

Effectiveness of Physical Therapy Treatments on Lateral Epicondylitis

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Objective: To analyze research literature that has examined the effectiveness of various physical therapy interventions on lateral epicondylitis. **Data Sources:** Evidence was compiled with data located using the PubMed, EBSCO, The Cochrane Library, and the Hooked on Evidence databases from 1994 to 2006 using the key words *lateral epicondylitis, tennis elbow, modalities, intervention, management of, treatment for, radiohumeral bursitis, and experiment*. **Study Selection:** The literature used included peer-reviewed studies that evaluated the effectiveness of physical therapy treatments on lateral epicondylitis. Future research is needed to provide a better understanding of beneficial treatment options for people living with this condition. **Data Synthesis:** Shockwave therapy and Cyriax therapy protocol are effective physical therapy interventions. **Conclusions:** There are numerous treatments for lateral epicondylitis and no single intervention has been proven to be the most efficient. Therefore, future research is needed to provide a better understanding of beneficial treatment options for people living with this condition.

Lateral epicondylitis, more commonly known as “tennis elbow,” or radiohumeral bursitis, occurs in approximately 1% to 3% of the general population.¹ Individuals between the ages of 35 and 54 are most commonly diagnosed with the syndrome.² While often perceived as an irritating condition, tennis elbow can be quite painful and may hamper the ability of those diagnosed with the disease to perform their role in society. While a high percentage of tennis players (nearly 40% to 50%) are diagnosed with the syndrome, many of those affected (15%) are workers in at risk industries, which commonly require individuals to engage in activities requiring overuse of the elbow, forearm, and wrist.^{1,3} A study conducted in The Netherlands showed that 10% of patients with lateral epicondylitis lost work productivity resulting from sick leave secondary to the pathology.⁴

Lateral Epicondylitis is characterized as a pain over the lateral epicondyle of the humerus, usually caused from overuse of wrist and forearm movements.^{5,6} The extensor carpi radialis longus and brevis along with the extensor carpi ulnaris and extensor digitorum originate along the lateral epicondylar ridge of the humerus. Of these specific muscles, the extensor carpi radialis brevis and extensor digitorum

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contribute the most to the manifestation of symptoms.^{5,6} The overuse of elbow and wrist extension causes the tendons of these muscles, especially the extensor carpi radialis brevis, to become irritated and inflamed, causing swelling and soreness around the lateral aspect of the elbow.⁵ Certain acute movements, such as wrist extension, can intensify symptoms, such as the movements involved when playing tennis, hence the term “tennis elbow.”⁵ Symptomatic individuals report pain and tenderness around the lateral aspect of the affected elbow when the wrist is extended. Wrist movements such as grasping and pinching are often hindered, consequently limiting the function of the hand.⁶

The treatment approach for lateral epicondylitis is usually conservative, consisting of relative rest, occasional bracing, inflammation control, and therapeutic exercise.^{5,6} Acute lateral epicondylitis can be immediately treated with rest and immobilization. The most common treatments of chronic lateral epicondylitis consist of soft tissue manipulation, phonophoresis of nonsteroidal anti-inflammatory drugs, and prolonged electrical stimulation.⁵ The purpose of this article is to analyze current literature regarding the most appropriate physical therapy intervention for the treatment of lateral epicondylitis and to subsequently make physical therapy recommendations for clinicians involved with the treatment of this syndrome.

