REVIEW ARTICLE

LATERAL EPICONDYLITIS: A COMMON CAUSE OF ELBOW PAIN IN PRIMARY CARE

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KEYWORDS:

Elbow Pain

Lateral Epicondylitis

Osteopathic Manipulative Medicine

Primary Care Sports Medicine

Lateral epicondylitis (LE) is an overuse injury of the lateral elbow. LE is caused by repetitive motion leading to micro-injury of the wrist extensor muscles that originate along the elbow's lateral aspect. Although LE is commonly referred to as "tennis elbow" many cases are observed in non-athletes. Due to its prevalence in the general population, primary care physicians must be prepared to diagnose and treat LE. Physicians should look for a history of repetitive activities involving patient's jobs or recreational activities. Exam findings are characterized by pain and tenderness just distal to the lateral epicondyle of the humerus. Resisted movement with an extension of the wrist will typically elicit pain. Ultrasonography is considered the imaging modality of choice for diagnosing LE. Standard radiographs and magnetic resonance imaging (MRI) may be helpful. However, diagnosis can usually be made by history and physical examination alone. Most cases of LE respond favorably to conservative therapy. There are several nonoperative options for treatment, but a combination of non-steroidal anti-inflammatory drugs (NSAIDs) and physical therapy that utilizes eccentric muscle stretching is considered first-line. Osteopathic manipulative medicine is also useful in the treatment of LE. Muscle energy (ME) and joint mobilization techniques have been shown to be particularly effective. If non-surgical therapy fails, surgical intervention may provide patients with an additional benefit. This article will review some of the treatment options described above and discuss other diagnostic and therapeutic considerations relevant to LE's management in the primary care setting.

INTRODUCTION

Lateral epicondylitis (LE) is a common cause of lateral elbow pain.[1–4] It is often referred to as "tennis elbow" due to its prevalence among beginner tennis athletes learning the one-handed backhand. Despite its reputation for affecting tennis players, the majority of LE cases are observed in non-athletes.[5,6] LE frequently develops as a work-related injury that occurs in jobs requiring repetitive manual labor or keyboard typing.[1,7–9] LE has been estimated to affect about 1 to 2% of the adult population[2] and tends to occur in men and women equally, with a peak incidence between 35 and 55 years of age.[10,11] The prevalence of LE among the general population makes it a commonly seen condition in most primary care offices.[12,13] Due to its tendency for prolonged recovery, LE has been shown to account for significant amounts of lost recreation time, decreased quality of life and frequent work-related disability claims.[14] Thus, the diagnosis and effective treatment of LE is an important component in family physician practices.

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 Print ISSN: 1877-573X
DOI: 10.33181/13014

Proper management of LE is dependent on a thorough understanding of the underlying etiology and pathophysiology of the condition. As its name implies, LE's injury and pathology are typically localized to the musculotendinous attachments at the lateral epicondyle of the humerus. Although several muscles originate at the lateral epicondyle, the extensor carpi radialis brevis (ECRB) is the most commonly cited structure responsible for the symptoms of LE.[15–17] The primary function of the ECRB is extension and abduction of the wrist. High force, heavy loads, and repetitive or awkward motion in wrist extension and abduction can lead to microtrauma of the ECRB. Cumulative microtrauma may cause a transient inflammatory response in the acute phase and development of angiofibroblastic hyperplasia in more chronic presentations of LE.[18]

HISTORY

A detailed history of presenting illness is the first step to separating LE from other common lateral elbow pain causes. Other differential diagnoses to consider include radial tunnel syndrome/posterior interosseous nerve syndrome, osteochondritis dissecans, radiohumeral synovitis, radiohumeral bursitis, posterolateral elbow instability and referred pain from the cervical or upper thoracic spine.[19,20] Physicians should ask about the duration of the patient's symptoms, exacerbating factors, recreational activities or sports, and previous history of elbow injury.[21] Determining the patient's hand dominance and occupation may also provide valuable clinical information.

