Valgus Extension Injuries of the Elbow in the Throwing Athlete

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Abstract

Valgus extension injuries of the elbow are common among throwing athletes. There is a wide spectrum of these injuries, ranging from early soft-tissue inflammatory changes to attenuation and incompetence of the ulnar collateral ligament, as well as bone changes, including chondromalacia, osteochondritis, and osteophyte formation. Early treatment should be directed toward decreasing pain and inflammation, followed by global strengthening and conditioning of the elbow with special emphasis on plyometric strengthening of the flexor-pronator musculature. In patients who remain symptomatic after an initial course of nonoperative treatment, arthroscopy of the elbow can address many of the later changes, including chondromalacia, osteochondritis, and osteophyte formation. Reconstruction of the ulnar collateral ligament should be reserved for those patients who wish to remain active at a highly competitive level and for whom rehabilitation and less invasive procedures have failed. Appropriate rehabilitation remains the cornerstone of successful treatment of these patients, facilitating their return to competitive play.

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The dominant elbow of the throwing athlete is particularly susceptible to injury due to the repetitive stress that is placed across it in the act of throwing. Bennett[1] and Waris[2] were among the first to note the problems that occur in throwing athletes. Since their reports, our understanding of medial elbow instability has continued to advance. The purpose of this article is to review all aspects of this clinical problem, including the anatomy, biomechanics, patterns of injury, and current treatment options.

Anatomy

The elbow is a hinged joint composed of three distinct articulations: the radiocapitellar joint, the ulnohumeral joint, and the proximal radioulnar joint. All three joints are enclosed within a common fibrous and synovial capsule, which is thickened medially and laterally to form the collateral ligaments. The configuration of the joints provides for stability of the elbow against varus and valgus stress at less than 20 degrees and more than 120 degrees of flexion.[3] Between these extremes, stability is provided by the medial and lateral ligaments of the elbow as well as the musculotendinous complexes that cross the joint.[4]

The ulnar collateral ligament complex is composed of three parts: an anterior oblique ligament, a fan-shaped posterior oblique ligament, and a transverse oblique ligament, which is relatively nonfunctional in terms of stability[3-5] (Fig. 1). Both the anterior and posterior ligaments originate on the anterior aspect of the medial humeral epicondyle, with the anterior ligament extending distally to insert on the medial aspect of the coronoid process. The anterior ligament is further subdivided into two functionally distinct bands.[6] Under valgus load, the anterior band is under tension from 0 to 85 degrees, while the posterior band is under tension from 55 degrees throughout the rest of flexion. The posterior oblique ligament inserts into the posteromedial aspect of the olecranon and is tight in flexion of more than 60 degrees.[7] The results of various sectioning studies indicate that the anterior oblique ligament is the primary stabilizer of the elbow against valgus stress.[8,9]

The lateral collateral ligament complex shows greater variability than the ulnar collateral ligament complex. It is composed of four structures. The radial collateral ligament originates at the lateral epicondyle and extends distally to insert into the annular ligament of the radioulnar articulation. Its primary function is to provide stability against varus stress. The radial ulnohumeral ligament arises from the lateral epicondyle just distal to the radial collateral ligament and extends distally to cover the annular ligament and insert on the lateral side

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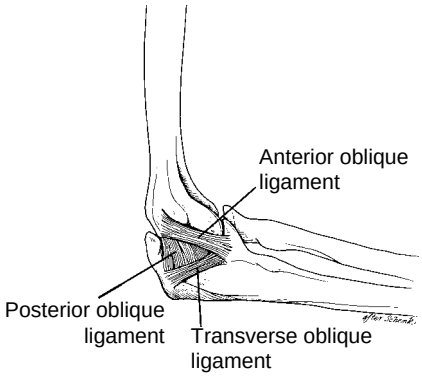


Fig. 1 Structure of the ulnar collateral ligament complex.

of the ulna and coronoid process. This ligament also functions to stabilize the elbow against varus stress. Rupture of this ligament has been determined by O'Driscoll et al[10] to be the primary lesion in posterolateral rotatory instability of the elbow. The other two components of the lateral collateral ligament complex are the annular ligament and the accessory collateral ligament. These ligaments ensure the proper articulation of the proximal radioulnar joint but contribute little to varus stability of the elbow, other than providing an insertion for the radial collateral ligament.

