SPOTLIGHT ON soft tissue

cme ARTICLE

Lateral Epicondylitis

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educational objectives

As a result of reading this article, physicians should be able to:

1. Identify the typical presentation of lateral epicondylitis based on history and physical examination.

2. Review the pathophysiology underlying the development of lateral epicondylitis and resulting histology.

3. Describe the first-line conservative therapy options for lateral epicondylitis and the supporting data in the literature.

4. Discuss the indications for initiating operative therapy and detail the operative options for lateral epicondylitis.

Lateral epicondylitis is the most common cause of lateral elbow pain presenting to the orthopedic surgeon, with an estimated occurrence in 4 per 1000 patients.[1,2] Every year 1% to 3% of adults are affected by lateral epicondylitis, with an equal prevalence between men and women.[3,4] Patients typically present in the fourth to fifth decade of life with symptoms more commonly in their dominant arm. While commonly called "tennis elbow," this condition affects many individuals who never pick up a tennis racket. Lateral epicondylitis is generally a self-limited condition with most patients having symptomatic relief within 1 year through nonsurgical management and modification of activities. Five to 10% of patients are recalcitrant to conservative therapy and may eventually require surgical intervention to relieve lifestyle-limiting symptoms.[5-10]

Pathoanatomy

While many etiologies have been proposed, the most accepted theory holds that lateral epicondylitis is a result of cumulative microtrauma resulting from repetitive wrist extension and alternating forearm supination and pronation.[11] The extensor carpi radialis brevis origin is most commonly implicated as the specific site of pathology.[6,12] Lateral epicondylitis is better described as a process of tendinosis rather than tendinitis, seen histologically as initial fibroblastic hyperplasia, followed by vascular hyperplasia and the production of abnormal collagen. In contrast, an inflammatory process would be distinguished by an increased number of lymphocytes and neutrophils.[13] The accumulation of internal microtears leads to a cellular response characterized by a noninflammatory, degenerative and avascular process that Nirschl termed angiofibroblastic tendinosis.[5]

Bunata et al[14] studied the bony and tendinous anatomy of the elbow joint in cadavers, and showed that the origin of the extensor carpi radialis brevis tendon

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impinges on the lateral edge of the capitellum during elbow extension and flexion. Cellular changes have been noted in patients with lateral epicondylitis, however, these changes may be more reactionary than the inciting event.[15-17]

CLINICAL PRESENTATION

Patients frequently describe an insidious onset of pain with no history of a particular traumatic event. On examination, pain is typically located anterior or just distal to the lateral epicondyle. Patients will often report a sharp pain exacerbated when carrying items in their hand, particularly with the arm in neutral rotation. On physical examination, patients report tenderness to palpation distal to the involved epicondyle, in particular over the origin of the extensor carpi radialis brevis. Practitioners can reproduce the patient's pain with resisted extension of the wrist or third finger.

The Thomson test18 (Table 1) is a provocative test performed with the patient's shoulder flexed to 60°, elbow extended, forearm pronated, and the wrist extended 30°. The examiner will then apply pressure to the dorsum of the send and third metacarpals to stress the extensor carpi radialis brevis and extensor carpi radialis longus. Several other provocative tests aid in the diagnosis of lateral epicondylitis; including the Chair Test,[19] Bowden test,[19] Cozen's test,[19] and Mill's test.[20] Grip strength can be tested and compared with the contralateral side as patients often report weakness when gripping items.[19]

Table 1

Provocative Tests for Lateral Epicondylitis

Test Name	Performance of Test
Thomson[19]	Flex patient's shoulder to 60° with elbow extended, forearm pronated, and wrist extended 30°. Apply pressure to the dorsum of the second and third metacarpals in the direction of flexion and ulnar deviation.
Chair[19]	Have patient lift a light chair by the chair back with the elbow extended and forearm pronated.
Bowden[19]	Have patient squeeze a blood pressure cuff to maintain a particular pressure.
Cozen's[19]	Have patient flex elbow and extend wrist against resistance.
Mill's[20]	Have patient extend elbow and flex wrist against resistance.