Methods

Several literature databases were used in this search, including PubMed, EBSCO, The Cochrane Library, and the Hooked on Evidence database accessed through the APTA website, specifically the *Physical Therapy Journal* component. Included articles were written in English, full text, peer reviewed, and no more than 12 years old. All of the articles were located using online databases. Excluded from this review were review articles and meta-analyses. Keywords used in the search were *lateral epicondylitis, tennis elbow, modalities, intervention, management of, treatment for, radiohumeral bursitis, and experiment.*

The articles were evaluated using two methods. The first method, developed by Megens and Harris, evaluated the scientific rigor.⁸ The second method was Sackett's five hierarchical levels of evidence and three grades of recommendation.⁷ Megens and Harris established the following six criteria to evaluate each study: (1) inclusion and exclusion criteria listed for the subjects and an operational definition of the clinical problem provided, (2) the treatment protocol explained fully enough to be replicated, (3) reliability of data obtained with outcome measures assessed, (4) validity of the outcome measures investigated, (5) assessors blinded to the treatment groups, and (6) study accounted for attrition. As represented in Table 1, the studies labeled “Y” satisfied the specific criteria, while those labeled “N” did not fully satisfy the criteria.⁸ Sackett's levels of evidence include Level I, which provides the strongest evidence and describes large, randomized controlled trials with low false positives and low false negatives. Level II evidence is provided by small, randomized controlled trials with high false positives and high false negatives. Nonrandomized concurrent, cohort studies represent level III. Level IV evidence corresponds to a nonrandomized historic cohort study. Level V includes case series studies, which lack control and provide the weakest evidence. Clinical recommendations were assigned as A, B, or C based upon the level of evidence established by

Table 1 Evaluation Criteria for Scientific Rigor

Inclusion and Exclusion Criteria and Operational Definition of Lateral Epicondylitis	Treatment Can Be Replicated	Reliability of Outcome Measures Assessed	Validity of Outcome Measures Investigated	Blind Assessment of Outcome	Account for Attrition
Y	Y	Y	Y	Y	Y
Y	Y	Y	Y	Y	Y
Y	Y	N	Y	Y	Y
Y	Y	Y	Y	Y	Y
Y	Y	N	Y	Y	Y
Y	Y	Y	Y	N	Y
Y	Y	Y	Y	N	N
Y	Y	N	N	Y	Y
Y	Y	N	N	Y	Y
Y	Y	N	N	Y	Y
Y	Y	N	N	Y	Y
Y	Y	N	N	Y	Y
Y	Y	N	N	N	Y
Y	Y	N	N	N	Y
Y	Y	N	N	N	Y
Y	N	N	N	N	Y
N	N	N	N	N	N

the studies. A grade “A” recommendation is supported by at least one level I study. A grade “B” recommendation is supported by at least one level II study. A grade “C” recommendation is supported by level III, IV, or V studies.⁷

At least, 2 independent reviewers classified each study according to Sackett’s levels of evidence and reported the scientific rigor according to Megen’s and Harris’s criteria. Intra class correlation coefficient (ICC 3,1) was used to establish interrater reliability.

Results

A total of 35 studies were reviewed, but only 16 articles fully met the study selection criteria. These 16 articles were reviewed and classified according to Sackett’s Levels of Evidence and evaluated for scientific rigor. The interrater reliability was formulated for Sackett’s Level of Evidence and Megen’s and Harris’s scientific rigor. The ICC (3,1) was found to be 0.84. A summary outlining the results of the literature review is illustrated in Table 2.

The physical therapy interventions included methods of iontophoresis and phonophoresis, ultrasound, bracing, Cyriax physiotherapy, shockwave therapy, Bioptron light therapy, glyceryl trinitrate transdermal patch, and standard physical therapy protocols. When the studies were critically evaluated, seven articles were categorized as level I and nine were classified as level II. The seven level I studies provided grade A clinical recommendations, and the nine level II studies provided grade B clinical recommendations. Further evaluation showed that only three of the studies fully met all six criterion of scientific rigor,^{1,9,12} while three of the studies only lacked one of the criteria.^{10,13,14} Four of the sixteen studies were not included in the results because they lacked strong evidence and/or scientific rigor.^{3,18–20} The other twelve studies provided enough evidence and scientific rigor to be included in the results. The results of these twelve studies were summarized as follows:

Grade A Recommendations

Short Term Interventions (≤ 6 mo):

