Lateral and Medial Epicondylitis of the Elbow

Frank W. Jobe, MD, and Michael G. Ciccotti, MD

Abstract

Epicondylitis of the elbow involves pathologic alteration in the musculotendinous origins at the lateral or medial epicondyle. Although commonly referred to as "tennis elbow" when it occurs laterally and "golfer's elbow" when it occurs medially, the condition may in fact be caused by a variety of sports and occupational activities. The accurate diagnosis of these entities requires a thorough understanding of the anatomic, epidemiologic, and pathophysiologic factors. Nonoperative treatment should be tried first in all patients, beginning with an initial phase of rest, ice, nonsteroidal anti-inflammatory agents, and possibly corticosteroid injection. A second phase includes coordinated rehabilitation, consisting of range-of-motion and strengthening exercises and counterforce bracing, as well as technique enhancement and equipment modification if a sport or occupation is causative. Nonoperative treatment has been deemed highly successful, yet the few prospective reports available suggest that symptoms frequently persist or recur. Operative treatment is indicated for debilitating pain that is diagnosed after the exclusion of other pathologic causes for pain and that persists in spite of a well-managed nonoperative regimen spanning a minimum of 6 months. The surgical technique involves excision of the pathologic portion of the tendon, repair of the resulting defect, and reattachment of the origin to the lateral or medial epicondyle. Surgical treatment results in a high degree of subjective relief, although objective strength deficits may persist.

J Am Acad Orthop Surg 1994;2:1-8

In an austere letter published in *Lancet* in 1882, Henry J. Morris introduced a previously undescribed entity, which he aptly termed "lawn tennis arm." From that seminal description has evolved a vast array of detailed diagnostic and therapeutic treatises on epicondylitis of the elbow. Morris focused on medial epicondylitis as caused by the lawn-tennis backstroke, but subsequent works have greatly expanded both the location and the etiology of this malady. Today, both medial and lateral epicondylitis are associated with a variety of sports activities and occupations.

Lateral Epicondylitis

Anatomy

The musculotendinous structures about the lateral epicondyle of the elbow are those of the common extensor origin, including the extensor carpi radialis longus, the extensor carpi radialis brevis, the extensor digitorum communis, and the extensor carpi ulnaris. The extensor brevis, which is most commonly involved in lateral epicondylitis, lies beneath the extensor longus. The complex origin of the extensor brevis includes the common extensor tendon at the lateral epicondyle, the lateral collateral and annular ligaments, the investing fascia, and the intermuscular septum.

Biomechanics

The normal biomechanics of the lateral epicondylar structures during sport have been most thoroughly described for tennis. Morris and associates[1] evaluated the muscle activity about the elbow during tennis strokes in healthy professional and collegiate players using an electromyographic (EMG) technique. The greatest muscle activity during the groundstrokes was noted in those muscles stabilizing the wrist, specifically, the extensor carpi radialis brevis, the extensor carpi radialis longus, and the extensor digitorum communis. The extensor carpi radialis brevis was noted to have the greatest activity of all muscles tested; this occurred during the acceleration and early follow-through phases. The authors suggested that these muscles provide optimal stability for these phases of

Dr. Jobe is Clinical Professor, Department of Orthopaedics, University of Southern California School of Medicine, Los Angeles. Dr. Ciccotti is Assistant Clinical Professor, Department of Orthopaedic Surgery, Rothman Institute, Thomas Jefferson University Hospital, Philadelphia.

Reprint requests: Dr. Ciccotti, Department of Orthopaedic Surgery, Thomas Jefferson University Hospital, Rothman Institute, 800 Spruce Street, Philadelphia, PA 19107.

the groundstroke by maintaining the position of the wrist in extension and radial deviation.

Epidemiology and Etiology

Lateral epicondylitis typically occurs in the fourth and fifth decades,[2] although it has been identified in patients ranging in age from 12 to 80 years. The male and female prevalence rates appear equal.[3] Seventy-five percent of patients experience symptoms in their dominant arm. Morris' initial implication of racket sports as the primary cause of epicondylitis led to a plethora of works reviewing the possible epidemiologic and etiologic factors in tennis. It is estimated that 10% to 50% of persons who play tennis regularly will experience symptoms of tennis elbow at some point during their careers. In 1979 Gruchow and Pelletier[3] noted an association between playing time and the incidence of tennis elbow in club players. The risk of developing symptoms consistent with tennis elbow was 2.0 to 3.5 times greater in players with over 2 hours of racket time per week than in those who played tennis less than 2 hours per week. Compared with younger players, male and female players over the age of 40 years had a fourfold and twofold greater incidence of tennis elbow, respectively.