DIFFERENTIAL DIAGNOSIS

Radial tunnel syndrome is caused by entrapment of the posterior interosseous nerve, usually as it passes between the superficial and deep parts of the supinator muscle. On physical examination these patients will display pain with resisted supination with the elbow flexed 20° (when the nerve is trapped in the supinator) or pain with resisted middle finger extension with the elbow fully extended (Maudsley's test).[21]

It is important to evaluate the integrity of the lateral collateral ligament on initial examination. Insufficiency of the lateral collateral ligament with progression to posterolateral rotatory instability should be considered in patients with either persistent or recurrent symptoms of tennis elbow who have undergone treatment for lateral epicondylitis. Incompetence of the lateral collateral ligament has been attributed to both iatrogenic injury during lateral epicondylitis surgery[22,23] and repeated corticosteroid injections.[24] Kalainov and Cohen[24] suggested that a lateral pivot-shift test should be performed during every lateral epicondylitis surgery.

Lateral elbow pain may also indicate intra-articular pathology such as an osteochondral lesion or a posterolateral plica in the radiocapitellar joint. In their series of posterolateral plicas, Ruch et al[25] showed the site of maximal tenderness to be posterior to the lateral epicondyle and centered at the posterior radiocapitellar joint. Patients may report painful locking or snapping, which can be reproduced with terminal extension and full supination.

IMAGING

Although lateral epicondylitis is a clinical diagnosis, various imaging modalities may be useful to rule out other etiologies of elbow pain. Pomerance[26] reviewed the radiographs of lateral epicondylitis patients and found that only 16% had abnormal findings, with the most common finding (in 7%) being faint calcifications along the lateral epicondyle. He concluded that routine use of elbow radiographs were not cost-effective, as only 2 of the 294 studied radiographs altered his clinical management.

Ultrasonography is most helpful for evaluating for joint fluid, guidance for aspiration, and assessing the integrity of supporting ligaments and tendons. The normal common extensor origin is seen as longitudinal bands of tendon fibrils running in close parallel without disruption. The most common sonographic appearance in patients with lateral epicondylitis is a focal hypoechoic area on a normal background or one showing a loss of the normal fibrillar pattern. Visualization of a complete tear of the common extensor origin may lead the surgeon to consider earlier surgical options.[27] Ultrasonography is highly operator-dependent and it is important to correlate preoperative findings with those seen during surgery.

Magnetic resonance imaging (MRI) can help to quantify the degree of tendon disease, look for alternative diagnoses and for preoperative planning. The visualization of intra-articular lesions on MRI might lead the surgeon to consider elbow arthroscopy before a planned open procedure. In early stages of lateral epicondylitis, 90% of symptomatic patients may show edema and thickening of the common extensor

Figure 1: Corticosteroid injection into the extensor carpi radialis brevis origin.

origin.[28-30] Because of the high sensitivity of MRI, it is important to reserve its use for recalcitrant lateral epicondylitis, as signal intensity changes of the common extensor origin may be a common finding in patients older than 40 years.[30]

Conservative Management

Therapy Modalities

The mainstay of lateral epicondylitis treatment is physical therapy and bracing. Bracing treatment is thought to inhibit the maximum contraction of the wrist and finger flexors and extensors leading to decreased tension in the common extensor origin.[31] In a randomized controlled trial comparing brace-only treatment, physical therapy and a combination of the two, Struijs et al[32] showed that a decrease in pain as the patient's main outcome measure was statistically better for physical therapy than brace-only, but these results did not hold out at 1 year. Another study[33] used a custom-made dynamic wrist extension orthotic and showed significant improvement in functionality, pain-free grip strength and a reduction in VAS score.

Comparing wait-and-see (ergonomic advice and nonsteroidal anti-inflammatory drug [NSAID] use) with corticosteroid injections and physical therapy, Smidt et al[34] showed that all modalities had significant increases in studied outcome measures. Physical therapy showed significant improvements over injection therapy, but no significant difference was found between physical therapy and wait-and-see policy. The authors concluded that steroids were good for short-term relief and physical therapy was more beneficial for long-term follow-up. Korthals et al[35] looked at the total costs of steroid, physical therapy, and wait-and-see and found none superior with regards to cost effectiveness.

Iontophoresis uses low electrical currents to deliver transdermal medications such as NSAIDs and corticosteroids. In a multicenter randomized controlled trial, Nirschl et al[36] compared dexamethasone versus saline iontophoresis, showing dexamethasone to have short-term significant improvements in visual analog scores and investigators' global evaluation of the patient's improvement.