A history of repetitive activities typically precedes LE. Recent changes in duration and intensity of sports training or changes in duties or equipment at work must be considered. The onset of pain may be insidious or acute and pain severity ranges from mild to incapacitating. Patients will typically localize their pain as just distal to the lateral humeral epicondyle, sometimes with radiation into the proximal forearm. Pain may be present at rest and worsened with daily activities that involve wrist extension or gripping.[20]

PHYSICAL EXAM

A comprehensive physical exam is often sufficient to diagnose LE without the need for additional tests or imaging. The physical exam should evaluate the complete upper extremity kinetic chain, including the cervical and thoracic spine, shoulder and scapula. The exam should also include a neurovascular assessment of the affected limb.[4,22] Once referred pain, biomechanical abnormalities of the kinetic chain and neurovascular conditions have been excluded, the exam should shift focus to the elbow and wrist.

Inspection of the elbow typically lacks obvious evidence of injuries such as swelling or ecchymosis. Tenderness to palpation is usually appreciated at, or just distal to, the origin of the ECRB and is considered a hallmark finding for LE.[14, 23] Range of motion and muscle strength of the elbow and wrist should be assessed, as grip strength may be diminished due to pain.[20]

DIAGNOSIS

The diagnosis of LE is mainly one of clinical suspicion. A thorough history and physical exam are typically all that is needed to make this diagnosis. The Thomsen test may be helpful when evaluating a patient with lateral elbow pain. This test involves flexing the shoulder to 60º, extending the elbow, pronating the forearm, extending the wrist to 30º and then asking the patient to further extend the wrist against pressure applied to the dorsum of the patient's hand.[4] Pain with this maneuver is considered a positive result. The chair test may also help narrow the diagnosis. This test involves lifting a chair with the forearm pronated and the elbow extended. A positive chair test occurs when the patient experiences pain at the lateral epicondyle.[24]

Other provocative tests such as the Cozen, Mill and Maudsley tests are commonly used in clinical practice to diagnose LE. They are all considered positive if they reproduce lateral elbow pain.[25] None of these tests are superior to the others and their diagnostic utilities are still under investigation.[26] No single physical exam technique can be used to diagnose LE by itself. All elements of the history and physical exam should be considered before determining a final diagnosis. If the history and physical exam are inconclusive, imaging can provide additional information to assist in the diagnosis of LE.

Imaging

While the gold standard diagnosis of LE is essentially based on a good history and physical examination, some imaging studies may be beneficial to confirm the diagnosis of LE and exclude potential alternative diagnoses. Radiographic images and ultrasound may be helpful in establishing the clinical diagnosis and extent of the injury. MRI is not needed initially.[27]

Antero-posterior and lateral radiographs of the elbow, while most commonly read as normal, can show calcifications along with the epicondylar tendons. Radiographic imaging can rule out a fracture, dislocation and prior trauma. Ultrasonography is the standard first-line investigation, as normal findings can rule out the diagnosis of LE.[28] Abnormal findings on ultrasound that indicate LE include tendon thickening or thinning and calcifications. Power doppler images may show neovascularization in the area of increased pain. The diagnosis of LE should be questioned with the absence of these findings. However, this diagnosis method will have varying sensitivity and specificity, depending on the operator's experience.

Magnetic resonance imaging, being more reproducible and less operator dependent, will yield more consistent results than an ultrasound. The MRI will show increased signal on T2 weighted images at the epicondylar tendon enthesis. Extension of the increased signal to the adjacent soft tissues indicates peripheral edema. The severity of tendon fissure and injury can also be assessed by using an MRI.[29] In the past, study results have varied regarding whether structural lesion severity on an MRI correlated with symptom severity.[30] However, more recently, a study in 2015 showed a positive correlation between patient-rated tennis elbow evaluation scores and the severity of MR signal changes.[31] Lastly, MRI can also rule out concomitant lesions, such as synovial folds and injuries to the lateral collateral ligament.[32] Other alternative diagnoses that can be visualized with MRI include humeroradial osteoarthritis, osteochondritis dissecans, foreign body, inflammation of the anconeus, inflammatory joint disease or radial tunnel syndrome.

