Arthroscopic Treatment of Lateral Epicondylitis

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Abstract: Lateral epicondylitis is a common orthopedic condition affecting up to 3% of the American population. Rest, activity modification, and conservative therapies are generally efficacious in relieving symptoms in the majority of patients; however, a small percentage of people will experience refractory pain and require surgical intervention to alleviate their discomfort. Surgical release of the extensor carpi radialis brevis tendon origin can be done through an open, percutaneous, or arthroscopic approach. Many authors report high success rates among these 3 procedures. A host of anatomic and cadaveric studies have highlighted the locations of important neurovascular and soft-tissue structures, helping to make the arthroscopic approach to lateral epicondylitis safer. In this study, we present the operative technique used by our senior authors for the arthroscopic management of lateral epicondylitis. In addition, our initial clinical experience and outcomes are presented. It appears that all 3 surgical approaches result in high success rates with a trend toward earlier return to work and full activity with less invasive procedures.

Key Words: lateral epicondylitis

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EPIDEMIOLOGY

Lateral epicondylitis, more commonly known as "tennis elbow," is a very common orthopedic condition affecting between 1% and 3% of the population.[1] Patients suffering from this condition are usually in their fourth or fifth decade of life. There is no difference in the incidence of the condition between men and women. Although the exact etiology and pathophysiology of the condition is not fully understood, it is generally accepted that lateral epicondylitis results from repetitive wrist extension and alternating forearm pronation and supination. A variety of modalities, both conservative and surgical, are used to help alleviate the pain that characterizes this condition. Most patients will do well with nonoperative treatment over time with up to 80% reporting symptomatic improvement at 1 year.[2–4] Despite this high response rate, a subset of patients will experience residual symptoms and surgical intervention is recommended for pain relief and functional return. In high-volume referral practices, up to 25% of patients may be candidates for surgery.[5] A host of poor prognostic factors have been identified among those patients with a poor response to nonsurgical interventions including manual labor, dominant arm involvement, long duration of symptoms with high baseline pain levels, and poor coping mechanisms.[3]

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ANATOMY

The lateral epicondyle is a pyramid-shaped bony prominence.[6] The posterior face of this pyramid is where the anconeus muscle originates whereas the extensor carpi radialis brevis (ECRB) and extensor digitorum communis (EDC) origins lie on the anterior surface. Slightly cephalad, on the anterior aspect of the supracondylar ridge, the origins of the extensor carpi radialis longus and brachioradialis are seen. Together, the ECRB and EDC comprise the common extensor tendon origin. Pathologic damage in lateral epicondylitis occurs in the more superior and deeper fibers of the ECRB. The apex of the epicondyle gives rise to the lateral collateral ligament (LCL) complex consisting of the lateral ulnar collateral ligament, radial collateral ligament, and annular ligament.[7] Just proximal to the radiocapitallar jont, the radial nerve courses between the muscle bellies of the brachialis and brachioradialis. The radial nerve sends terminates with the posterior interosseous nerve (PIN) and superficial radial nerve at the level of the radial head. The PIN innervates the supinator by diving deep into its fibers in the so-called radial tunnel, a potential site of nerve entrapment that has been implicated as a source of pain in refractory cases of lateral epicondylitis.[8] Intra-articular and extra-articular structures are likely to be responsible for the pain experienced by patients afflicted with this condition. Indeed, free nerve endings have been isolated in the aponeurosis and granulation tissue around the lateral epicondyle that have receptors for neurokinin 1.[9,10] Several case series have shown a high incidence of intra-articular pathology, including plical folds and synovitis.[11–13]

HISTOLOGY

Characteristic microscopic findings of tissue samples from diseased ECRB tendon insertion sites show noninflammatory angiofibroblastic tendinosis with neovascularization, a disordered collagen scaffold and mucoid degeneration.[12] Hallmarks of acute inflammation are almost never seen and Nirschl et al[12,14] have reported that up to 50% of patients with affected ECRB will also have degeneration of the EDC as well.