Injections

Corticosteroid is the most commonly injected substance for patients with lateral epicondylitis (Figure 1). Based on an ultrasound diagnosis of early lateral epicondylitis, Torp-Pederson et al[37] reported on a decrease in hyperemia after corticosteroid injection into the common extensor origin, suggesting that there is an initial inflammatory component in this disease that is affected by corticosteroid treatment. The standard injection for lateral epicondylitis combines 20 mg triamcinolone with 1.5 cc 1% lidocaine for a total volume up to 2 mL, with most randomized controlled trials showing a treatment regime of up to three corticosteroid injections.[38] A meta-analysis by Assendelft et al[38] reported on 10 trials, 6 of which showed that steroid was a more effective short-term therapeutic agent (up to 6 weeks) compared with the reference therapy. The two most common adverse effects were worsening pain 24 to 48 hours after injection and skin atrophy at the injection site.

In a randomized controlled trial comparing steroid injection, therapy, and observation in 183 patients, success rates at 6 weeks were 92% for corticosteroid, 47% for physical therapy, and 32% for wait-and-see and 69%, 91% and 83%, respectively at 52 weeks.[34] Although corticosteroid was favored by all studied outcomes at 6 weeks, therapy was favored at both 26 and 52 weeks. The authors hypothesized that these results may be secondary to the fact that patients may misjudge their initial pain relief after steroid injection and resume aggravating activities too soon after treatment or the possibility of the corticosteroid causing direct damage to the tendon. A high rate of good results was seen with the wait-and-see group, and therefore it was suggested that physicians thoroughly explain all advantages and disadvantages of the different therapeutic modalities.

Recent in vitro studies[39,40] have shown that dexamethasone has direct deleterious effects on human tenocyte cell number, proliferation, and collagen synthesis. These investigations also showed that dexamethasone suppresses proteoglycan synthesis, an important factor in tendon healing and repair. Although tendon rupture has not been reported in the lateral epicondylitis literature,[37] there are case reports of Achilles tendon rupture after corticosteroid injection.[41-43] It has been suggested that an early return to sports after the steroid injection exposes the weakened tendon to excessive stress and therefore may lead to a spontaneous tear.[41]

In 2003 Edwards and Calandruccio[44] first reported use of autologous blood injection for the treatment of refractory lateral epicondylitis. In their study, 50% of the 28 patients with chronic lateral epicondylitis had complete relief of pain after 1 autologous blood injection and 6 of the remaining 14 had a similar response after 2 injections. The pain relief seen with blood injection is hypothesized to be secondary to transforming growth factor-β and basic fibroblast growth factor acting as humoral mediators to induce a healing cascade.[45]

On a macroscopic level, Taylor et al[46] showed no abnormality or structural changes in the arrangement of collagen after direct injection of autologous blood into rabbit patellar tendons. Clinical studies have also shown low complication rates for autologous injections, with no infections or tendon ruptures seen.[47,48] Researchers have also begun to use platelet-rich plasma, containing platelet-derived growth factor, epidermal growth factor and transforming growth factor beta, which have been shown to have a role in tendon healing and collagen production.[49,50]

Injection of botulinum toxin Type A causes a paralytic effect in muscles by irreversibly inhibiting acetylcholine release at the neuromuscular junction. In a multicenter, randomized controlled trial, Placzek et al[51] found a mean clinical pain score of 2.88 versus 4.29 (P=.009) in those treated with botulinum toxin compared with placebo at 18 weeks following injection. Table 2 lists a summary of the most common injectates.

Other Treatments

The Cochrane Database review by Green et al[52] showed a trend toward short-term pain relief using acupuncture to treat lateral epicondylitis. With the addition of newer studies, a systemic review showed that acupuncture is an effective short-term pain reliever, although again these authors were limited by the heterogeneity of the studies definitions of pain relief, types of acupuncture used, and definitions of lateral epicondylitis.

The use of extracorporeal shock wave therapy[53] has remained a controversial addition to the treatment regime of lateral epicondylitis. Rompe et al[18] showed significant improvement in VAS and 60% good or excellent results on the Roles and Maudsley score at 12-month follow-up. A Cochrane database analysis reported that shock wave therapy provides little or no benefit in terms of improving pain and function in tennis elbow.[54]

Murrell et al[55] used a rat Achilles tendon model to demonstrate that nitric oxide is induced during tendon healing and the inhibition of nitric oxide synthase results in a decrease in tendon cross-sectional area and failure load. This discovery led to the use of transdermal glyceryl trinitrate patches to deliver nitric oxide to the site of maximal tenderness in lateral epicondylitis patients. Paoloni et al[56] showed that 81% of patients receiving this treatment reported excellent improvement at 24 weeks compared with 60% of placebo patients (P=.005).

