isometric point approximates a best fit. It is at the center of a circle circumscribed along the contour of the capitellum. The other method for locating this point is to place a suture through the ulnar drill holes and apply the suture ends to the lateral epicondyle while moving the elbow through a range of motion (Fig. 6). The isometric point is found when the sutures maintain the most constant tension through the arc of motion. The humeral drill hole should be placed so that the isometric point is at the distal-most and posterior-most part of the drill hole.

The graft can be attached to the humerus by either a figure-of-eight weave or the docking technique. The figure-of-eight weave requires creation of diverging 4-mm tunnels from a 5-mm drill hole at the isometric point. The graft should be measured to allow the creation of a yoke with 1 cm of graft to recess into the condyle and a free limb of graft to pass through the humeral tunnel. The suture from the yoke will exit the humeral tunnel opposite the graft limb. The graft exiting the humerus can then be brought back through the opposite humeral tunnel. Before the graft is secured, the capsule should be repaired so that the graft lies extra-articularly. The elbow is reduced and is placed in 45° of flexion with the forearm in pronation and with an axial load applied while the graft is secured. The graft can also be secured to the humerus with a docking technique. The yoke is measured to allow at least 1 cm of tissue to recess into the humerus. Two small humeral tunnels are placed to accommodate the high-strength suture that is sewn to the yoke and brought through the humeral tunnels. The sutures are tied to tension and secure the graft.

**Aftercare**

The elbow is splinted at 90° of flexion with the forearm in pronation for seven to ten days. At the first postoperative...
visit, the splint is removed and a hinged elbow brace with a 30° extension block is applied. For the first six weeks, the patient performs active-assisted elbow range-of-motion exercises. Flexion and extension range-of-motion exercises are done with the forearm in pronation. Pronation and supination range-of-motion exercises are done with the elbow in 90° of flexion. The patient should not lift anything weighing more than 1 lb (0.45 kg) for six weeks.

The hinge on the brace is unlocked six weeks after the surgery, and the patient continues active-assisted exercises with progression of the range of motion to include flexion and extension with the forearm in neutral and then in supination. Strengthening can be added after eight weeks. The brace is removed between eight and twelve weeks after the surgery, depending on the compliance of the patient. Unrestricted activity is allowed four to six months after the surgery. Care is taken during the early phase of recovery to avoid varus elbow stresses, including arm abduction.

Results
In one series, ten of eleven patients with posterolateral rotatory instability who underwent reconstruction had a stable elbow at the time of follow-up, and seven results were classified as excellent.

The authors believed that success required reconstruction of a competent lateral ulnar collateral ligament. In another report, forty-four patients were operated on to treat posterolateral rotatory instability at the Mayo Clinic. Various techniques were used, and at the time of follow-up thirty-nine patients were deemed to have a stable elbow, with 75% having a good or excellent result. The best outcomes were thought to be in patients with posterolateral rotatory instability due to trauma and in those who complained of instability rather than only pain. The authors thought that use of a graft provided better results than did use of local tissue.

Overview
In summary, the treatment of the unstable elbow requires an understanding of the nuances of the pathological characteristics. To treat these injuries properly, one must understand the intricate anatomy and the contributions of both the osseous articulations and the soft tissues to stability.

Anand M. Murthi, MD
Shoulder and Elbow Service,
Department of Orthopaedic Surgery,
Union Memorial Hospital,
3333 North Calvert Street,
Suite 400, Baltimore,
MD 21218.
E-mail address: amurthi@ucoa.net

Jay D. Keener, MD
Department of Orthopaedic Surgery,
Washington University School of Medicine,
600 South Euclid Avenue,
St. Louis, MO 63110.
E-mail address: keenerj@wudosis.wustl.edu

April D. Armstrong, MD
Department of Orthopedics,
Penn State University School of Medicine,
500 University Drive,
P.O. Box 850, Hershey,
PA 17033.
E-mail address: aarmstrong@hmc.psu.edu

Charles L. Getz, MD
Department of Orthopaedic Surgery,
Thomas Jefferson University School of Medicine,
Rothman Institute,
1015 Walnut Street, Philadelphia,
PA 19107.
E-mail address: charlesgetz@hotmail.com

Printed with permission of the American Academy of Orthopaedic Surgeons. This article, as well as other lectures presented at the Academy’s Annual Meeting, will be available in February 2011 in Instructional Course Lectures, Volume 60. The complete volume can be ordered online at www.aaos.org, or by calling 800-626-6726 (8 A.M.-5 P.M. Central time).

References