PATIENT EVALUATION

Sharp pain, made worse by wrist extension, is the most common and reliable finding among patients with lateral epicondylitis. Pain may also be elicited from passive wrist flexion with the arm extended or resisted extension of the middle fingers. A history of repetitive activity is often noted but many patients experience an insidious onset of symptoms as well.

PHYSICAL EXAMINATION

The classic presentation for a patient with lateral epicondylitis is the presence of maximal tenderness slightly anterior and distal to the lateral epicondyle over the origin of the EDC and ECRB muscles. Patients may sometimes be most tender over the bony apex of the lateral epicondyle. Erythema, induration, and warmth are usually not present upon physical examination. The most reliable physical finding suggestive of the diagnosis is the reproduction of pain with resisted wrist and digit extension. However, the elbow joint should be thoroughly examined and taken through its full arc of motion, including valgus and varus stress testing so as to identify any intra-articular pathology or ligamentous injury. It is always important to examine the cervical spine in patients with any upper extremity complaint to rule out radiculopathy.

DIFFERENTIAL DIAGNOSIS

Several conditions may mimic or coexist with lateral epicondylitis and a careful physical examination and history are essential to differentiate among these diagnostic entities. Radial tunnel syndrome results from the compression of the PIN but usually does not cause pain with resisted wrist extension. Crepitus and decreased range of motion are more likely indicative of osteochondral radiocapitellar lesions or a posterolateral elbow plica.

IMAGING

Lateral epicondylitis is a clinical diagnosis and routine imaging studies are not necessary when the history and physical examination support the presence of the condition. Magnetic resonance imaging may be helpful in defining suspected intra-articular pathology, the extent of ECRB tearing and the integrity of the radial collateral ligament complex. Ultrasound can identify intrasubstance tears, hypoechoic areas, peritendinous fluid, and thickening of the common extensor origin; however, this modality is user-dependent and most sensitive and specific when conducted by experienced individuals.[15]

TREATMENT OPTIONS

Nonsurgical treatment modalities are the first steps in managing lateral epicondylitis. A combination of activity modification, rest, and nonsteroidal anti-inflammatory drugs (NSAIDs) are often highly effective at reducing inflammation and tendon strain, thereby promoting cellular repair. Though lateral epicondylitis is more aptly termed a tendinosis rather than a tendonitis, NSAIDs may relieve pain from associated synovitis or acute inflammation in the surrounding adipose, connective, and muscle tissue.[14] However, after conducting a multi-center, double-blind randomized trial, Labelle and Guibert[16] recommended against using NSAIDs for treating lateral epicondylitis. The investigators found that whereas patients in the treatment group reported less subjective pain, the lack of improved grip strength and functional ability coupled with gastrointestinal side effects were considered risks that did not exceed the benefits. Similarly, another double-blind randomized control trial comparing a 2-week course of naproxen to placebo showed no significant difference in treatment effect at 4 weeks, 6 months, and 12 months.[17] Topical NSAID use has produced mixed results in the literature.[18] Physical therapy, of varying duration and regimens, is frequently prescribed for lateral epicondylitis. Most protocols focus on increasing forearm strength, endurance, and flexibility combining aspects of eccentric, concentric, and isometric muscle contractions.

Steroid injection can be quite effective at reducing painful symptoms from lateral epicondylitis. Studies have shown that steroid injections are better at reducing pain in the short-term follow-up period (5 d to 6 wk).[2,4,17,19] However, with longer-term follow-up (12 wk to 12 mo), it seems that patients receiving steroid injections are the same or worse than those receiving other treatment modalities.[4,19] Steroid injections do have known side effects including skin depigmentation, fatty atrophy, decreased collagen production, and decreased tenocyte replication. Typically, our senior authors will inject up to 3 times over the course of a year before recommending alternative therapies.

