

# A Review of the Evaluation and Treatment of Lateral Epicondylitis

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## Introduction

Lateral Epicondylitis, or more commonly called “tennis elbow,” is a musculoskeletal condition characterized by pain upon extension and contraction of the fingers, wrist, and elbow. Such elbow pain can oftentimes be debilitating, as patients find themselves unable to work, enjoy their hobbies, or perform simple household tasks [1]. Thus, proper diagnosis and treatment of Lateral Epicondylitis is crucial for returning afflicted patients to a standard quality of life.

Lateral Epicondylitis is reported to affect around 2% of the general population, though among certain professions and hobbyists, such as carpenters, bricklayers, surgeons, tennis players, golfers, violinists and the like, this incidence can be up to 20-fold higher. For example, among frequent tennis players, almost 50% will be diagnosed with Lateral Epicondylitis, while about a third of this subpopulation will report pain so severe as to inhibit daily household activities [1-4]. Notably, this condition is brought about by either an acute, oftentimes sport-related injury (primarily affecting younger individuals), or, more commonly, brought about by repetitive flexion or gripping stress from work and hobby-related activities (primarily affecting older individuals) [3]. As a consequence, despite equal prevalence between men and women, the prevalence of Lateral Epicondylitis increases significantly with increasing age, with a notable fourfold increase after age 40 [5]. Additionally, pain resulting from repetitive flexion and gripping stress tends to be more difficult to manage, and, if not properly treated, can confer chronic debilitation to the Patient [1].

## Anatomy

The elbow is a synovial hinge joint that enables the contraction and extension of the forearm with respect to the upper arm, as well as the pronation and supination of the forearm and wrist. It is formed at the juncture of three major bones- the medial ulna and lateral radius at the forearm, and the humerus at the upper arm. The distal end of the humerus flattens dorsoventrally, yet expands mediolaterally to articulate onto the proximal end of the radius and the coronoid process of the ulna; additionally, the distal humerus features a ventral cavitation, called the olecranon fossa, wherein which the most proximal end of the ulna (also called the olecranon) is articulated [6,7]. The humeroulnar and humeroradial sub-joints enable contraction and extension of the elbow, while a third joint- the proximal radioulnar joint characterized by a lateral notch at the ulna that articulates with the medial radius- works in concert with the distal radioulnar joint by the wrist to enable forearm pronation and supination [6,7]. The most medial and lateral edges of the distal humerus are referred to as the medial and lateral epicondyle, respectively, and are the origin sites of the ligaments that anchor the humerus to the forearm bones (the ulnar collateral ligament arises from the medial epicondyle and adheres to the ulna, while the radial collateral ligament arises from the lateral epicondyle and adheres to the radius). Furthermore, the medial and lateral epicondyles are also the origin sites of the muscles that confer respective contraction and extension of the wrist [6,7].

## Examination and Diagnosis

Whereas decades ago the exact nature of elbow pain remained elusive, Lateral Epicondylitis is now precisely understood to be an injury to either or both of the wrist extensors originating from the lateral epicondyle – the Extensor Carpi Radialis Brevis Muscle (ECRB), and Extensor Digitorum Communis muscle (EDC) [7,8]. Injury to the ECRB, which originates from the outermost tip of the lateral epicondyle and confers wrist extension, is more commonly associated with Lateral Epicondylitis than injury to the EDC, which originates distal and posterior to the lateral epicondyle and confers extension of the medial four fingers of the hand [7,8]. While the exact site of extensor muscle injury in Lateral Epicondylitis remains debated, much evidence supports the claim that micro-tears in the ECRB or EDC at either their attachment site to the lateral epicondyle or their musculotendinous junctions are responsible [1,9].

Consequently, this may account for the evidence of degenerative responses in these sites upon histopathological examination, including the high presence of granulation tissue and vascular proliferation (interestingly and unintuitively, there is frequently no inflammatory response observed, and has rendered some to favor the more accurate term, “lateral elbow tendinosis,” over “Lateral Epicondylitis”) [10].

Likewise, only a small portion of patients with Lateral Epicondylitis present macroscopic tears or degeneration to the ECRB or EDC, and, to further mystify this injury, the degree of macroscopic injury is uncorrelated to the degree of pain experienced by the patient [11].