TREATMENT

Treatment recommendations for LE can vary based upon the level of pain, duration of injury, patient desires and comorbidities. Research has shown that LE may resolve spontaneously without treatment within one to two years.[33] Knowing this timetable can help both the physician and the patient determine the best treatment plan. Patient expectations regarding the time to heal should be considered. Several different nonoperative treatment strategies have been shown to be effective for LE. The time at which to refer a patient for surgery is still an unanswered question. There is no clear evidence pointing towards a precise timeline for surgical treatment. It is reasonable to recommend surgery as a treatment after a patient has had an inadequate response to conservative treatments for greater than six months to one year.[34]

Nonsurgical

Newly diagnosed LE can be treated with various nonoperative modalities, some of which can take an osteopathic approach. Treatment options include activity modification, ice, NSAIDs, physical therapy, bracing, osteopathic manipulation, topical nitric oxide (NO), ultrasound therapy, extracorporeal shock wave therapy, corticosteroid injection, dry needling, autologous blood injection (ABI) and platelet-rich plasma injection (PRP). Because of the large variety of treatment modalities, treatment choice can be tailored specifically to individual patient presentations.

Topical NSAIDs may be more effective than placebo for reducing pain and the evidence for oral NSAID use is conflicting.[35] As for physical therapy, a study by Smidt *et al*. randomized patients to corticosteroid injections, physiotherapy or no treatment other than analgesics.[36] At one year, outcomes were only slightly better in the physiotherapy group than the remainder. Thus, physiotherapy may be superior to other treatments for patients willing to put in the time and effort needed for physical therapy.

Several studies have demonstrated greater pain relief to eccentric muscle stretching over concentric, isometric and isokinetic techniques. Specifically, Tyler *et al*. found a significant benefit of eccentric exercise to isotonic extensor exercises. Participants in both groups received a multimodal program of stretches, ultrasound, friction massage, heat and ice. A majority of the participants reported greater pain relief and functional improvement with eccentric stretching.[37] Augmented rest through active bracing may also aid in pain relief. The wrist extension splint has been shown to allow a greater degree of pain relief than the forearm strap brace for patients with lateral epicondylitis.[9]

Several manipulative techniques can be used for the treatment of LE. In one study, ME techniques led to greater improvement of pain, strength and function in chronic LE following 52 weeks of treatment compared to corticosteroid injection.[38] This treatment was focused on ME to the extensor tendons of the forearm. It is thought that the treatment of a posterior radial head may also help relieve some pain. Myofascial release has been shown effective in improving pain, functional performance and grip strength in patients with chronic LE over four weeks of treatment.[39] Mill's manipulation and other joint mobilization techniques have been thought to be effective in the past. Recent studies have shown that some joint mobilization techniques do positively affect both pain and function compared with control groups.[40]

The application of topical nitric oxide (NO) has been shown to improve pain in LE patients. In animal models, the addition of NO improved tendon healing, suggesting that exogenous NO to an area of tendon damage may support tendon recovery.[41] In a randomized clinical trial, the application of 1.25mg topical glyceryl trinitrate every 24 hours showed statistically significant improvements in pain scores over a six month treatment period. It is important to note the potential side effects of topical vasodilators. Adverse effects within studies using NO derivatives include severe and persistent headache, dermatitis rash and facial flushing.[42] As with all vasodilators, symptomatic hypotension can be a possible adverse effect when prescribing topical NO.