Several specific technique, equipment, and playing surface factors have been implicated in the development of lateral epicondylitis. A higher incidence of poor stroke mechanics, such as leading with a flexed elbow and striking the ball off center on the racket, has been identified in affected players. Improper grip size, racket weight, and racket stringing generate higher loads in the lateral muscle-tendon unit. Also, harder court surfaces impart greater momentum to the ball and subsequently increase the force transmitted through the racket to the extensor mass.

Numerous other sports and occupational activities that require forceful or repetitive forearm use have also led to lateral epicondylitis[2] (Table 1).

Pathophysiology

A wide spectrum of theories on the pathophysiology of lateral epicondylitis have been proposed. In 1922 Osgood suggested that inflammation of an extra-articular radial humeral bursa was the primary cause. An inflamed synovial fringe was described by Trethowan in 1929. Fibrositis of the annular ligament resulting from trauma was championed by Bosworth[4] in 1955. Traumatic periostitis of the extensor carpi brevis from repeated wrist extension and forearm supination was advocated by Garden[5] in 1961. Radial nerve entrapment was suggested by Kaplan[6] in 1959, while chondromalacia of the radiocapitellar joint was proposed by Newman and Goodfellow[7] in 1975.

The current consensus based on clinical and surgical evidence suggests that lateral epicondylitis is initiated as a microtear, most often within the origin of the extensor carpi radialis brevis. This process may originate in the extensor digitorum communis or extensor carpi radialis longus tendon as well. The affected tendon usually contains grayish, homogeneous, edematous, friable tissue. Tendon fibers may appear fibrillated, with an apparent sinus tract extending from the elbow joint. In the series of 88 surgically treated elbows reported by Nirschl and Pettrone,[2] 97% demonstrated varying amounts of this gross pathologic tissue at the origin of the extensor carpi radialis brevis tendon. Of those elbows with macroscopic pathologic tissue within the extensor carpi radialis brevis, 35% also demonstrated gross tendon rupture. Nirschl has described a characteristic microscopic appearance of "angiofibroblastic hyperplasia" of the involved tissue. The normal parallel orientation of collagen fibers is disrupted by an invasion of fibroblasts and vascular granulation-like tissue without an acute or chronic inflammatory component.

Diagnosis

Lateral epicondylitis is characterized by pain at the lateral epicondyle, which often radiates into the forearm and is typically insidious in its onset. A history of repetitive activity or overuse can often be elicited.

Examination reveals tenderness over the conjoined tendon origin, usually localized to the extensor carpi radialis brevis portion. The area of maximal tenderness lies 2 to

Table 1
Common Activities Leading to Epicondylitis

	Lateral	Medial
Recreational	Tennis (groundstrokes)	Golf
	Racquetball	Rowing
	Squash	Baseball (pitching)
	Fencing	Javelin throwing
Occupational	Meat cutting	Tennis (serving)
	Plumbing	Bricklaying
	Painting	Hammering
	Raking	Typing
	Weaving	Textile production

5 mm distal and anterior to the midpoint of the lateral epicondyle. Resisted wrist and finger extension with the elbow in full extension will intensify the pain. Range of motion of the elbow and wrist is usually complete. Sensation is typically normal in the extremity, but wrist extensor weakness secondary to pain may be detected.

Radiographs of the affected elbow are usually normal, but 22% to 25% of patients may have calcification within the soft tissues about the lateral epicondyle.[2] The calcification appears to have no prognostic implications and may disappear after treatment.

A thorough evaluation of the neck and entire upper extremity is prudent in patients with lateral elbow pain. The differential diagnosis includes cervical disease with radiculopathy, radial nerve compression at the elbow, and intra-articular elbow disease, such as arthritis or osteocartilaginous loose bodies. If the diagnosis is in doubt, cervical spine radiographs, electrodiagnostic studies analyzing in particular the posterior interosseous nerve, and detailed imaging of the intra-articular anatomy of the elbow may be necessary.