Detection of Lateral Epicondylitis is even further complicated by its similarity to other injuries characterized by elbow pain, such as medial epicondylitis (also called “golfer’s elbow,” a tendinopathy of the muscles conferring contraction of the wrist and fingers), elbow bursitis (an inflammation of the bursa posterior to the olecranon), sprains to either the ulnar or radial collateral ligaments, cubital or radial tunnel syndrome (the compression of the ulnar or radial nerves, respectively, by the elbow), and many more [7].

Thus, differential diagnosis must be made through provocative testing. In this case, Cozen’s test is used, in which the patient keeps the elbow stabilized at 90-degree flexion, is instructed to form a fist, fully pronate the forearm, and then radially deviate and extend the wrist against resistance from the examiner.

If sudden and sharp pain is experienced by the patient when the examiner applies pressure to the lateral epicondyle during this test, then the physician may reliably diagnose Lateral Epicondylitis [7].

In patients presenting Lateral Epicondylitis from acute trauma, prompt care has shown to be highly effective in curtailing pain symptoms. Likewise, it has been noted that the success in alleviating pain significantly diminishes the longer the patient had been enduring pain [12]. Treatment for Lateral Epicondylitis is very difficult considering that, despite a myriad of possible treatment alternatives with a very broad range of invasiveness and manipulation, clinicians frequently fail to alleviate pain in patients with their initial interventions (though, over the course of numerous treatments, physicians generally have a good track record in alleviating pain) [1,13]. For example, conservative interventions have been found to be just as efficacious as surgical interventions [14]. Furthermore, given a dearth of controlled studies examining the efficacy of particular treatments, physicians are oftentimes unable to base their treatment decisions on sound science [1]. As such, it is commonly favored by physicians to take a conservative approach to treatment of Lateral Epicondylitis, increasing the invasiveness of treatments over time in response to the recalcitrance of prior, less-invasive alternatives [1,7].

## Conservative Approaches

### Rest and Prevention

Sensibly, the first recommendation physicians give patients suffering from Lateral Epicondylitis is to immediately cease the repetitive action or hobby that is exacerbating the elbow, if the patient has not stopped already. This may involve a hiatus from tennis, baseball, and other sports or a leave from work for a duration specified by the physician [13].

Notably, no matter the initial treatment approach, the majority of patients who experience a recurrence of tennis elbow are those who resume the exacerbating activity prior to when permitted by the physician. Furthermore, in such cases, the prior treatment is usually recalcitrant in alleviating pain, thereby requiring the physician to pursue more invasive treatment measures [15]. Prevention techniques primarily focus on strengthening and readying the involved muscles prior to the exacerbating activity (i.e. mildly stretching and exercising the muscles prior to playing tennis or icing them after use), though other techniques focus on adjusting the biomechanics of the exacerbating activity to be less noxious (i.e. modifying equipment-such as loosening racket strings- or adjusting hammering/swinging technique) [15-17].

To our knowledge, there are no studies that examine the efficacy by which only resting the elbow can alleviate and prevent pain upon resuming activity; we presume that this is likely due to physicians pursuing additional treatments in concert with disuse (i.e. the administration of non-steroidal anti-inflammatory drugs- NSAIDs-bracing techniques, etc.) [13].

### NSAID Administration

Over-the-counter, Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) are widely popular in relieving generally mild pain for short durations. NSAIDs provide both anti-inflammatory and analgesic effects, the latter of which is helpful for Lateral Epicondylitis treatment (since most cases of tennis elbow do not directly present inflammation) [18].

There are few quality trials that have directly assessed the benefits of NSAID administration in alleviating pain from Lateral Epicondylitis. In such studies, it was determined that both oral and topical NSAID administration provided notable pain relief in patients with acute Lateral Epicondylitis, though confounds in these studies may preclude the realization of a reliable conclusion. However, it was also noted that NSAID treatment proved futile in alleviating pain in patients with more chronic cases, nor did it prove more beneficial in comparison to placebo administration [19].

### Physical Therapy and Rehabilitation

Physical therapy and rehabilitation protocols are usually preceded by resting of the elbow, and at times a complete immobilization of the elbow for up to three weeks [1,13]. The purpose of such programs is primarily preventive in nature, as they aim to curtail the recurrence of pain upon resuming the exacerbating activity. For example, typical physical therapy protocols focus on strengthening the forearm muscles gradually, so as to healthily develop the muscular strength necessary for performing repetitive forearm extension without the potential for injurious strain. Such protocols also involve regular stretching (both passive and manual) before and after strengthening exercises [1,14,17].