The flexor-pronator muscle group of the forearm originates from the medial epicondyle and the distal medial epicondylar ridge of the humerus and functions as a dynamic stabilizer of the elbow against valgus stress. The other major structure on the medial side of the elbow is the ulnar nerve, which passes posterior to the medial humeral epicondyle in the ulnar groove and then distally in close relation to the medial collateral complex.

Biomechanics of Throwing

While the specific techniques of throwing vary slightly among different sports, the same basic throwing mechanism is common to all. The baseball pitch provides a good example of the throwing mechanism and can be broken down into five phases: windup, early cocking, late cocking, acceleration, and follow-through.[11]

Injury usually occurs during the acceleration phase of throwing.[6] With the arm in the fully cocked position, a large forward force is generated by the musculature of the shoulder girdle, bringing the upper arm forward. The forearm, the hand, and the object being thrown lag behind,[12] causing rapid flexion of the elbow measuring between 90 and 120 degrees.[6] This position is maintained as the arm is brought forward, generating a considerable valgus force at the elbow. Peak angular velocities have been measured at greater than 4,500 degrees per second.[13] These large forces must be absorbed by the supporting structures on the medial side of the elbow, primarily the anterior oblique ligament of the ulnar collateral ligament complex and secondarily the flexor-pronator musculature. If the forces generated exceed the tensile strength of the ulnar collateral ligament, microtears will occur. If throwing continues in the presence of injury, attenuation and eventual rupture of the ligament will result. At the same time, considerable compressive force is placed on the lateral side of the elbow; this force is primarily absorbed by the cartilaginous surfaces of the radial head and the capitellum.[12]

As acceleration of the arm continues, the triceps forcefully contracts and the elbow rapidly extends as the thrown object is released. Normally, the force of this extension is absorbed by the anterior capsular structures as well as the biceps and brachialis, but if the elbow is slightly subluxated in a valgus position due to insufficiency of the ulnar collateral ligament as extension occurs, this can cause impaction of the posterior medial olecranon in the olecranon fossa of the humerus. Over time, this impaction can lead to chondromalacia and osteophyte formation, producing pain during the late acceleration and follow-through phases of throwing.[14]

Types of Throwing Injuries

Muscular Injuries

Slocum[15] classified throwing injuries of the elbow into medial tension overload injuries, lateral compression injuries, and extensor overload injuries. Medial tension injuries were further subdivided into muscular and ligamentous injuries.

The flexor-pronator musculature provides dynamic support for the static stabilizing structures on the medial side of the elbow and also flexes and pronates the wrist and forearm during throwing. Continued activity beyond the limits of fatigue of this muscle group can result in injury to the muscle or ligament, and ruptures of the flexor muscles in throwing athletes, although rare, have been reported.[16,17] Swelling is noted along the medial aspect of the elbow and is associated with pain that may be exacerbated by extension of the wrist combined with extension of the elbow. Minor injuries usually persist for 24 to 48 hours and may be relieved by ice, rest, and nonsteroidal anti-inflammatory medications.[12] More severe injuries can lead to scarring and fibrosis, with resultant loss of elbow or wrist extension.

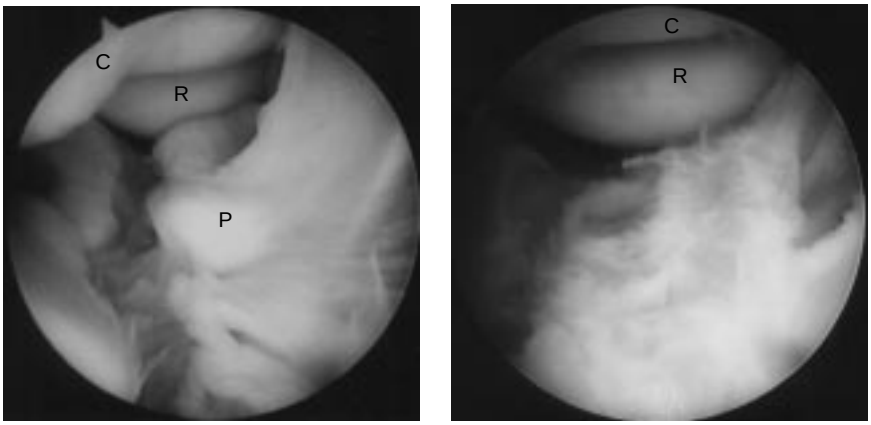
Bennett[1] described a compartment syndrome due to hypertrophy of the flexor-pronator musculature. This syndrome is characterized by pain in the medial aspect of the

elbow and the proximal forearm. This is due to localized swelling within the flexor muscles, which causes pain that forces retirement after only two or three innings of pitching. This syndrome can be prevented by adequate warm-up and careful timing of pitching to allow adequate rest days.