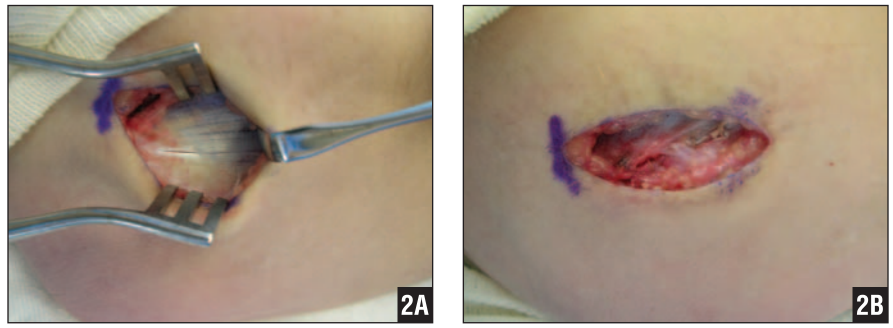

Figure 2: Open surgical resection of the extensor carpi radialis brevis origin before (A) and after (B) resection.

Low-level laser therapy is a treatment with local dose-response effects that at low levels displays anti-inflammatory activity and fibroblast stimulation and can inhibit fibroblasts at higher levels.[57] A systematic review by Bjordal et al[58] reported on 7 trials that used 904 nm wavelength applied to the tendon pathology that demonstrated positive results. The authors found that more rapid recovery was seen in patients who had low-level laser therapy combined with an exercise regime.

Surgical Management

Numerous surgical options are available to the surgeon treating patients with recalcitrant lateral epicondylitis, usually considered after 6 to 12 months of failed nonoperative management. Most options involve debridement of the pathologic tissue within the extensor carpi radialis brevis origin or extensor carpi radialis brevis release. The optimal surgical treatment is debatable as most options are associated with a high proportion of successful patient outcomes.

Open Debridement

Described by Nirschl and Pettrone[5] in 1979, open debridement of the common extensor origin has been the mainstay of operative treatment for lateral epicondylitis (Figure 2). Care must be taken not to dissect too far posteriorly on the lateral epicondyle, risking injury to the lateral collateral ligament. All fibrous and granulation tissue, which appears grey, shiny, and abnormal, is excised at the extensor carpi radialis brevis origin, often encompassing 75% of the origin of the extensor carpi radialis brevis.[5] Any abnormalities in the extensor carpi ulnaris, extensor carpi radialis longus, or extensor digitorum communis should be identified and excised. To stimulate blood flow to the surgical site and provide a raw bleeding surface for the tendon repair, the exposed lateral epicondyle is decorticated with an osteotome or rongeur or with the drilling of multiple small holes.

Nirschl reported short-term follow-up results showing a 97.7% subjective improvement from patient perceived preoperative pain level.[5] Eighty-five percent of the patients returned to full activity, with 84% of the tennis players in his cohort returning to competitive play at an average of 6.1 months. In 2008, Dunn et al[59] reviewed 92 patients with a 10- to 14-year follow-up after a Nirschl procedure. Only 3 elbows had to be revised and no operative complications were described. Patients had an increase in mean strength with 93% returning to sports at their previous level. Continued symptoms of elbow pain after surgical excision may be secondary to an inadequate excision of the damaged tissue or iatrogenic lateral collateral ligament injury leading to posterolateral instability.[60]