The proximal forearm band and the cock-up wrist splint are the most commonly used orthotic devices for treating lateral epicondylitis. These products are designed to relieve tension at the common extensor tendon origin helping to promote healing. There is no uniform consensus as to which brace is better or whether bracing even works as some clinicians feel that the devices may hinder recovery.[20]

Newer treatment modalities include extracorporeal shock waves, laser light, and noncoherent light therapy. Recently, some investigators have shown success with the use of injected platelet-rich plasma and other blood products for the treatment of lateral epicondylitis.[21,22] The mechanisms by which these therapies work are poorly understood and the available outcome data have yielded conflicting results from study to study.[23–27]

When conservative therapy fails and patients are experiencing pain and functional disability for more than 6 months, surgical management of lateral epicondylitis is recommended. There are 3 surgical options available to the patient: open debridement, percutaneous ECRB release, and arthroscopic debridement. The focus of this review article will be arthroscopic ECRB debridement, but for the sake of completeness, the other 2 procedures will be briefly discussed.

The open surgical technique requires a 3-cm incision centered just distal to the lateral epicondyle. The common extensor tendon origin is exposed through sharp dissection followed by debridement of degenerative tissue within the ECRB and decortication of the lateral epicondyle. If possible, the remaining ECRB tendon is reattached, although many surgeons prefer not to reattach the remaining ECRB.[12,28–31] Percutaneous releases can also be performed without reattaching the remaining ECRB tendon.

OPERATIVE TECHNIQUE

The operative technique outlined in this article is based upon our senior authors' (A.A.R., M.S.C., B.J.C.) extensive experience in performing this procedure and the findings of several anatomic studies.[32]

Positioning

The procedure is performed with the patient lying in the lateral decubitus or prone position. The extremities are well padded and the iliac crests are padded with a cylindrical rolled bolster. Beneath the arm a rolled blanket is placed allowing the elbow to flex to 90 degrees. A tourniquet is placed as proximal as possible. After routine prepping and draping, bony landmarks are sketched on the patient's skin and include the olecranon, lateral epicondyle, and medial epicondyle. The course of the ulnar nerve is also traced to constantly remind the surgeon of its location (Fig. 1). The tourniquet is inflated to a cuff pressure of 250 mm Hg and the extremity is exsanguinated.

The soft spot, outlined by the lateral epicondyle, radial head, and olecranon is identified by palpation and used as the entry point for joint insufflation with 20 to 30 cc of normal saline. Arthroscopic portals are drawn next. The medial viewing portal is located just anterior to the intermuscular

FIGURE 1. Anatomic landmarks drawn on skin.

septum, approximately 1 cm anterior to the medial anterior humeral surface and 2 cm proximal to the medial epicondyle[33] (Fig. 2).

The lateral working portal is located 1 cm anterior and 2 cm proximal to the lateral epicondyle. The portal sites are injected with a mixture of 0.25% bupivicane and epinephrine. A skin incision is made over the site of the medial portal and a hemostat is inserted through the fascia and used to bluntly dissect in the immediate vicinity of the joint capsule. A blunt trocar is inserted through the incision to pierce the joint capsule to introduce the arthroscope. The scope cannula is always directed toward the anterolateral edge of the humerus toward the radial head. After entering the joint, the trocar is removed and a standard 30-degree arthroscope is introduced. Many investigators feel that the procedure is facilitated by the use of a smaller arthroscope but in our experience this has not been necessary.

A diagnostic arthroscopy is performed before the creation of the lateral working portal. Again, this portal is located 2 cm proximal and 1 cm anterior to the lateral epicondyle. An 18-gauge spinal needle is introduced into the joint to localize the