Nonsurgical Treatment

The volumes of orthopaedic literature addressing lateral elbow epicondylitis illustrate the success of nonoperative treatment for this entity. The common objectives of all conservative measures are relief of the pain and reduction of inflammation followed by guided rehabilitation.

Relief of pain and inflammation is the primary goal of the first phase of nonsurgical treatment. Cessation of the offending activity is required initially, but complete inactivity or immobilization is avoided as this may lead to disuse atrophy, which compromises later rehabilitation. Ice is recommended for its local vasoconstrictive and analgesic effects. An oral anti-inflammatory medication should be administered for a 10- to 14-day period if the patient has no medical contraindication to use of such a drug. Those patients who demonstrate some improvement without complete relief may require a second course of medication after a brief period of abstinence.

If the patient does not respond to these initial therapeutic measures, a corticosteroid injection should be considered. The choice and dose of steroid preparation has remained arbitrary, however, since carefully controlled prospective comparisons of commonly used agents have not been done.[8] Care should be taken to instill the mixture deep to the extensor carpi radialis brevis, anterior and distal to the lateral epicondyle, into the fatty subaponeurotic recess. Injection of the mixture superficially may result in subcutaneous atrophy, while intratendinous injection may lead to adverse permanent changes within the tendon ultrastructure. Several short-term studies have evaluated the use of steroid injections. Pain relief was observed in 55% to 89% of patients, but recurrence of symptoms was noted in 18% to 54% of those patients who initially experienced relief.[8]

The physical therapy modalities of ultrasound and high-voltage galvanic stimulation have been used with variable success. However, there are no prospective, randomized, controlled studies to demonstrate their efficacy.

Upon relief of initial pain and inflammation, the second phase of nonsurgical treatment is begun. This phase emphasizes continued tissue healing through avoidance of the abusive aspects of the causative activity and guided rehabilitation. If the patient uses aberrant techniques in sports or occupational activities, these should be identified and corrected. For example, in tennis, the forehand stroke should allow the player to hit the ball in front of the body with the wrist and elbow extended. This allows the torso and upper arm to provide most of the stroke power, rather than the wrist extensors solely. The two-handed backhand stroke allows a distribution of force between the upper extremities, and thus greatly diminishes force at the leading lateral epicondyle.

Proper equipment, especially in the racket sports, is essential to preventing lateral epicondylitis. Proper racket grip size is assessed by measuring from the proximal palmar crease to the tip of the ring finger, along its radial border. Lighter rackets, though providing less momentum, allow ease of positioning for impact. Frames of low-vibration materials, such as graphite and epoxies, dampen impact forces imparted to the extensor origin. Using rackets that are less tightly strung or that have a higher string count per unit area and playing on "slower" surfaces, such as clay courts, will diminish the loads transmitted to the elbow.

Counterforce bracing was introduced by Ilfeld in 1965. Theoretically, this type of brace inhibits full muscular expansion and thus decreases the force experienced by sensitive or injured muscular tissue proximal to the band. Groppel and Nirschl[9] demonstrated with three-dimensional cinematography and surface electromyography that lower extensor muscle activity was produced by the use of counterforce bracing during the tennis serve and one-handed backhand. Snyder-Mackler and Epler,[10] employing the more sensitive indwelling EMG technique, noted significantly reduced muscle activity in the extensor carpi radialis brevis and extensor digitorum communis of healthy subjects during maximum voluntary isometric contraction while using an air-bladder type of counterforce brace. Counterforce bracing may be used during the early rehabilitation period; if pain recurs, the first-phase treatments may be reinitiated.

The rehabilitative program begins with wrist extensor stretching and progressive isometric exercises. Initially, these exercises may be done with the elbow flexed to minimize the pain; then, as the symptoms allow, the exercises are done with the elbow in full extension. As strength, endurance, and flexibility improve, eccentric and concentric resistive exercises are performed. When the patient is capable of sprint repetitions to fatigue without significant elbow symptoms, a sport or job simulation is staged. If it is successfully completed, the patient is encouraged to return to normal activity and to gradually increase the duration and intensity of exposure.