Ultrasound therapy has been thought to have thermal and mechanical effects on the target tissue leading to increased metabolism, circulation, extensibility of connective tissue and tissue regeneration. However, there has been insufficient evidence to support or refute its benefit for LE compared with other treatment modalities in available studies.[43] Similarly, there has been no firm evidence to support treatment with shockwave, laser, nerve stimulation or pulsed magnetic wave therapies.[44]

Corticosteroid injections, dry needling, ABI and PRP, while more invasive, have also been used as nonsurgical treatments for LE. Corticosteroid injections have been shown to provide pain relief in the short term. However, as with all steroids, side effects can lead to treatment failure and should not be used in the long term.[36] Dry needling is thought to promote local blood supply and inflammation in the short term leading to increased healing over some time. Lastly, ABI and PRP are newer treatment methods that have shown promising results. The majority of the available data is favorable, with many reporting better pain outcomes than corticosteroid injections and physiotherapy.[44] Initially thought to be equally effective in improving pain scores, PRP is now thought to be superior to ABI for the short-term treatment of chronic LE.[45]

Surgical

There have been several surgical techniques developed over the years to provide relief for LE. There is no one procedure recommended over another and outcomes after treatment with surgery versus nonoperative modalities have not been adequately compared. One report indicated if the initial physician evaluation is with a surgeon rather than a non-surgeon, the likelihood of receiving surgical treatment is 12 times higher.[46] Identifying certain risk factors for failure of nonoperative treatment may help select patients for surgery earlier in the treatment timeline. These risk factors include older age, obesity, smoking, receiving workers' compensation, radial tunnel syndrome, prior corticosteroid injection, splinting, orthopedic surgery and the use of psychoactive medications.[3] However, since there is no clear evidence identifying when surgical treatment is indicated, it has become reasonable to recommend surgery as a treatment after a patient has had an inadequate response to nonoperative treatments for more than six months to one year.[34]

Today's most widely used open surgical procedure involves excision of the degenerative fibrous tissue within the extensor carpi radialis brevis at the epicondylar enthesis, as described by Nirschl and Pettrone.[16] Formerly, this procedure was combined with a bone decortication step to increase blood supply to the region. However, this was abandoned due to greater post-operative pain.[47] It has been suggested that the excision procedure performed by Nirschl and Pettrone may be partially successful due to unknowingly performing a lateral denervation procedure as well.[48] Denervation of the lateral epicondyle by blocking or transecting the posterior branches of the posterior cutaneous nerve of the forearm was shown to be effective in relieving pain in 80% of patients with chronic lateral epicondylitis.[49] Therefore, these procedures have been thought to have something in common.

Arthroscopic procedures have been described as well. These have led to the development of several minimally invasive percutaneous methods. Combinations of percutaneous methods and PRP injections have also been shown to be of some benefit. In one study, investigators reported an earlier return to work time than an open surgical procedure.[50]

There is not one surgical procedure currently available that has been shown to be statistically superior to another. A recent literature review by Pierce *et al*. compared information on 848 open surgery, 578 arthroscopic surgery and 178 percutaneous cases.[51] Satisfaction and complication rates were similar in all three groups.

CONCLUSION

In summary, LE is a common cause of elbow pain in the primary care setting. LE is an overuse injury caused by repetitive wrist extension and gripping and typically occurs in individuals who participate in jobs or activities that require these movements. The injury is characterized by microtrauma to the ECRB, causing reproducible pain over the lateral elbow and pain with resisted wrist extensor muscle movements. A diagnosis of LE can usually be made by a comprehensive history and physical examination alone. Imaging studies, such as ultrasonography and MRI, can provide supplemental diagnostic information. LE typically responds well to nonsurgical therapies. First-line treatment is a combination of ice, activity modification, topical NSAIDs and physical therapy that focuses on eccentric muscle stretching. Osteopathic manipulation is another useful modality that has shown promising results. Newer options, including ABI and PRP, have shown positive results and should be considered when constructing a patient's treatment plan. Surgical interventions are rarely needed, but some operative procedures may be beneficial when nonsurgical treatments fail.