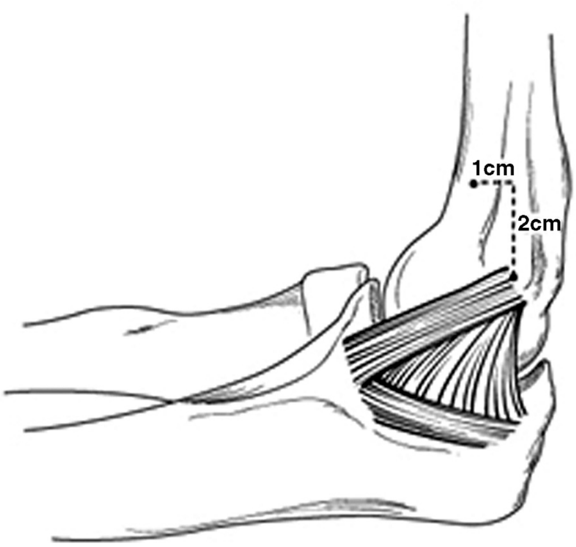

FIGURE 2. Location of medial portal.

correct position and to ensure that the arthroscopic instruments can be effectively used. A small stab incision is made over the lateral portal entry site and a 5.25 mm threaded cannula is introduced. Next, a 3.5 mm mechanical shaver is inserted through the cannula and the procedure is initiated. Paying careful attention to the location of the PIN at all times, debridement of the ECRB origin commences with the shaver blade always directed away from the nerve. Our anatomic studies have shown that the nerve passed through the Arcade of Frohse on an average distance of 30 ± 7 mm distal to the radiocapitellar joint (Fig. 3). From the lateral epicondyle the mean distance was 47 ± 8 mm to the Arcade of Frohse.[32]

The site of debridement is trapezoidal in shape and approximately 13×7 mm of the ECRB origin will be debrided. The known dimensions of the shaver facilitate accurate arthroscopic resection (Fig. 4).

Step 1

The origin of the ECRB tendon is extra-articular and must be visualized during the procedure. As such, the joint capsule must be resected and this is accomplished with either a shaver or an electrothermal device. The release point of the joint capsule is above the midline of the radiocapitellar joint anteriorly. Once the tendon comes into view the surgeon might see that its attachment site has already been torn. Debridement of the insertion site continues (Figs. 5, 6).

Step 2

Next, the area just below the superior capitellum is resected, which is proximal to the ECRB. The resection stops once the extensor carpi radialis longus fibers come into view. The anterior margin of tendon resection is delineated by the superior aspect of the capitellum (Figs. 7, 8).

Step 3

Resection of the region just anterior to the LCL is performed next. The LCL marks the posterior boundary of the arthroscopic resection. Careful attention is paid during this part of the procedure so as to avoid damage to the LCL (Fig. 9).

Step 4

Next, the resection is transferred to the region of the EDC ridge and the fibrous origin posteroinferiorly. It is important to stop at the fibrous origin of the EDC, which is superficial to the ECRB (Fig. 10).

Once the release is completed attention is turned to decortication of the epicondyle origin with either a shaver and burr or a hand-held rasp. Here again, careful attention must be paid to avoid damage to the LCL or the EDC tendon. No attempt is made to repair the ECRB after it is released.

The wounds are closed using interrupted #3 nylon sutures placed in a figure-of-eight manner. The tourniquet is deflated and a sterile compressive dressing is applied from the wrist to the axilla and the arm is placed in a sling. Patients are encouraged to ice regularly during the first 72 hours and begin immediate gentle passive range of motion. The sutures are removed at 7 to 10 days, but patients can shower with waterproof dressing placed over the incisions at 72 hours. Formal occupational therapy begins at 10 days and continues for 6 to 8 weeks. The sling is discontinued as comfort improves and active range of motion incorporating the wrist extensors and elbow supination is avoided for 3 to 4 weeks to avoid inciting inflammation at the surgical site. Return to higher-level activities is avoided for the first 8 to 12 weeks.