Although most authors report that the majority of patients with lateral epicondylitis respond to nonoperative care, there are few studies on the long-term outcome of nonsurgical treatment. The available literature suggests that 5% to 15% of patients will suffer a recurrence of symptoms, but the majority of these patients with relapses will not have been fully rehabilitated or will have prematurely discontinued preventive measures. In a prospective review of nonoperative treatment, Binder and Hazleman[11] noted that 26% of patients had a recurrence of symptoms and over 40% had prolonged minor discomfort. The previously documented rates of 85% to 90% for successful nonoperative treatment may be somewhat optimistic, and persistent or recurrent symptoms may occur more frequently than has been reported in the past. However, most clinical reports agree that nonoperative management remains the mainstay of treatment for lateral epicondylitis and that surgical treatment is infrequently necessary.

Surgical Treatment

The indications for surgical treatment of lateral epicondylitis include persistent debilitating pain at the lateral epicondyle unresponsive to a well-managed nonoperative program spanning a minimum of 6 to 12 months, after the exclusion of other pathologic causes for the pain.

The history of surgical treatment for lateral epicondylitis spans nearly three quarters of a century and includes a host of techniques of varying popularity. In general, four main approaches have been employed: (1) extra-articular procedures that involve the common extensor origin; (2) intra-articular procedures that excise the synovial fringe and a portion of the orbicular ligament; (3) extra-articular procedures that lengthen the extensor carpi radialis brevis tendon distally; and (4) extra-articular procedures that excise the pathologic tendon and then reattach the origin.

Hohmann initiated the surgical treatment of tennis elbow in 1926 when he described release of the extensor aponeurosis at the level of the lateral epicondyle. Modifications of this extra-articular, tension-relieving technique have ranged from open fasciotomy to percutaneous release and even epicondylectomy. Although proponents of these techniques suggest that proximal release reduces tension at the extensor tendon origin with low morbidity and rapid recovery, there remains concern about persistent postoperative strength deficits, especially in athletes and laborers.

In 1955 Bosworth[4] reported on several variations of an intra-articular technique that included a release of the orbicular ligament at the radial head. The author proclaimed this technique “curative,” most probably due to the inadvertent debridement or removal of the extensor brevis origin that accompanied annular ligament resection. The current consensus on the extensor origin as the primary site of pathologic changes in lateral epicondylitis has led to the conclusion that annular ligament resection is unnecessary.

In 1961 Garden[5] presented an alternate extra-articular method of reducing tension at the extensor carpi radialis brevis origin by open Z-plasty lengthening at its distal musculotendinous junction. Although Garden’s success rate approached 100%, other authors reporting on this technique have been unable to duplicate those results. In fact, subsequent reports have noted persistent pain or recurrence in up to 80% of patients treated in this manner.

We advocate an extra-articular technique wherein the pathologic portion of the extensor tendon origin is excised, the defect is repaired, and the origin is reattached to the epicondyle.

Technique

With the patient supine and the arm supported by an arm board, a tourniquet is applied to the upper arm. An 8- to 10-cm incision centered over the lateral epicondyle is created (Fig. 1, A). The deep antebrachial fascia is incised over the lateral epicondyle and continued distally toward the radiocapitellar articulation. The common extensor tendon is then sharply detached subperiosteally from the epicondyle and reflected distally to expose the lateral compartment of the elbow (Fig. 1, B). The undersurface of the extensor mechanism is inspected for granulation tissue or tears. The degenerated portion of the tendon, including any granulation tissue and fibrillated edges, is sharply excised (Fig. 1, C). Decorti-