AUTHOR DISCLOSURE(S): No relevant financial affiliations or conflicts of interest. If the authors used any personal details or images of patients or research subjects, written permission or consent from the patient has been obtained. This work was not supported by any outside funding.

REFERENCES:

1. Lenior H, Olivier M, Carlier Y. Management of lateral epicondylitis. *Orthop Traumatol Surg Res*. 2019;105:241-246.
2. Verhaar JA. Tennis elbow: anatomical, epidemiological and therapeutic aspects. *Int Orthop*. 1994;18(5):263-267.
3. Knutsen EJ, Calfee RP, Chen RE, Goldfarb CA, Park KW, Osei DA. Factors Associated With Failure of Nonoperative Treatment in Lateral Epicondylitis. *Am J Sports Med*. 2015;40(9):2133-2137.
4. Brummel J, Baker CL, Hopkins R, Baker Jr CL. Epicondylitis: lateral. *Sports Med Arthrosc Rev*. 2014;22:e1–6.
5. Ollivierre CO, Nirschl RP. Tennis elbow: Current concepts of treatment and rehabilitation. *Sports Med*. 1996;22:133–139.
6. Jobe FW, Cicotti MG. Lateral and medial epicondylitis of the elbow. *J Am Acad Orthop Surg*. 1994;2:1–8.
7. Herquelot E, Bodin J, Roquelaure Y, Ha C, Leclerc A, Goldberg M, et al. Work-related risk factors for lateral epicondylitis and other causes of elbow pain in the working population. *Am J Ind Med*. 2013;56:400–409.
8. Carroll R. Tennis elbow: incidence in local league players. *Br J Sports Med*. 1981;15:250–256.
9. Garg R, Adamson GJ, Dawson PA, Shankwiler JA, Pink MM. A prospective randomized study comparing a forearm strap brace versus a wrist splint for the treatment of lateral epicondylitis. *J Shoulder Elbow Surg*. 2010;19(4):508–512.
10. Hamilton PG. The prevalence of humeral epicondylitis: a survey in general practice. *J R Coll Gen Pract*. 1986;36(291):464-465.
11. Hennig EM, Rosenbaum D, Milani TL. Transfer of tennis racket vibrations onto the human forearm. *Med Sci Sports Exerc*. 1992;24:1134–1140.
12. Calfee RP, Patel A, DaSilva MF, Akelman E. Management of lateral epicondylitis: current concepts. *J Am Acad Orthop Surg*. 2008;16(1):19-29.
13. Sanders TL, Kremers HM, Bryan AJ, Ransom JE, Smith J, Morrey BF. The Epidemiology and Health Care Burden of Tennis Elbow. *Am J Sports Med*. 2015;42(5):1066-1071.
14. Taylor SA, Hannafin JA. Evaluation and Management of Elbow Tendinopathy. *Sports Health*. 2012;4(5):384-393.
15. Nirschl RP, Ashman ES. Elbow tendinopathy: tennis elbow. *Clin Sports Med*. 2003;22(4):813-836.
16. Nirschl RP, Pettrone FA. Tennis elbow: the surgical treatment of lateral epicondylitis. *J Bone Joint Surg Am*. 1979;61(6):832-839.
17. Alizadehkhaiyat O, Frostick SP. Electromyographic assessment of forearm muscle function in tennis players with and without lateral epicondylitis. *J Electromyogr Kinesiol*. 2015;25:876–886.
18. Kraushaar BS, Nirschl RP. Tendinosis of the elbow (tennis elbow). Clinical features and findings of histological, immunohistochemical, and electron microscopy studies. *J Bone Joint Surg Am*. 1999;81:259–278.
19. Kane SF, Lynch JH, Talor JC. Evaluation of Elbow Pain in Adults. *Am Fam Physician*. 2014;89(8):649-657.
20. Brukner P, Khan KM. Brukner & Khan's Clinical Sports Medicine: Injuries. 5th Edition. North Ryde, N.S.W.: McGraw-Hill Education, Australia; 2016.
21. Meunier M. Lateral Epicondylitis/Extensor Tendon Injury. *Clin Sports Med*. 2020;39(3):657-660.
22. Ellenbecker TS, Nirschl R, Renstrom P. Current Concepts in Examination and Treatment of Elbow Tendon Injury. *Sports Health*. 2013;5(2):186-194.
23. Van Hofwegen C, Baker CL III, Baker CL Jr. Epicondylitis in the athlete's elbow. *Clin Sports Med*. 2010;29(4):577–597.
24. Gardner RC. Tennis elbow: diagnosis, pathology and treatment. Nine severe cases treated by a new reconstructive operation. *Clin Orthop Relat Res*. 1970;72:248–253.
25. Dones VC, Grimmer K, Thoirs K, Suarez CG, Luker J. The diagnostic validity of musculoskeletal ultrasound in lateral epicondylalgia: a systematic review. *BMC Med Imaging*. 2014;10:1-11.
26. Lebrun C: What are the best diagnostic criteria for lateral epicondylitis? In Evidence-based Orthopaedics: the Best Answers to Clinical Questions. *Elsevier Health Sciences*. 2008:148–157.
27. Qi L, Zhu ZF, Li F, Wang RF. MR imaging of patients with lateral epicondylitis of the elbow: is the common extensor tendon an isolated lesion? *PLoS One*. 2013;8:e79498.
28. du Toit C, Stieler M, Saunders R, Bisset L, Vicenzino B. Diagnostic accuracy of power Doppler ultrasound in patients with chronic tennis elbow. Br *J Sports Med*. 2008;42:872–876.
29. WalzDM, NewmanJS, KoninGP, RossG, Epicondylitis: pathogenesis, imaging and treatment. *Radiographics*. 2010;30:167–184.