Ligamentous Injuries

Injuries to the ulnar collateral ligament are usually caused by chronic overuse of the elbow. Athletes who engage in repeated overhand throwing regularly subject the elbow to valgus forces that may equal or exceed the tensile strength of the medial supporting structures. Studies have shown that the anterior oblique ligament is the primary medial stabilizer of the elbow. With overhand throwing, the forces are concentrated in this ligament, and repeated microtrauma over time can lead to attenuation and eventual rupture. Undersurface tears of the ulnar collateral ligament in which the external portion of the ligament remains intact have recently been reported in a study in which arthroscopic findings were confirmed by open surgical findings.[18] A sudden valgus stress that exceeds the tensile strength of the ligament, such as from impact, can also lead to acute rupture of the ligament.

Secondary changes can also develop in the soft tissues on the lateral side of the elbow as a result of instability or repetitive throwing. In the pediatric or adolescent athlete, osteochondral lesions of the capitellum may occur. Another possible change is thickening of the plicae found in the radial capsule in the posterolateral gutter (Fig. 2). Although thickening of this capsule can be a normal finding, repetitive compressive stress can cause irritation and fibrosis of the synovium in this area, resulting in a pathologic lesion that can cause impingement and chondromalacia of the radial aspect of the ulnohumeral articulation as well as the posterior aspect of the radiocapitellar joint. The same thickening can be noted on occasion in the radial ulnohumeral ligament.



A B

Fig. 2 Arthroscopic views of the posterolateral corner of the elbow, looking toward the radial head (R). **A,** Before removal of plica (P), which is a thickening of the posterolateral capsule and synovium. C = capitellum. **B,** After removal of plica with use of a shaver.

Bone Injuries

Attenuation of and injury to the medial stabilizing structures of the elbow allow valgus subluxation of the elbow during throwing. Over time, this can lead to further changes on both the medial and the lateral sides of the joint. Traction spurs may be found on the medial aspect of the ulnar notch[17] (Fig. 3). Calcium deposits can also form within the substance of the ligament and may be visible on plain radiographs.[19] In young athletes, partial or complete avulsion of the medial epicondyle through the apophysis can occur (Fig. 4).

Valgus subluxation of the elbow causes a compressive force on the lateral radiocapitellar joint, which can lead to chondromalacia and subsequent osteochondral lesions of the capitellum.[17] If fragmentation occurs, loose bodies may be formed. This can be associated with pain on both the lateral and the medial aspects of the elbow during pitching.

Fig. 3 Large traction spur on the medial aspect of the ulnar notch. Note osteophyte formation on the medial aspect of the trochlea.

Fig. 4 Avulsion of the medial epicondyle.

Another common site of bone changes is the posteromedial olecranon. King et al[17] have shown that hypertrophy of the humerus is a consistent finding in pitchers and involves all components of the joint, including the olecranon fossa and the olecranon. This hypertrophy, combined with the valgus angulation that occurs during throwing, results in a compromise in the space available for articulation of the olecranon process within the fossa and leads to impingement of the posteromedial olecranon within the fossa as the elbow goes into extension. Over time, chondromalacia may develop on the tip of the olecranon as well as in the posteromedial fossa, which can lead to osteochondritis and loose-body formation. An osteophyte can then form on the posteromedial aspect of the olecranon process, which can further compromise the space available within the fossa and lead to increased pain posteriorly during pitching[14] (Fig. 5).