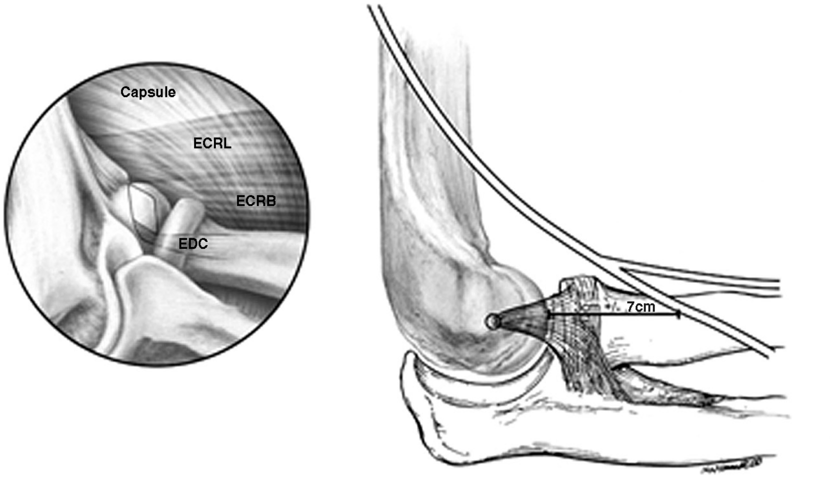

FIGURE 3. Distance from radiocapitellar joint to the arcade of Frohse and the posterior interosseus nerve. Reprinted with permission from *Orthop Tech Review.* 2002;4:206.[34]

DISCUSSION

In 1979, Nirschl and Pettrone[12] published their results on the outcome of open surgical treatment of lateral epicondylitis. Their procedure, consisting of inspection and excision of the abnormal appearing ECRB tendon, inspection of the anterior edge of the EDC, and arthrotomy of the elbow joint served as the template for a host of subsequent minor variations to come. They reported good or excellent results in 75 of 88 patients with an overall improvement rate of 97.7% and 85.2% of patients returned to full activity including rigorous sports.[12] Several studies corroborate these high success rates. Goldberg et al[35] reported good or excellent results in 31 of 34 (91%) patients treated with an open surgical release of the common extensor tendon for lateral epicondylitis refractory to conservative management of at least 6 months duration. Posch et al[36] reported good or excellent outcomes in 37 of 43 (86%) patients receiving an extensor fasciotomy technique for the management of the tennis elbow. They also found that their initial results held up for an average of 8 years suggesting good long-term results. Verhaar et al[37] conducted a long-term prospective study on the outcome results of lateral release of the common extensor origin in 57 patients followed for a mean of 59 months (range, 50 to 65 mo). At 1 year, 69% of patients reported good or excellent outcomes, a rate that increased to 89% after 5 years. Ninety-one percent of patients had no pain or only slight pain at the time of final follow-up.[37]

However, despite these high success rates, mild persistent intermittent pain has been documented after open surgical release for lateral epicondylitis. A case series of 19 patients treated with open extensor tendon release and reattachment found that 18 of 19 patients were "better," yet 6 (60%) of those playing high-demand sports and 2 (15%) of those with high-demand employment changed jobs or sports postoperatively.[31] Another long-term study of 63 patients who underwent open release found that 40% of patients had persistent pain at 6 weeks postoperatively. This rate ultimately decreased to 24% and then 9% at 1 and 5 years postoperatively, respectively.[37]

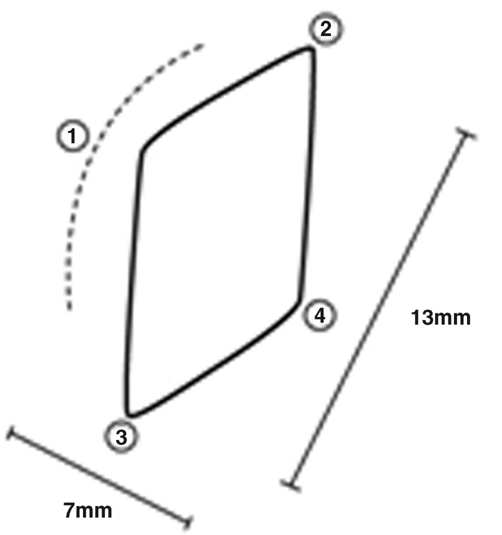

FIGURE 4. Illustration of insertion of ECRB. Reprinted with permission from *Orthop Tech Review.* 2002;4:206.[34]