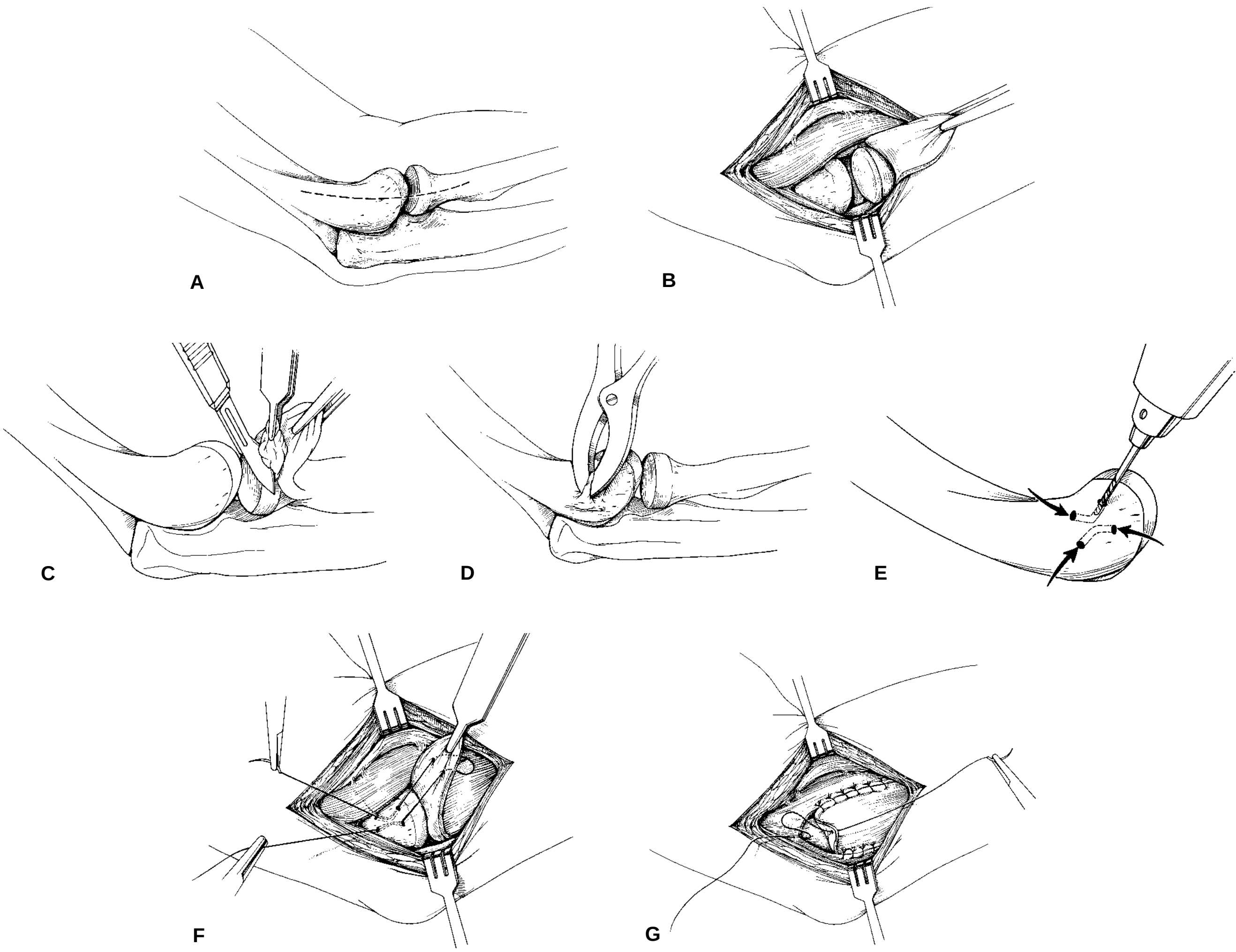

Fig. 1 Technique for surgical treatment of lateral epicondylitis. **A,** Skin incision over the lateral epicondyle. **B,** Distal reflection of the extensor mechanism exposing the lateral compartment of the elbow. **C,** Excision of pathologic tissue from the underside of the extensor mechanism. **D,** Decortication of the lateral epicondyle. **E,** Drilling of two V-shaped tunnels within the lateral epicondyle. **F,** Reattachment of the extensor mechanism to the lateral epicondyle. **G,** Side-to-side repair of the extensor tendon mechanism.

cation of the lateral epicondyle is then performed with a rongeur to provide a bleeding surface for extensor reattachment (Fig. 1, D).

A $\frac{5}{64}$-inch drill is used to create two parallel V-shaped tunnels directed anteroposteriorly in the lateral epicondyle (Fig. 1, E). A heavy suture is passed from posterior to anterior through the proximal tunnel, then through the extensor origin in a horizontal mattress fashion, and finally back from anterior to posterior through the distal tunnel (Fig. 1, F). A side-to-side repair of the extensor mechanism is completed with simple interrupted absorbable sutures (Fig. 1, G).

After closure of the subcutaneous tissues and the skin, a molded posterior plaster splint is applied. The splint is maintained for 7 to 10 days. The patient then begins a progressive mobilization program, including gentle passive and active elbow, wrist, and hand motion. Light resisted isometric exercises are begun by 4 weeks and progressive strengthening by 6 weeks. Return to lifting activities or athletics is usually permissible by the third or fourth month.