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Table 2

Injectables for Lateral Epicondylitis

Study/Type	Injectant/Control	No. of Patients	Age Range (y)	Follow-up (mo)	Outcomes Data
Smidt et al[34]/RCT	Triamcinoloneacetonide (10 mg/mL)	185	41-54	12	Mean difference in improvement (95% CI) in pain during the day: at 3 weeks, injectiion vs wait and see, 30 (23-36); injections vs physiotherapy, 30 (23-37). At 52 weeks, −4 (−13 to 6), −11(20 to −2)
Lindenhovius et al[69]/RCT	Dexamethasone (4 mg/mL) Lidocaine 1%	64	35-70	6	Average DASH[a] score: At 1 month, 24 for dexamethasone and 27 for control. At 6 months, 18 and 13 respectively.
Connell et al[48]/CS	Autologous blood (2 mL)	35	26-62	6	Median VAS# pre-injection 9, 6 at 4 weeks and 0 at 6 months (z=5.16, *P*<.001)
Mishra et al[70]/Cohort	Platelet-rich plasma (2-3 mL)/Bupivacaine with epinephrine (2-3 mL)	140	45.2[a]	25.6[a]	Mean improvement in VAS at 4 weeks 46% platelet-rich plasma vs 17% control; at 8 weeks 60% vs 16%; at final follow-up 93%
Placzek et al[51]/RCT	Botulinum toxin Type A (60 mouse units of Dysport)/NaCl 0.9%	130	47.2[a]	3.5	VAS for continuous pain at 2 weeks 3.6 botulinum vs 4.25 control (*P*=.147); at 18 weeks 1.82 vs 2.68 (*P*=.035)
Scarpone et al[71]/RCT	Dextrose and sodium morrhuate[b]/NaCl 0.9%	24	19-62	12	Resting elbow pain on the Likert scale at baseline 5.1 dextrise vs 3.3 control; at 8 weeks 0.5 vs 4.5; at 16 weeks 3.6 vs 3.5, respectively (*P*<.001). At the 52-week follw-up, 60% of dextrose group reported "no elbow pain or impact on activities of daily living vs 10% of the control group.

Abbreviations: CS, case series; DASH, disabilities of the arm, shoulder, and hand questionnaire; RCT, randomized controlled trial, VAS, visual analog pain score.
[a]*Mean.*
[b]*An extract of cod liver oil.*

Percutaneous Release

Percutaneous release of the common extensor origin is an office-based procedure performed using local anesthetic to lengthen the extensor carpi radialis brevis tendon.[61] The blade is kept in contact with the lateral epicondyle and the entire thickness of the extensor origin is cut through from the proximal to the distal portion of the epicondyle. An approximately one-half inch defect will be palpable overlying the anterior aspect of the lateral epicondyle. Yerger and Turner[62] described the gradual relief of pain within 3 months for 70% of the patients, with up to 20% of the patients having pain for up to 6 months after the procedure. In their 1- to 11-year follow-up, they reported on 109 cases with 93.5% good or excellent results. More recently, a study reported 27 of 30 patients returning to their former job or activities that had previously caused their symptoms.[63] Reported complications are a palpable residual band, inadequate release, synovial fistula or cyst formation and superficial infection.[61,62] In a prospective randomized controlled trial comparing open versus percutaneous surgery for lateral epicondylitis, Dunkow et al[64] found that percutaneous treatment has a significantly higher level of patient satisfaction as well as a shorter median return to work.

Arthroscopic Debridement

Arthroscopic debridement involves resecting the damaged area of the extensor carpi radialis brevis tendon while preserving the common extensor origin, and the lateral epicondyle and distal portion of the lateral condylar ridge are decorticated. Arthroscopic procedures also allow for the evaluation of concomitant intra-articular pathology within the joint. Active range-of motion is usually begun within 24 hours and Baker et al[65] showed an average return to work of 2.2 weeks. The most common complications of arthroscopic treatment of lateral epicondylitis are transient low radial or median nerve palsies, excessive drainage or swelling, loss of motion postoperatively, and superficial wound infections.[66] In a retrospective review of a single surgeon's open and arthroscopic releases,[67] one report showed no statistical difference between the 2 procedures with regards to mean time to return to work. There was no statistically significant difference between the 2 groups in good or excellent results or the amount of postop physical therapy required after the operative procedure, although the study may have been underpowered.

Szabo et al[68] retrospectively reviewed the clinical results of a single surgeon's experience with open (modified Nirschl), arthroscopic and percutaneous operative treatment for lateral epicondylitis. In their cohort of 102 patients they found that all 3 procedures were successful in significantly reducing patients VAS scores at an average follow-up of 45 months. In all of the open cases and 1 of the arthroscopic cases, overuse was the cause of recurrence. They concluded that the benefit of arthroscopy was the ability to address concomitant intraarticular pathology avoiding violating the extensor aponeurosis.

SUMMARY

Lateral epicondylitis is the most common cause of elbow pain in patients presenting to orthopaedic surgeons. While physical therapy, NSAIDs, and activity modification are the mainstay of treatment, other modalities have been used successfully, including many injectable substances. While surgery is reserved for patients with refractory symptoms after failed nonoperative management, good results can be anticipated with most of the reported techniques, including open debridement, arthroscopic debridement, or percutaneous release.

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