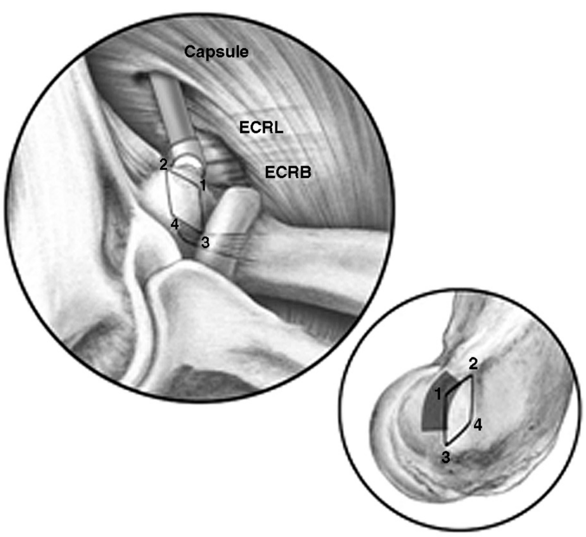

FIGURE 5. Step 1. Reprinted with permission from *Orthop Tech Review.* 2002;4:206.[34]

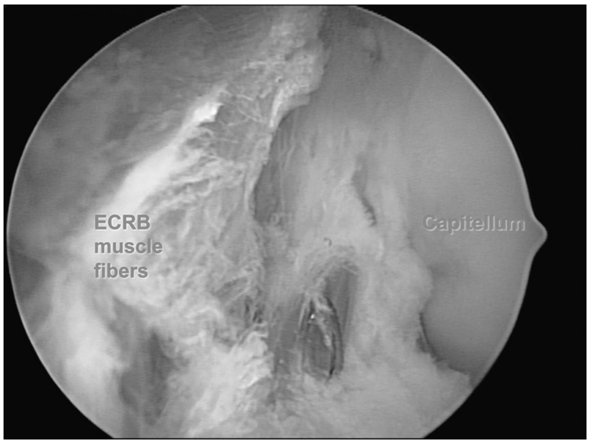

FIGURE 6. Arthroscopic view of torn muscle fibers.

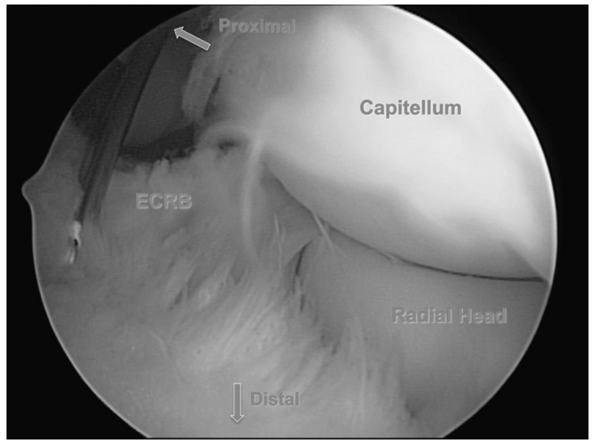

FIGURE 8. Arthroscopic approach to radiocapitellar joint.