Diagnosis

The diagnosis of ulnar collateral ligament instability is based on a history of pain in the elbow along the medial side that is associated with the acceleration phase of throwing. There may also be complaints of grinding, catching, or popping in the elbow, which indicates the presence of loose bodies, posterolateral impingement, or chondromalacia. Ulnar neuropathy has been shown to be associated with chronic medial instability[6] and should be carefully evaluated as part of the history and examination. In addition to the normal elements of a routine physical examination of the arm, special attention should be paid to flexibility of the shoulder and valgus stress testing of the elbow. Excessive tightness of the shoulder results in increased stress across the elbow by altering the normal throwing motion. The altered biomechanics can place increased valgus stress on the elbow, causing symptoms over the medial elbow. Thus, if a throwing athlete has medial elbow pain, one should always examine the shoulder carefully as well.

Valgus stress testing of the elbow is performed by placing the patient's hand against the side of the examiner's body, with the elbow held at 30 degrees of flexion to relax the bone constraints. The examiner uses one hand to apply valgus stress to the patient's elbow while with the other hand palpating the medial side of the elbow. The stability is tested throughout the entire arc of flexion. Valgus force is continued as the arm is extended, allowing palpation of possible crepitation of the medial ulnohumeral and radiocapitellar articulations as the olecranon seats into the fossa. Proper positioning of the fingers allows evaluation of the medial epicondyle, the ulnar groove and nerve, the flexor-pronator origin, and the medial ulnohumeral joint for tenderness or opening.

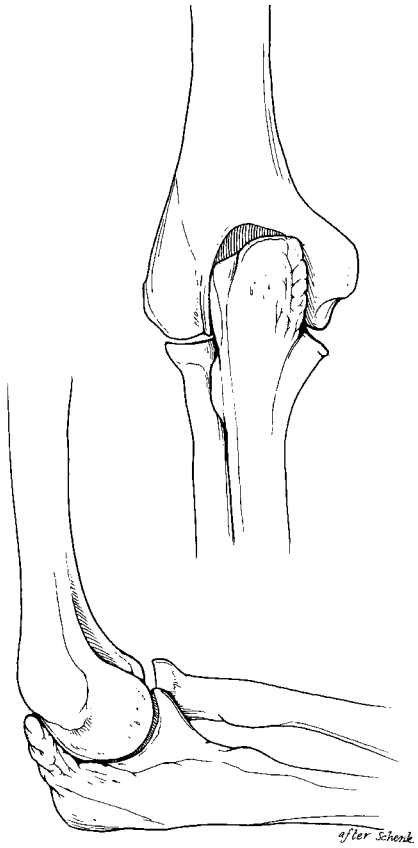


Fig. 5 Valgus subluxation of the elbow with secondary osteophyte formation on the posteromedial olecranon.

The examination is first done with the patient supine and is then repeated with the patient prone. The prone examination allows direct visualization of and access to the area of interest. Because the upper arm is stabilized on the table, varus and valgus stress testing of the elbow (Fig. 6) and flexibility testing of the shoulder are facilitated.

Routine anteroposterior and lateral radiographs of the elbow should be obtained to check for evidence of loose bodies, osteochondritis, bone spurs, or calcification in the ulnar collateral ligament. Oblique views are also helpful. Wilson et al[14] have described an olecranon view that

Fig. 6 Positioning for valgus stress testing of the elbow with the patient prone.

may demonstrate posteromedial osteophytes. Valgus stress radiographs (Fig. 7) can be obtained to further document valgus subluxation, but a normal stress view does not rule out the diagnosis. Magnetic resonance imaging and computed tomographic arthrography have also been utilized in the evaluation of these injuries,[20,21] but their use in this setting is still in the early stages of development.

Conservative Treatment

There are two primary goals of conservative treatment of the symptomatic elbow in the throwing athlete. The first objective is the relief of pain and inflammation. This can be achieved with an initial period of rest of the affected elbow combined with icing to help decrease pain and swelling. Icing should be used with caution as it can cause or exacerbate ulnar nerve symptoms. Oral nonsteroidal anti-inflammatory medications should also be used to help decrease inflammation both initially and during the rehabilitation phase. Injections into the joint should be used very sparingly due to the potential deleterious effects on the cartilaginous surfaces and already attenuated pericapsular structures.