Results

Eighty-five percent to 90% of patients who undergo such an extra-articular extensor debridement and repair technique return to full activity without pain. Approximately 10% to 12%, however, are noted to have improvement but with some pain during aggressive activity.[2] In approximately 2% to 3% no appreciable improvement is obtained.[2] In those patients with persistent symptoms, the other previously mentioned causes of lateral elbow pain should be pursued again.

We have reported our experience at the Kerlan-Jobe Orthopaedic Clinic,[12] where 1,140 of 1,200 patients (95%) in whom lateral epicondylitis was diagnosed over a 10-year period have been successfully treated with nonoperative measures. Sixty patients (5%) were unresponsive to nonoperative treatment and subsequently underwent extensor debridement and repair. Thirty-nine of these patients (65%) were seen 2.5 to 10 years after the procedure. Ninety-four percent of the patients reported dramatic improvement in symptoms. The objective outcome measures showed that 36% had limitations with heavy lifting, 15% had grip-dynamometer deficits, and 100% had some degree of isokinetic deficit. These data suggest that the excellent subjective results after surgical treatment do not necessarily correlate with the objective findings of persistent weakness. These complications of persistent pain, residual strength deficits, and functional limitations remain concerns with surgical management of lateral epicondylitis.

Medial Epicondylitis

Anatomy

The musculotendinous structures about the medial epicondyle include the flexor pronator muscle mass origin. From proximal to distal, this includes the pronator teres, the flexor carpi radialis, the palmaris longus, the flexor digitorum superficialis, and the flexor carpi ulnaris. The pronator teres and flexor carpi radialis, which are most commonly involved in medial epicondylitis, both arise from the medial supracondylar ridge.

Biomechanics

The biomechanics of the medial elbow have been most thoroughly defined by the pitching mechanism. Peak angular velocity and valgus forces exceeding the tensile strength of the medial musculotendinous and ligamentous structures may be produced primarily during the acceleration phase, which extends from the point at which forward velocity of the ball is essentially zero to ball release. These forces are transmitted initially to the flexor pronator musculature at the medial epicondyle and subsequently to the deeper medial collateral ligament.

In an EMG evaluation of the tennis serve, Morris and associates[1] corroborated the biomechanical theories of the baseball pitch. They noted that the highest muscle activity occurred during the acceleration phase and was seen in the pronator teres of the flexor pronator mass. They suggested that during this phase the pronator is providing optimal forearm positioning while transferring momentum and power to the ball.

Epidemiology and Etiology

Medial epicondylitis is much rarer than its lateral counterpart, the latter occurring from 7 to 20 times more frequently.[13] It also occurs within the fourth and fifth decades, with apparently equal male and female prevalence rates. Although termed “golfer’s elbow,” medial epicondylitis occurs often in baseball pitchers and in those who participate in a variety of other sports and occupational activities that create valgus force at the elbow[13,14] (Table 1).

Pathophysiology

Valgus forces at the elbow create stress in the flexor pronator origin as well as the medial collateral ligament. Improper technique, poor conditioning, inadequate warm-up, and fatigue can all lead to inflammation of the flexor pronator mass. The pronator teres and flexor carpi radialis have been identified as the most common sites of pathologic change.[2,13] Vangsness and Jobe[15] noted macroscopic tearing of the flexor pronator origin in 100% of their patients who underwent surgical treatment for recalcitrant medial epicondylitis.

In 1992 Glousman and associates[14] used cinematography and indwelling electromyography to examine elbow muscle activity in 30 pitchers with normal elbows and 10 pitchers with medial collateral ligament injuries. They noted less pronator teres and flexor carpi radialis activity during the late cocking and acceleration phases in the subjects with collateral ligament injuries. The authors proposed that flexor pronator overuse subsequently led to progressive medial ligamentous injury in these subjects.

Diagnosis

Medial epicondylitis is characterized by pain along the medial elbow that is worsened by resisted forearm pronation or wrist flexion. This medial pain is often insidious in onset.

Tenderness is usually distal and lateral to the medial epicondyle, most often over the pronator teres and flexor carpi radialis. Resisted wrist flexion and forearm pronation exacerbate the pain. The range of motion of the elbow and that of the wrist are usually complete. Normal strength and sensation are typically noted in the extremity. If, however, concomitant ulnar neuropathy exists, varying degrees of diminished sensibility in the ring and little fingers, as well as a Tinel’s sign at the elbow, may be present.