Minimally invasive procedures for the management of lateral epicondylitis date back to about 1995. First described by Grifka et al,[38] these investigators outlined an endoscopic technique that used an arthroscope and 2 stab incisions, one 5 cm above the lateral epicondyle in the dorsolateral aspect of the arm and the second 3 to 4 cm distal to the lateral epicondyle with the arm bent at 90 degrees. The ECRB was incised with an electrotome in a proximal-to-distal manner. However, there was no follow-up among the 30 patients whom they operated upon. It was Baker and Cummings[39] who described the first purely arthroscopic technique for treating lateral epicondylitis in 1998. Their procedure consisted of a lateral capsule excision, debridement of the undersurface of the ECRB, and decortication of the lateral epicondyle. In a retrospective review of arthroscopic releases for lateral epicondylitis, Baker and Cummings[39] found that all patients available for follow-up at an average of 2.8 years were rated "better" or "much better." Patients returned to work early and grip strength averaged 96% of the strength of the unaffected limb.[11] The investigators also showed that the early high rate of success in patients was maintained at long-term follow-up. Thirty patients from the original study group (30 elbows) were located for an extended follow-up at a mean of 130 months. Using a visual analogue pain scale (VAS), the mean pain score at rest was 0, 1 with activities of daily living, and 1.9 with work or sports. Out of a possible 12 points, the mean functional score was 11.7. No patients required further treatment after the initial surgery although 1 patient chose to wear a brace with heavy activities.[40] Owens et al[41] reported similar findings at an average of 2 years of follow-up with all patients reporting improvement from their preoperative status and returning to unrestricted work at an average of 6 days postoperatively.

Three of the senior authors, B.J.C., M.S.C., and A.A.R., have extensive experience with arthrosocpic management of refractory lateral epicondylitis. One of their earliest cohorts evaluated consisted of 36 patients, most of whom were heavy manual laborers with refractory lateral epicondylitis between January 2001 and January 2004. The average age at time of surgery was 42.3 years and the average time elapsed between onset of symptoms and surgery was 18.9 months. The subjective pain rating (VAS) improved from 1.5 ± 1.3 to 8.1 ± 2.4 $P \leq 0.012$. The physical examination showed an

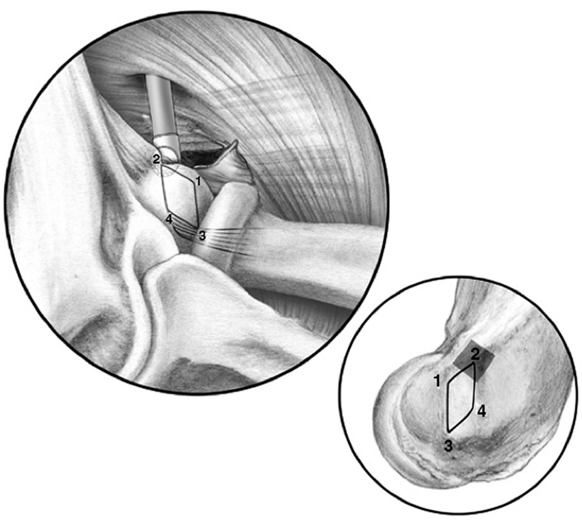

FIGURE 7. Step 2. Reprinted with permission from *Orthop Tech Review.* 2002;4:206.[34]

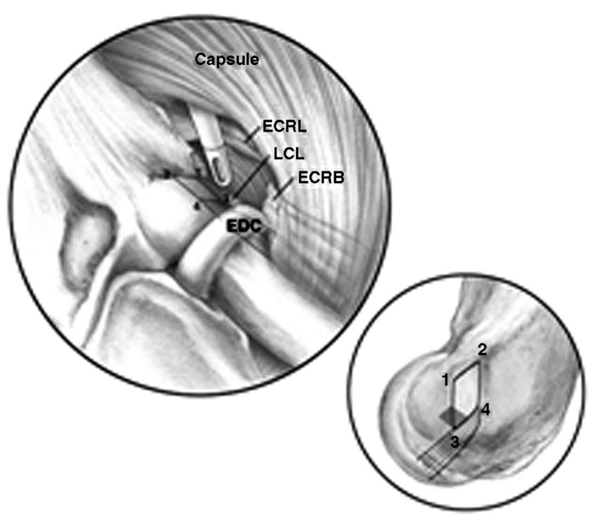

FIGURE 9. Step 3. The number 3 on the inset represents the collateral ligament. Reprinted with permission from *Orthop Tech Review.* 2002;4:206.[34]