- Low dose shockwave is effective for short term pain reduction.⁹
- Corticosteroid injection is more effective in treating lateral epicondylitis than exercise, elbow manipulation, and Cyriax techniques.^{1,10}
- A physical therapy protocol consisting of pulsed ultrasound, friction massage, strengthening, stretching, and exercise is more effective than a brace and a combination of a brace and pulsed ultrasound.⁴
- Acoustic shockwaves were not effective for decreasing pain or increasing grip strength.¹¹

Long Term Interventions (> 6 mo)

- There is no difference between physical therapy consisting of elbow manipulation and exercise, the wait-and-see method, and corticosteroid injection.¹
- Acoustic shockwaves were not effective for decreasing pain or increasing grip strength.¹¹

Table 2 Sackett's Levels of Evidence and Other Study Characteristics

Author	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Baskurt et al ³	Randomized controlled trial; Level II; 2 group pre-post test	61 patients, age 29 to 72 with lateral epicondylitis	Group A: naproxen phonophoresis applied via Pagani Ultrasound followed using standard physiotherapy program (n = 29) Group B: naproxen iontophoresis applied via Pagani Galvanic Current, followed by standard physiotherapy program (n = 32)	2.7 to 6.3 months	Pain severity was evaluated using a visual analog scale; grip strength was measured at 90 degrees elbow flexion and extension using a dynamometer; patients were classified as excellent, good, moderate, poor according to the Nirschl-Petterone Scoring System.	Pain severity decreased in both groups, but there was no significant difference between the groups; grip strength increased in both groups, but there was no significant difference when the groups were compared. There were no changes in the scores of the Nirschl-Petterone Scoring System.

(continued)

Table 2 (continued)

Author	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Bisset et al ¹	Randomized controlled trial; Level I	198 volunteer participants aged 18 to 65 with a clinical diagnosis of tennis elbow of a minimum six week duration	Group A: corticosteroid injection with a follow up injection if necessary (n = 65) Group B: 8 treatments of physiotherapy, combining elbow manipulation and exercise, spanning six weeks (n = 66) Group C: sit and wait (n = 67)	52 weeks	Global improvement recorded on a Likert-type scale (6-point scale); pain-free grip force was measured with a digital grip dynamometer; the blinded assessor rated severity of the elbow complaints on a continuous visual analogue scale.	Corticosteroid injection showed significantly better effects at six weeks but with high recurrence rates thereafter and significantly poorer outcomes in the long term compared with physiotherapy treatments. No difference was seen at 52 weeks, when most participants in both groups reported a successful outcome. Participants who had physiotherapy sought less additional treatment compared to the others.

Chung B et al ^{1,3}	Randomized controlled trial; Level II	60 patients with previously untreated lateral epicondylitis	<p>Group A: extracorporeal shock wave therapy and a forearm stretching program (n = 29)</p> <p>Group B: sham extracorporeal shock wave therapy and a forearm stretching program (n = 31)</p>	8 weeks	Quality of life, grip strength, pain	There was no difference between the two groups; however, both groups showed substantial decrease in pain and pain-free maximum strength.
Demirtas et al ⁵	Randomized controlled trial; Level II	40 patients with lateral epicondylitis and pain for at least 2 months; 26 women; 14 men; none of the patients had received prior treatment.	<p>Group A: iontophoresis with sodium diclofenac followed by infrared treatment (n = 20)</p> <p>Group B: iontophoresis with sodium salicylate followed by infrared treatment (n = 20)</p>	18 days	Pain was measured during wrist extension, lateral epicondyle palpation, and was evaluated on a three point subjective scale.	Patients in both groups experienced a reduction in pain after treatment. Group A experienced a greater reduction in pain following treatment than group B.