30. Savnik A, Jensen B, Nørregaard J, Egund N, Danneskiold-Samsøe B, Bliddal H. Magnetic resonance imaging in the evaluation of treatment response of lateral epicondylitis of the elbow. *Eur Radiol*. 2004;14:964–969.

31. Qi L, Zhang YD, Yu RB, Shi HB. Magnetic Resonance Imaging of Patients With Chronic Lateral Epicondylitis: Is There a Relationship Between Magnetic Resonance Imaging Abnormalities of the Common Extensor Tendon and the Patient's Clinical Symptom?. *Medicine (Baltimore)*. 2016;95(5):e2681.

32. Kniesel B, Huth J, Bauer G, Mauch F. Systematic diagnosis and therapy of lateral elbow pain with emphasis on elbow instability. *Arch Orthop Trauma Surg*. 2014;134:1641–1647.

33. Haahr JP, Andersen JH. Physical and psychosocial risk factors for lateral epicondylitis: a population based case-referent study. *Occup Environ Med*. 2003;60(5):322-329.

34. Soeur L, Desmoineaux P, Devillier A, Pujol N, Beaufils P. Outcomes of arthroscopic lateral epicondylitis release: should we treat earlier? *Orthop Traumatol Surg Res*. 2016;102:775–780.

35. Pattanittum P, Turner T, Green S, Buchbinder R. Non-steroidal anti-ˇˇinflammatory drugs (NSAIDs) for treating lateral elbow pain in adults. *Cochrane Database of Systematic Reviews*. 2013, Issue 5. Art. No.: CD003686.

36. Smidt N, van der Windt DA, Assendelft WJ, Devillé WL, Korthals-de Bos IB, Bouter LM. Corticosteroid injections, physiotherapy, or a wait-and-see policy for lateral epicondylitis: a randomised controlled trial. *Lancet*. 2002;359:657–662.