Plain radiographs of the elbow are most often normal. Throwing athletes however, may have medial ulnar traction spurs and medial collateral ligament calcification.

When evaluating the patient with suspected medial epicondylitis, it is essential to consider primary ligamentous instability or primary ulnar neuropathy in the differential diagnosis. Valgus stress testing with the wrist flexed and the forearm pronated will produce pain and laxity if collateral instability is present. Maximum elbow flexion and wrist extension for 3 minutes (elbow flexion test) will produce pain and numbness if ulnar neuropathy is present.

Nonsurgical Treatment

The basic principles of nonsurgical treatment for lateral epicondylitis apply to medial epicondylitis as well. Phase 1 consists of rest from the offending activity for initial relief of pain and inflammation. The use of nonsteroidal anti-inflammatory agents, galvanic stimulation, and possibly corticosteroid injection may provide adjuvant benefit.

The second phase includes technique enhancement, equipment modification, possibly counterforce bracing, and a rehabilitation program. The rehabilitation program begins with wrist flexor and forearm pronator stretching and progressive isometric exercises. As flexibility, strength, and endurance improve, eccentric and concentric resistive exercises are included. A sport or job simulation is then performed, followed by a gradual return to normal activity. The majority of authors[2,13,15] suggest that medial epicondylitis, like lateral epicondylitis, is most often successfully treated with such a nonsurgical regime.

Surgical Treatment

The indications for surgical treatment of medial epicondylitis include persistent pain at the medial elbow unresponsive to a well-managed nonoperative program for a minimum of 6 to 12 months, after exclusion of any other pathologic causes for the pain.

Historically, there is a dearth of information regarding the surgical treatment of medial epicondylitis. The various techniques that have been described range from percutaneous release of epicondylar muscles to open epicondylectomy. These techniques, however, result in significant flexor-pronator strength deficits that are particularly debilitating for the athlete or laborer. Vangsness and Jobe[15] described the following technique of reactive-tissue excision and flexor-pronator reapproximation for medial epicondylitis.

Technique

With the patient supine and the arm resting on an arm board, a tourniquet is applied. An 8- to 10-cm incision is centered over the medial epicondyle (Fig. 2, A). The common flexor origin is incised sharply and reflected with care not to violate the medial collateral ligament. The position of the ulnar nerve is noted, and the nerve is protected throughout the procedure. The pathologic tissue is identified on the undersurface of the flexor pronator mass and excised (Fig. 2, B). The underlying medial epicondyle is debrided of soft tissue, and multiple small holes are drilled to create a vascular bed. The common flexor pronator origin is then reattached to this bleeding surface with interrupted absorbable sutures (Fig. 2, C). After appropriate subcutaneous and skin closure, a molded posterior plaster splint is applied.

Sponge-squeezing and wrist and hand range-of-motion exercises are initiated immediately. The splint and skin sutures are removed 7 to 10 days postoperatively. Gentle passive and active elbow, wrist, and

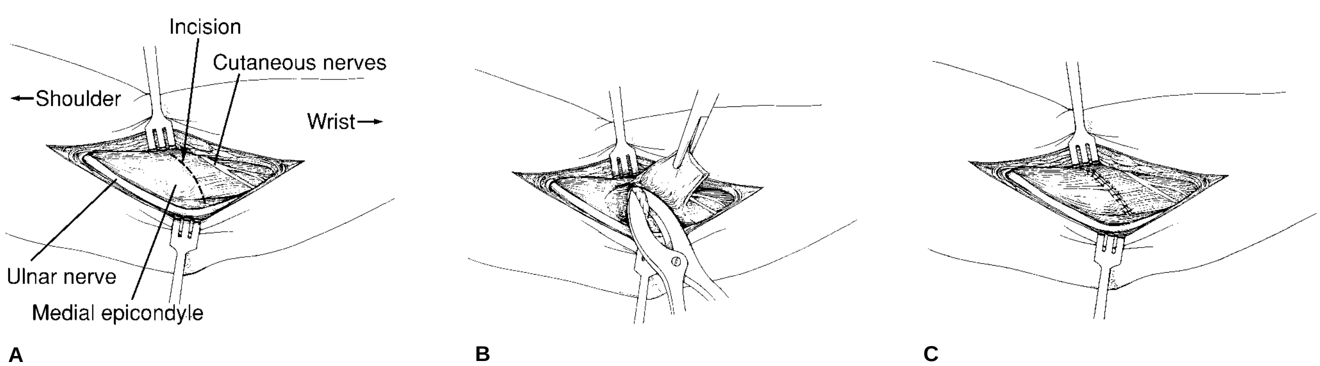

Fig. 2 Technique for surgical treatment of medial epicondylitis. **A,** Skin incision over the medial epicondyle and intended incision of common flexor pronator mass. **B,** Distal reflection of the common flexor pronator origin with debridement of pathologic tissue. **C,** Reattachment of the common flexor pronator origin to the medial epicondyle.