In pediatric patients, most injuries are the result of overuse, poor technique, or a combination of the two. An increase in throwing will often precede or exacerbate the onset of symptoms. Studies have demonstrated that the wrist extensor and supinator muscles show increased electromyographic (EMG) activity during the late cocking, acceleration, and follow-through phases of throwing a curve ball due to the posture needed at the point of release of the ball.[22,23] This results in increased tension and stress to the medial muscular and ligamentous structures and subsequent injury. Consideration should be given to limiting the amount of throwing and the use of curve balls. Rest, physical therapy, and instruction in proper throwing mechanics are the keys to proper treatment of these injuries.

The second objective is to increase the functional strength of the elbow with specific attention to the forearm musculature. Wilson et al[14] have described a detailed physical therapy regimen, which they used in five patients with valgus extension overload. Stretching exercises for the flexor and extensor muscles of the forearm are begun and repeated on a daily basis. Isotonic exercises emphasizing high repetition and low weight are used to increase endurance without placing high stress across the elbow. Special attention is specifically directed to the forearm flexors and extensors. Grip exercises, isokinetic programs, and isometrics may also be used for further conditioning and strengthening. Special attention should be directed to an evaluation of shoulder flexibility, especially external rotation, and an appropriate stretching program should be included in the athlete's rehabilitation program.

Fig. 7 Positioning for a valgus stress radiograph. The elbow should be flexed 20 degrees as an anteroposterior view is obtained.

Therapeutic modalities can be used to help control symptomatic episodes of inflammation, but the mainstay of conservative treatment is strengthening and conditioning. Ice, ultrasound, and phonophoresis with 10% hydrocortisone can be used at the discretion of the surgeon with advice from the physical therapist or certified trainer.

The activity of various muscle groups crossing the elbow joint has been studied with the use of electromyography.[24] Glousman et al[25] recently studied EMG findings in normal pitchers and in pitchers with ulnar collateral ligament injuries. In symptomatic patients with valgus instability, the flexor-pronator muscle mass demonstrated decreased EMG activity, and the extensor carpi radialis brevis and extensor carpi radialis longus exhibited increased activity during the late cocking and acceleration phases of throwing. If the flexor-pronator musculature functions as a secondary medial stabilizer of the elbow, muscle activity would be expected to increase in an attempt to stabilize the elbow; however, just the opposite occurred. The authors considered that this reflected either the primary problem that rendered the joint more susceptible to injury or a secondary reactive phenomenon. This study also indicates the potential for successful rehabilitation of throwing athletes by utilizing specific programs for strengthening of the flexor-pronator muscles. In our

practice, this is accomplished by using a set of exercises emphasizing plyometric strengthening of the flexor-pronator muscle mass.

The patient progresses as rapidly as is tolerable through isolated forearm, biceps-triceps, and rotator-cuff strengthening before advancing to functional patterns of exercise, including proprioceptive neuromuscular facilitation and combined flexor-pronator movements. When the patient has achieved normal strength without dysfunction, plyometrics and an interval throwing program for functional progression to normal sports activity are begun.

Plyometrics are exercises that induce a rapid transition from eccentric to concentric muscle contraction and dynamic joint loading. They are designed to develop normal power for sports activity. The specific program we use includes using a baseball or 1- to 2-lb weighted medicine ball for one-hand horizontal baseball throws, throws against a rebounder, and wall bounces at various angles. A two-hand 8- to 12-lb medicine ball is used for push passes, power drops, and left- or right-side passes. Plyometric push-ups are also used.

As strength improves, the athlete can be returned to throwing through an interval throwing program.[26] Icing should be used after practice or throwing sessions to help decrease inflammation. Plyometric exercises should be continued throughout the training period to maintain functional gains.

Surgical Treatment

Surgical treatment should be recommended only for those patients for whom conservative treatment measures have failed. There is a wide spectrum of stability of the elbow, and most patients will demonstrate adequate resolution of symptoms with a concerted effort at nonoperative treatment. The mere presence of loose bodies, spurs, or ligamentous laxity does not indicate the need for surgery unless these lesions are clearly the cause of symptoms and have not responded to other treatment measures.