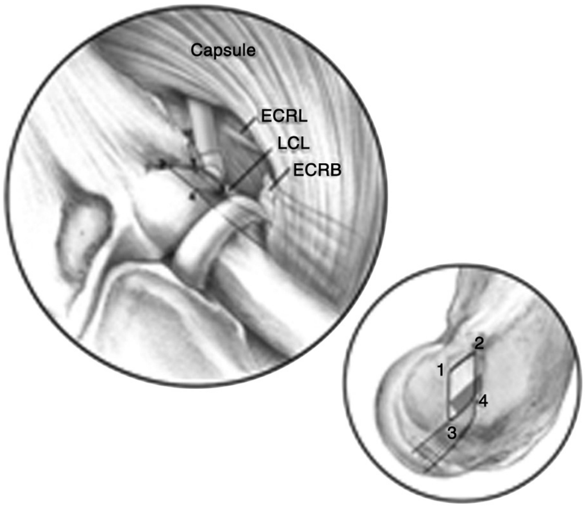

FIGURE 10. Step 4. Reprinted with permission from *Orthop Tech Review.* 2002;4:206.[34]

average extension of 3.4 degrees (range, −5 to 15 degrees) and flexion of 125degrees (range, 90 to 147 degrees). No patient had more than a 10-degree difference in the range of motion for flexion or extension compared with the opposite side. The overall grip strength measured as a percentage of the opposite side was 91% (41 to 100%). These results suggest that arthroscopic release of the ECRB is an effective procedure in the immediate and short-term follow-up period.

Arthroscopic release of the ECRB for refractory lateral epicondylitis is a relatively simple and straightforward procedure. The few clinical studies reporting on the short-term and long-term outcomes of the procedure suggest that it is a highly effective operation and enables patients to become pain free and return to work very quickly. Although there are important neurovascular structures and ligamentous complexes that require special attention by the surgeon, a host of anatomic studies have helped define the safe zones for portal placement and debridement.[42,43] The arthroscopic data reviewed in this article come exclusively from level IV studies that are limited by small patient sample sizes, the lack of consistent and validated outcome measures, and various postoperative regimens, each of which adds a degree of uncertainty to the validity of the high success rates reported.

Although a few comparative studies can be found in the literature comparing the open, percutaneous, and arthroscopic techniques, insufficient data are available to favor 1 procedure over the other. Nevertheless, the findings suggest similar outcomes in all treatment groups with a trend toward a quicker return to full activity with the less-invasive procedures. Peart et al[30] carried out a retrospective nonrandomized study comparing treatment with open release versus arthroscopic release. Eighty-seven patients were treated: 54 with open procedures and 33 with arthroscopic procedures. Results showed no significant difference in outcomes with 69% of open cases and 72% of arthroscopic cases having good or excellent outcomes. The authors did find that the arthroscopic cohort returned to work earlier and required less postoperative therapy than the open group.[30] Szabo et al[44] published the only study comparing the surgical results of lateral epicondylitis with all 3 techniques. Using the Andrews–Carson score and the VAS, all 3 groups improved substantially at an average follow-up of 4 years. Dunkow et al[29] conducted a randomized controlled trial of tennis elbow surgical treatment, comparing the open Nirschl procedure with percutaneous release and found substantial differences in the mean time to return to work: 2 weeks for the percutaneous group and 5 weeks for the open group.

CONCLUSIONS

The majority of individuals suffering from lateral epicondylitis will improve with rest, activity modification, and conservative treatment. In the small percentage of patients that go on to experience refractory symptoms, surgical management is safe and efficacious. Open debridement, percutaneous, and arthroscopic releases are currently the treatments of choice as there is no significant body of high-level evidence favoring 1 procedure over another. However, the available data do suggest that with the less-invasive approaches patients do return to work and full activity sooner. Our senior authors report excellent outcomes with the arthroscopic technique. However, the surgical technique chosen should generally be based on the surgeon's experience, safety record, and level of comfort with the procedure.

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