37. Tyler TF, Thomas GC, Nicholas SJ, McHugh MP. Addition of isolated wrist extensor eccentric exercise to standard treatment for chronic lateral epicondylosis: a prospective randomized trial. *J Shoulder Elbow Surg Am*. 2010;19:917–922.

38. 38. Kucuksen, S., et al. Muscle Energy Technique Versus Corticosteroid Injection for Management of Chronic Lateral Epicondylitis: Randomized Controlled Trial with 1-Year Follow-Up. *Archives of Physical Medicine and Rehabilitation*. 2013;94(11):2068-2074.

39. Khuman, Ratan & Trivedi, Parth & Devi, Lourembam & Sathyavani, D. & Nambi, Gopal & Shah, Kimi. Myofascial Release Technique in Chronic Lateral Epicondylitis: A Randomized Controlled Study. *International Journal of Health Science and Research*. 2013;3:45-52.

40. Ann M. Lucado, R. Barry Dale, Joshua Vincent, Joseph M. Day.Do joint mobilizations assist in the recovery of lateral elbow tendinopathy? A systematic review and meta-analysis. *Journal of Hand Therapy*. 2019; 32(2):262-276.

41. Ozden R, Uruç V, Doğramaci Y, Kalaci A, Yengil E. Management of tennis elbow with topical glyceryl trinitrate. *Acta Orthop Traumatol Turc*. 2014;48(2):175-180.

42. Paoloni JA, Appleyard RC, Nelson J, Murrell GA. Topical nitric oxide application in the treatment of chronic extensor tendinosis at the elbow: a randomized, double-blinded, placebo-controlled clinical trial. *Am J Sports Med*. 2003;31(6):915-920.

43. Bisset L, Paungmali A, Vicenzino B, Beller E. A systematic review and meta-analysis of clinical trials on physical interventions for lateral epicondylalgia. *Br J Sports Med*. 2005;39:411–422.

44. Murray DJ, Javed S, Jain N, Kemp S, Watts AC. Platelet-rich-plasma injections in treating lateral epicondylosis: A review of the recent evidence. *J Hand Micro Surg*. 2015;7:320–325.

45. Thanasas C, Papadimitriou G, Charalambidis C, Paraskevopoulos I, Papanikolaou A. Platelet-Rich Plasma Versus Autologous Whole Blood for the Treatment of Chronic Lateral Elbow Epicondylitis. *Am J Sports Med*. 2011;39(10):2130–2134.

46. Kachooei AR, Talaei-Khoei M, Faghfouri A, Ring D. Factors associated with operative treatment of enthesopathy of the extensor carpi radialis brevis origin. *J Shoulder Elbow Surg*. 2016;25:666–670.

47. Kim JW, Chun CH, Shim DM, Kim TK, Kweon SH, Kang HJ, et al. Arthroscopic treatment of lateral epicondylitis: comparison of the outcome of ECRB release with and without decortication. *Knee Surg Sports Traumatol Arthrosc*. 2011;19:1178–1183.

48. Rose, Nicholas E. "Lateral Epicondylitis 'Placebo' Surgery Was Actually a Lateral Denervation Procedure: Letter to the Editor." *Am J Sports Med*. 2018;46(9):NP41-NP42.

49. Rose NE, Forman SK, Dellon AL. Denervation of the lateral humeral epicondyle for treatment of chronic lateral epicondylitis. *J Hand Surg Am*. 2013;38(2):344-349.

50. Carlier Y. Recalcitrant lateral epicondylitis: early results of a new technique combining ultrasonographic percutaneous tenotomy with platelet-rich plasma injection. *The Orthop J Sports Med*. 2019;7.

51. Pierce TP, Issa K, Gilbert BT, Hanly B, Festa A, McInerney VK, et al. A systematic review of tennis elbow surgery: open versus arthroscopic versus percutaneous release of the common extensor origin. *Arthroscopy*. 2017;33:1260–1268 [e2].