Arthroscopy

Arthroscopy of the elbow can be used satisfactorily in patients with short- and medium-term duration of symptoms. Rosenwasser[27] has recommended arthroscopy for patients with symptoms of relatively short duration in order to address chondromalacia of the ulnohumeral or radiocapitellar joint or to remove any loose bodies. Chondromalacia can be treated with debridement or drilling as indicated by the arthroscopic findings. A lateral meniscoid lesion or posterolateral plica can be debrided with a shaver through posterolateral portals. This treatment combined with adequate rehabilitation may prevent later changes, such as posteromedial osteophytes of the olecranon.[27]

In patients with long-term symptoms, chondromalacia often occurs due to impingement of the olecranon on the posteromedial olecranon fossa. Osteophytes can occur both posteriorly and medially on the olecranon, as described by Wilson et al.[14] Debridement of these spurs and decompression of the fossa can be accomplished arthroscopically with the use of posterior and posterolateral portals. Additional loose bodies or advanced osteochondritis of the radiocapitellar joint can also be debrided at this time.[28]

The diagnosis of ulnar collateral ligament laxity on the basis of physical examination findings is difficult. Arthroscopy can be used as an aid. Valgus stress testing is performed while directly viewing the ulnohumeral articulation from the anterolateral portal with the elbow in 70 degrees of flexion. An opening of the ulnohumeral space of as little as 1 mm has been reported to be evidence of an undersurface tear of the ulnar collateral ligament and an indication for reconstruction in the symptomatic patient.[18] However, in the experience of the senior author (FHS), many patients with this degree of instability can be successfully treated with rehabilitation or less invasive procedures.

Reconstruction

Reconstruction of the ulnar collateral ligament has been described by Jobe et al[19] as a method of restoring medial stability to the elbow (Fig. 8). An autologous tendon graft from the palmaris longus, the plantaris tendon, or a short-toe extensor is placed in a figure-of-eight fashion through drill holes in the medial epicondyle and the ulna. This procedure is usually combined with an anterior transposition of the ulnar nerve due to the significant incidence of ulnar nerve symptoms in these patients, as well as the necessity of placing the drill holes on the humeral side in the ulnar groove. Of 16 patients reported on by Jobe et al,[19] 10 were able to return to their previous level of competition, 1 was able to return to play but at a lower level of competition, and 5 did not return to play for reasons other than their elbow injury. All patients regained a full range of motion with complete resolution of their preoperative symptoms. The average length of time between surgery and the full return to previous activities was 15 months (range, 11 to 19 months).

Conway et al[6] subsequently reported the results in 14 patients who had undergone repair of the ulnar collateral ligament and 56 patients who had undergone reconstruction for medial instability. Almost all of the patients were athletes competing at a college or professional level of competition. The

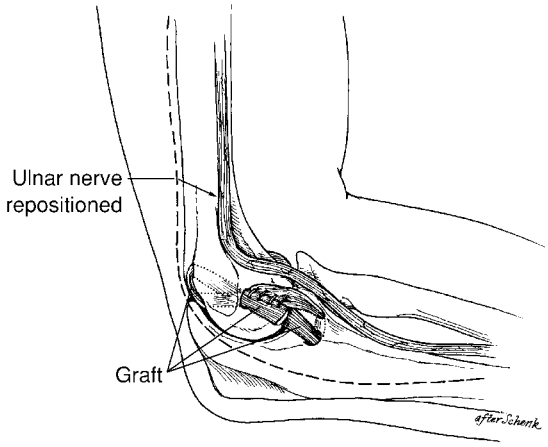


Fig. 8 Reconstruction of ulnar collateral ligament. Ulnar nerve has been transposed anteriorly. Tendon graft is placed in a figure-of-eight fashion through drill holes.

results were rated on the basis of the patient's ability to return to competition at the previous level of play. The results were reported to be excellent in 64% of patients, good in 14%, fair in 14%, and poor in 7%. Previous operative procedures on the elbow were associated with a decreased chance of returning to the previous level of competition. Forty percent of the patients had preoperative symptoms related to the ulnar nerve, and 21% (15) had ulnar nerve symptoms postoperatively. Six of the latter 15 patients had transient ulnar nerve paresthesias that resolved spontaneously, but 8 of the remaining 9 patients underwent revision procedures on the ulnar nerve. Only 2 patients were prevented from returning to their sport by ulnar nerve symptoms.