The efficacy of physical therapy and rehabilitation protocols that primarily focus on strengthening and stretching the afflicted musculature has not yet been studied in a randomized control trial. Rather, evidence exists for physical therapy protocols that further incorporate other therapy techniques, such as the application of high-energy pulsed ultrasound to the afflicted tendons (also called extracorporeal shock wave therapy) or the administration of friction

massages [20]. While the precise mechanisms of action are unknown for shock wave therapy and friction massages, it is widely contested that these procedures provide mechanothermal disturbances of the affected tissue-whereby the consequent increase in temperature may aid in decreasing joint stiffness and improving the elasticity of muscles, and the mechanical pulsing may aid in the disruption of granulation deposits within the muscle that are byproducts of tendinous injury [1,21,22].

Physical therapy incorporating shock wave therapy has shown to alleviate elbow pain in few randomized controlled trials, though such studies were deemed to be in poor quality by other reviewers, while physical therapy incorporating friction massages has been shown to alleviate pain in a single, albeit poor quality, randomized control trial [20]. As such, a reliable success rate for physical therapy treatment of Lateral Epicondylitis has yet to be assessed.

### Bracing

In cases when patients resume the exacerbating activity that resulted in Lateral Epicondylitis, some physicians have recommended that patients resume activity while wearing a forearm brace [1,13]. The brace usually takes shape as a tight, constricting band around the proximal end of the forearm towards the elbow. Such a band prevents complete contraction of the ECRB and EDC, thereby also preventing potential pain from overexertion of the muscles as well as further injury [23].

Despite this clear mechanism of action, however, bracing has not been shown to be more efficacious in alleviating pain symptoms when compared to simple physical therapy (that is, after patient examination with the brace removed) [24]. Furthermore, while forearm braces render Lateral Epicondylitis patients more confident upon resuming the exacerbating activity, some physicians contend that bracing may ultimately be more harmful, as they reduce circulation to the forearm and can potentially permanently limit a patient's range of wrist extension [17].

### Low-Level Laser Therapy

Low-Level Laser Therapy (LLLT) has been recently examined with respect to a large variety of medical conditions, ranging from acute arthritic pain to neuropathological injury [25]. It typically involves the administration of red to near-infrared light (within wavelengths between 600-1000nm) at low laser powers, with varying pulse-widths and irradiance areas depending upon the treatment. With respect to many musculoskeletal conditions, LLLT has been shown to reduce pain related to inflammation, although the precise mechanisms are largely unknown [25]. While the efficacy of LLLT in alleviating elbow pain from Lateral Epicondylitis is strongly contested, evidence from five randomized placebo-control trials has supported that LLLT may significantly improve short-term pain symptoms when administered at certain parameters (namely, an irradiant wavelength of 904nm, whereas studies administering light at other wavelengths have primarily shown negative results) [26]. However, despite these promising results, more examination is necessary to determine whether continued LLLT may alleviate pain in the long term, as well as whether LLLT proves more efficacious in comparison to the other conservative Lateral Epicondylitis treatments described above.

## Minimally-Invasive Approaches

### Clinical Acupuncture

Acupuncture is a form of alternative medicine rooted in traditional Chinese culture, wherein which needles are pierced into the skin in hopes of alleviating disease symptoms [27]. This treatment modality has been a topic of great debate in the medical community for decades, as acupuncture has been used to treat a great variety of conditions- pain, migraines, allergies, nausea, and many more- though there is a notable lack of clinically-significant evidence confirming that its effects are no more efficacious than placebo administration (though, studies have shown that acupuncture elicits release of endorphins and may trigger a healing response in reaction to the needle injury, so a physiological basis by which acupuncture may relieve pain is indeed plausible) [28,29]. As such, even upon treating similar conditions, acupuncturists (the vast majority who are not licensed physicians) exhibit a lack of uniformity and standardization in practice (such as the types of needles, puncture areas, etc.) [27]. With respect to Lateral Epicondylitis, only one randomized clinical trial had been completed demonstrating that acupuncture to clinically-relevant sites (i.e. ECRB) yielded greater pain relief to patients than did acupuncture to irrelevant sites.<sup>30</sup> Noted, however, such differential pain relief was only reported for up to two weeks, and there were found to be numerous confounding factors to the study (such as a limited sample size and the possibility that acupuncture to clinically-irrelevant sites serves as a poor control, among others) [30]. More trials are currently underway to help confirm or refute these results; though, at best, evidence seems to suggest that the benefits of clinical acupuncture are purely psychosomatic (though, benefits nonetheless) [28,31]. Additionally, given its invasiveness, acupuncture does pose potential risks such as bleeding and infection at puncture sites [27].