(continued)

Table 2 (continued)

Author	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Drechsler et al ¹⁸	Randomized controlled trial; Level II	18 patients with lateral epicondylitis were recruited from the general clinic population and physicians in the community.	Group A (Neural Tension Group): passive mobilization of radial head and radial nerve (n = 8) Group B (Standard Treatment Group): ultrasound, transverse friction massage, stretching, and strengthening exercises for wrist extensors (n = 10)	15 weeks	Patient-rated level of recreational activities, occupational activities, and chronicity of symptoms.	Subjects who received radial head mobilization showed improvement while subjects in the standard treatment group did not.
Haahr et al ¹⁹	Randomized controlled trial; Level I	266 patients with lateral epicondylitis diagnosed in general practice.	Control Group: received treatment as agreed upon and preferred by the patient and the patient's general practitioner (n = 125)	1 year	Primary: self-reported progression of the condition	There was no advantage to the intervention, but 83% of the cases improved in both groups.

Haake et al ¹¹	Randomized multicenter trial; Level I	272 patients with 2 or more positive lateral epicondylitis diagnosis and recent unsuccessful conservative therapy.	Intervention Group: received advice on activities to avoid exaggerating the pain, adjust work conditions; later consulted with an ergonomist, who prescribed an exercise program (n = 141)	12 month procedure with checkups at 6 and 12 weeks	Secondary: reports on patient activity reported by the patient's general practitioner	Primary: No difference between placebo and electro shockwave tx.
			Intervention Group: acoustic shock waves from lithotriptors at low energy with local anesthetic injection (n = 135)		Secondary: Roles and Maudsley intensity pain scale; Bowdens grip strength test	Secondary: No difference between groups
			Control Group: local anesthetic with placebo shockwave therapy (n = 137)			There was clear improvements seen in all patients, regardless of therapy groups.

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Table 2 (continued)

Author	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Korthals-de Bos et al ²⁰	Randomized controlled trial; Level I	185 patients with pain at lateral side of elbow for 6 wk; pain increasing with pressure on lateral epicondyle during resisted dorsiflexion; between 18 and 70 yrs old	Group A: local corticosteroid injections (n = 62)	52 weeks	Six-point ordinal pain scale; six-point ordinal success scale; elbow disability measured by means of PFFQ ^{II}	Physiotherapy is more effective long term than corticosteroid injections and the wait and see approach.
			Group B: six weeks of physiotherapy with pulsed ultrasound treatment, deep friction massage, and an exercise program (n = 64)			
			Group C: Wait and see: visited general practitioner for discussion and prescribed medication if necessary (n = 59)			

Melegati et al ¹⁷	Randomized controlled trial; Level II	44 patients diagnosed with lateral epicondylitis at a sports rehabilitation center	Group A: electroshock wave treatment with a lateral tangential focus (n = 21) Group B: electroshock wave treatment with a back tangential focus (n = 20)	6 months	Two scoring systems, a visual analog scale and a TESS [†] analysis applied to both pre and post assessments.	Both groups showed a homogeneous decrease in the visual analog scale and an increase in scores of the TESS [†] , although no resolution of pain was exhibited.
Paoloni et al ²	Randomized, double-blinded, controlled trial; Level II	86 patients diagnosed with lateral epicondylitis for more than 3 months	Intervention Group: active glyceryl trinitrate transdermal patch (n = 43) Control Group: placebo patch (n = 43)	24 weeks with assessments at 0, 2, 6, 12, and 24 weeks	Patient-rated elbow pain at rest, with activity, and at night; tenderness around lateral epicondyle; Maudsley's dynamometer test; ORI-TETS;‡	Patients in the glyceryl trinitrate group had significantly reduced elbow pain with activity at 2 wk, reduced epicondylar tenderness at 6 and 12 wk, and an increase in wrist extensor mean peak force and total work at 24 wk. The intervention group showed better improvement than the placebo group.
Petrone et al ⁹	Randomized controlled trial; Level I	114 patients unresponsive to conventional therapy with at least six month history of lateral epicondylitis	Group A: low dose shockwave without anesthetic (n = 56) Group B: placebo (n = 58)	12 weeks; 52 week follow up	Visual analog scale and function was evaluated using an upper extremity functional scale.	Low dose shockwave therapy without anesthetic showed greater improvement compared to the placebo in every outcome measure. Each group showed improvements.