Conway et al[6] utilized a submuscular transfer of the ulnar nerve and considered that placement of the nerve near the graft may have led to scarring around the nerve and the development of an entrapment neuropathy. At present, however, there is no clear preference for subcutaneous transfer rather than submuscular transfer. The senior author uses both techniques, and we also believe that there is a role for ulnar nerve transposition without reconstruction in patients with isolated ulnar nerve symptoms.

Rehabilitation

In our practice, most patients have been successfully treated nonoperatively with global strengthening of the upper extremity and the use of plyometrics in the selective strengthening of the flexor-pronator musculature. Most of the athletes who do not respond to this rehabilitative program have resumed high school and college sports after an arthroscopic debridement and resumption of the rehabilitation. Surgical reconstruction of the medial collateral ligament should be reserved for high-level (professional or high-caliber collegiate) competitive athletes for whom an extended course of rehabilitation has failed.

Arthroscopy

Postoperative rehabilitation is the single most important factor that determines the success of treatment. After arthroscopic treatment, a bulky dressing is normally used, and the patient is immediately allowed to start range-of-motion exercises. Physical therapy to regain and maintain full range of motion is begun as soon as postoperative pain and swelling subside. After 1 week, elbow-strengthening exercises are begun and are advanced as tolerated by the patient. The decision as to when to allow the patient to return to play is individualized according to the arthroscopic findings and progression of rehabilitation, but all patients normally progress through a gradual throwing program and can usually resume playing within 1 to 3 months.

Reconstruction

The postoperative regimen for reconstruction of the ulnar collateral ligament consists of an initial period of postoperative immobilization during which hand-grip and wrist-mobilization exercises are allowed immediately after surgery. The immobilization is discontinued in 7 to 10 days, and active range-of-motion exercises for the elbow and shoulder are begun with the patient wearing a protective hinged elbow brace. As pain and swelling subside, the patient progresses to gentle strengthening exercises, usually within 4 to 6 weeks. Global strengthening exercises for the shoulder and periscapular muscles are continued throughout the postoperative course. Valgus stress on the elbow should be avoided for at least 4 months.

At 4 months, rehabilitation is individualized according to the sport of the patient. Baseball players are started on an interval throwing program,[26] beginning with easy tossing of the ball over a distance of 35 to 45 ft two to three times a week. The program is combined with warm-up, stretching, and warm-up throwing exercises. Throwing distances are increased as symptoms permit. The occurrence of pain or swelling is an indication to stop further advancement or to regress to a previous level until the symp-

toms have resolved. Proprioceptive neuromuscular facilitation exercises are incorporated into the early postoperative regimen. In our practice, most athletes are able to return to competition within 12 months.

It should be emphasized that Jobe et al[19] and Conway et al[6] performed medial reconstructive procedures in athletes who wished to remain at a highly competitive level of participation. It is not known whether this procedure is indicated for less competitive athletes. Valgus instability of the elbow appears to cause little disability in activities of daily function,[29,30] and good functional results have been reported after nonoperative treatment of ulnar collateral ligament ruptures associated with elbow dislocation.[31] Recent EMG studies indicating a decrease in function of the flexor-pronator muscle mass in athletes with medial instability of the elbow indicate the potential for nonoperative treatment through selective strengthening.[2]

Summary

Valgus extension injuries of the elbow are very common among throwing athletes. There is a wide spectrum of such injuries, ranging from early soft-tissue inflammatory changes, such as medial epicondylitis and posterior lateral plica syndrome, to attenuation and incompetence of the ulnar collateral ligament, and finally proceeding to bone changes, such as chondromalacia, osteochondritis, and posteromedial osteophyte formation. Early treatment should include measures to decrease pain and inflammation, with an initial period of rest and the use of anti-inflammatory medications. Physical therapy is the cornerstone of rehabilitation and should emphasize global upper-extremity strengthening and conditioning of the elbow, with special emphasis on plyometric strengthening of the flexor-pronator muscle mass. In patients who remain symptomatic after an initial course of nonoperative treatment, arthroscopy of the elbow can address many of the early changes within the elbow, including chondromalacia, posterolateral plica, and posteromedial osteophyte formation. Reconstruction of the ulnar collateral ligament should be reserved for those patients who wish to remain active at a highly competitive level and then only after rehabilitation and less invasive procedures have failed. Physical therapy is the key to successful postoperative rehabilitation of these patients and their return to competitive play.

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