### Steroid Injections

A very common treatment for Lateral Epicondylitis is to inject a steroid preparation- usually consisting of a corticosteroid such as Kenalog and a local anesthetic such as lidocaine- deep into the ECRB at the lateral epicondyle, and possibly at several other sites just distal to the epicondyle [1,2,13]. Injections of this type usually aid in providing immediate pain relief by blocking nociceptive transmission while simultaneously suppressing inflammatory responses and promoting joint motility [32].

Corticosteroid injections have widely been demonstrated to relieve pain from tennis elbow with great efficacy [1,13]. Yet, despite its considerable pain-relieving effects for up to two months post-injection, the duration of these effects are likely transient, with a majority of patients reporting the recurrence of pain symptoms six-months post-injection [33]. Additionally, periodic corticosteroid injections do pose the potential for inadvertent side effects, such as subcutaneous fat atrophy, skin depigmentation, and tendon rupture [34]. Furthermore, there is a lack of randomized control trials comparing the efficacy of different steroid preparations in alleviating pain from Lateral Epicondylitis, rendering physicians to base their decisions based on experience and intuition rather than significant evidence [1]. Nonetheless, many physicians do opt to administer periodic steroid injections to patients with positive results [13].

## Platelet-Rich Plasma Therapy

Platelet-Rich Plasma therapy (PRP) is a method by which autologous blood is drawn from a patient, centrifuged to remove erythrocytes, leukocytes, and platelet-poor plasma, then injected back into the patient as a plasma preparation with a high platelet concentration [35]. In cases of muscle and tendon injury, PRP has been demonstrated to promote healing via the injection and recruitment of numerous factors necessary for tissue repair [36].

The efficacy of PRP in alleviating tennis elbow pain is still an area of active investigation. While some double-blinded randomized control trials demonstrated that PRP does not elicit a discernable effect on pain relief when compared to saline injections, others have demonstrated that PRP elicits pain relief of similar magnitude to corticosteroid injections, yet with substantially greater longevity (in some cases, up to two years) [37-40]. PRP injections nonetheless pose potential side effects, such as risks of infection, bleeding, skin depigmentation, and other effects relating to needle puncture [36-40].

## Botulinum Toxin A Injections

Botulinum Toxin A, commonly referred to as Botox, is a neurotoxin harvested from bacteria that blocks neurotransmitter release. As such, it has been used to cause palsy of skeletal muscle (a reason for its widespread cosmetic use in preventing facial wrinkle formation) [13].

With respect to Lateral Epicondylitis, injection of botulinum toxin into the wrist extensors causes their partial paralysis, thereby facilitating healing without the prospect of further aggravation [13,41]. While conflicting results of its efficacy have been described in the literature, meta-analyses have concluded that botulinum toxin treatment may provide moderate pain relief for up to three months [42]. However, given the inherent toxicity of the medication, significant risks of permanent paralysis or muscle weakness are possible if not administered correctly [43].

## Surgical Approaches

For the nearly 10% of Lateral Epicondylitis patients who have demonstrated no improvement in pain symptoms after exploring many of the conservative and minimally-invasive approaches described above, surgery is a final option [1,3]. There is little consensus among physicians about the optimal surgical approach for treatment of Lateral Epicondylitis. Indeed, numerous individual groups have pursued their own surgical techniques in addressing ECRB injury and have published their results; yet, very few- if any have compared surgical techniques in controlled trials [1]. Thus, many efficacy values for such surgeries are not only treatment-specific, but also specific to the surgical center or even specific to the surgeon [1].

The most popular surgical approach involves simply the removal of abnormal tissue from the ECRB tendon without modifying any of the surrounding tissue. Published results deem an 85% success rate (evaluated by good or excellent pain relief based on the visual analog test and the ability to resume full activity) with this particular technique, though evidence from further follow-up examinations is lacking [1,44].