hand range-of-motion exercises are encouraged. Resisted wrist flexion and pronation exercises are initiated at 4 to 6 weeks, followed by a progressive strengthening program. Return to activity is generally attained by the fourth postoperative month.

Results

In a review of 35 patients with recalcitrant medial epicondylitis treated surgically, Vangsness and Jobe[15] noted an improvement in subjective elbow function from 38% to 98% of normal. Excellent or good results were obtained in 97% of the patients, and 86% had no limitation in the use of the elbow. Isokinetic and grip-strength testing in 16 patients revealed no significant difference between those elbows that had been treated surgically and those that had not. All of the 20 athletically active patients returned to their sport. The surgical treatment for recalcitrant medial epicondylitis is efficacious in relieving pain and allowing return to previous activities; however, the complication of residual strength deficit remains a concern.

Summary

Since the first description of epicondylitis of the elbow in 1882, there has been a plethora of descriptive, diagnostic, and therapeutic reports detailing every aspect of this entity. It is now known that epicondylitis can be caused by occupational activities as well as by sports participation, that its diagnosis may be confused with that of a variety of other pathologic entities affecting the elbow, and that the majority of patients will respond favorably to a well-guided nonoperative treatment program.

References

1. Morris M, Jobe FW, Perry J, et al: Electromyographic analysis of elbow function in tennis players. *Am J Sports Med* 1989;17:241-247.
2. Nirschl RP, Pettrone FA: Tennis elbow: The surgical treatment of lateral epicondylitis. *J Bone Joint Surg Am* 1979; 61:832-839.
3. Gruchow HW, Pelletier D: An epidemiologic study of tennis elbow: Incidence, recurrence, and effectiveness of prevention strategies. *Am J Sports Med* 1979;7:234-238.
4. Bosworth DM: The role of the orbicular ligament in tennis elbow. *J Bone Joint Surg Am* 1955;37:527-533.
5. Garden RS: Tennis elbow. *J Bone Joint Surg Br* 1961;43:100-106.
6. Kaplan EB: Treatment of tennis elbow (epicondylitis) by denervation. *J Bone Joint Surg Am* 1959;41:147-151.
7. Newman JH, Goodfellow JW: Fibrillation of head of radius as one cause of tennis elbow. *BMJ* 1975;2:328-330.
8. Price R, Sinclair H, Heinrich I, et al: Local injection treatment of tennis elbow: Hydrocortisone, triamcinolone and lignocaine compared. *Br J Rheumatol* 1991;30:39-44.
9. Groppel JL, Nirschl RP: A mechanical and electromyographical analysis of the effects of various joint counterforce braces on the tennis player. *Am J Sports Med* 1986;14:195-200.
10. Snyder-Mackler L, Epler M: Effect of standard and Aircast tennis elbow bands on integrated electromyography of forearm extensor musculature proximal to the bands. *Am J Sports Med* 1989;17:278-281.
11. Binder AI, Hazleman BL: Lateral humeral epicondylitis: A study of natural history and the effect of conservative therapy. *Br J Rheumatol* 1983; 22:73-76.
12. Ciccotti MG, Lombardo SJ: Medial and lateral epicondylitis, in Jobe FW (ed): *Upper Extremity Injuries in Sports*. St Louis: CV Mosby (in press).
13. Leach RE, Miller JK: Lateral and medial epicondylitis of the elbow. *Clin Sports Med* 1987;6:259-272.
14. Glousman RE, Barron J, Jobe FW, et al: An electromyographic analysis of the elbow in normal and injured pitchers with medial collateral ligament insufficiency. *Am J Sports Med* 1992;20:311-317.
15. Vangsness CT Jr, Jobe FW: Surgical treatment of medial epicondylitis: Results in 35 elbows. *J Bone Joint Surg Br* 1991;73:409-411.