Other approaches debride the damaged tissue similarly, but may also involve alteration to neighboring structures. For example, one

technique involves the excision of the annular ligament of the radius alongside abnormal tissue of the ECRB tendon, with a published success rate of 92% [45]. Other similar techniques involve a partial osteotomy of the lateral epicondyle or a distal lengthening of the ECRB tendon, both to relieve tension on the ECRB attachment site to the lateral epicondyle [46,47].

Further approaches produce even greater alterations to elbow anatomy. A common surgery is to simply release the ECRB tendon from the lateral epicondyle completely. Such an operation has yielded up to an 80% success rate [48]. Another surgery involves the denervation of the lateral epicondyle. In patients who responded positively to local anesthetic blocks of select posterior branches of the forearm posterior cutaneous nerve, destruction of such nerve branches yielded a significant reduction in pain symptoms for 80% of patients at 28 months post-operation [49]. Despite notable and durable improvements in pain symptoms from surgery, it has been argued that up to 40% of surgery patients still experience occasional moderate pain from Lateral Epicondylitis, while up to 10% of patients may experience no benefit whatsoever [1,50]. Furthermore, the surgical approaches described above may also require significant immobilization of the elbow for up to six weeks, after which substantial elbow strengthening and rehabilitation is necessary (however, recovery and rehabilitation times are significantly shorter when the same surgical techniques are performed through arthroscopic approaches) [1,14]. For these reasons, it is apparent why surgery is considered the final option for treatment of tennis elbow. Yet, it has also been claimed the rate of surgical success is inversely correlated to the duration of preoperative symptoms; as such, unnecessary prolonging of surgery in favor of ineffective conservative treatments may prove ultimately more harmful [1,50].

## Impairment Assessment

Most episodes of lateral epicondylitis are not permanent; therefore, in most cases there is no permanent impairment.

### Sixth Edition

With the Sixth Edition, lateral epicondylitis is rated on the basis of the Diagnosis-Based Impairment (DBI) using Table 15-4 Elbow Regional Grid: Upper Extremity Impairments (6<sup>th</sup> ed, 398). Under the heading of "Muscle / Tendon" for the diagnosis of "Epicondylitis: Lateral or Medial" the patient may be placed in Class 0 or 1. If there are no significant objective abnormal findings at Maximal Medical Improvement (MMI) the rating is 0. If there is a "history of painful injury, residual symptoms without consistent objective findings" the patient is assigned to Class 1 with a default rating of 1% upper extremity and potential range of 0 to 3%; however, this impairment can be given only once in an individual's lifetime.

If there was a surgical release of flexor or extensor origins with residual symptoms the patient is assigned to Class 1 with a default rating of 3% and range of 3% to 7%. If there is ratable impairment, i.e. assigned to Class 1, grade modifier adjustments are made for functional history, physical examination and clinical studies, as appropriate.

### Fifth Edition

In the Fifth Edition, Section 16.7d, Tendinitis (5<sup>th</sup> edn, 507), states, "Several syndromes involving the upper extremity are

variously attributed to tendonitis, fasciitis, or epicondylitis. Although these conditions may be persistent for some time, they are not given a permanent impairment rating unless there is some other factor that must be considered. If an individual has had tendon rupture or has undergone surgical release of the flexor or extensor origins of the epicondyles, there may be some permanent weakness of grip as result of the tendon rupture or the surgery. In this case, impairment can be given on the basis of weakness of grip strength according to Section 16.8b.” (5<sup>th</sup> edn, 507). Grip strength ratings are often unreliable; therefore, it is important to determine that the measurements are reliable by obtaining at three times during the evaluation, measuring in all five positions with the Jamar dynamometer, and obtaining rapid alternating grip measurements. If the patient continues to have pain, however, has not had surgery, it would not be appropriate to rate by strength loss since the Guides states, “Decreased strength cannot be rated in the presence of decreased motion, painful conditions...” (5<sup>th</sup> edn, 508).

## Conclusion

Elbow pain is often a joint that can often present with injury and problems. Many times, the proper exam and diagnosis are imperative to determine proper treatment and management for a maximal recovery. Lateral Epicondylitis, or more commonly known as tennis elbow, is common amongst both the general population and the occupational population. Quick diagnosis and treatment are paramount to recovery, however, in stubborn cases, multiple approaches and multimodal treatments are required.

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