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Table 2 (continued)

Author	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Rompe et al ¹²	Randomized controlled trial; Level II	78 tennis players with MRI-confirmed lateral epicondylitis of at least 12 month duration	Group A: weekly active low-energy extracorporeal shockwave treatment for 3 weeks (n = 38) Group B: weekly placebo extracorporeal shockwave treatment for 3 weeks (n = 40)	3 months	Upper extremity function scale was used to evaluate reduction of pain.	After three months, there was a significantly greater improvement in pain during wrist extension in patients who received the intervention as compared to those who received the placebo.
Stasinopoulos et al ¹⁴	Randomized controlled trial; Level II	75 patients who had been diagnosed with lateral epicondylitis at least 4 wk prior	Group A: Cyriax physiotherapy* (n = 25)	4 weeks; 3 treatments per week for four weeks	Pain evaluated using visual analogue scale; pain-free grip strength.	The exercise program scored best in every outcome measure for the short, intermediate, and long term. Cyriax physiotherapy produced greater improvement compared to light therapy in every outcome measure. All interventions showed improvement.

Author(s)	Study Design	Subjects	Intervention	Function measured	Results
Struijs PAA, Damen PJ et al ¹⁶	Randomized controlled trial, Level II	31 subjects with a history consistent with lateral epicondylitis	<p>Group B: supervised exercise program consisting of slow progressive eccentric exercises of wrist extensors and static stretching exercises. (n = 25)</p> <p>Group C: Biopteron light therapy (n = 25)</p> <p>Group A: manipulation of the wrist (n = 15)</p>	Function measured with a visual analog scale	<p>Group receiving wrist manipulation scored better on global improvement scale at 3 weeks.</p> <p>Group receiving wrist manipulation scored better on pain decrease during the day at 6 weeks.</p>
			<p>Group B: ultrasound, friction massage, and muscle strengthening exercises (n = 16)</p>		<p>Primary: Subjective "global measurement of improvement" on a 6-point scale.</p> <p>Secondary: Patient reported pain, severity of main complaint, and inconvenience during daily activities; pain-free grip force and maximum grip force using hand dynamometer.</p>

(continued)

Table 2 (continued)

Author	Experimental Design and Level of Evidence	Participants	Intervention	Length of Study	Outcome Measures	Results
Struijs PAA, Kerkhoffs, et al ⁴	Randomized controlled trial; Level 1	180 subjects with clinically diagnosed lateral epicondylitis	Group A: physical therapy protocol** (n = 56) Group B: brace only (n = 68) Group C: brace plus pulsed ultrasound (n = 56)	52 weeks; examined at 6, 24, and 52 weeks	Patient self-assessed improvement measured on a 6-point scale; severity of patient's complaints; score of pain intensity of the patient's most important complaint; modified PFFQ.	Physical therapy protocol is beneficial over a short term period for pain, disability, and satisfaction. The combination treatment is more effective than the brace but only at 6 weeks. Brace only was superior on the ability of daily living activities. At 26 weeks and 52 weeks, no difference present between the three treatments.

Verhaar et al ¹⁰	Prospective; Randomized, controlled trial; Level I; Posttest only	106 outpatient patients with a mean age of 43 years who were referred to the University Hospital in Maastricht, The Netherlands for treatment of tennis elbow.	Group A: local corticosteroid injections (n = 53)	6 weeks; 1 year follow up	Subjective pain levels; physical examination testing resisted dorsiflexion of the wrist and middle fingers, as well as local tenderness; grip strength using a dynamometer; subjective satisfaction rating.	After six weeks of treatment, there was a significant improvement in the entire group, but corticosteroid injections were better than the Cyriax physiotherapy. After one year, there were no significant differences between the two groups.
			Group B: Cyriax therapy (n = 53)			

*Cyriax Physiotherapy - Deep transverse friction followed by passive elbow extension.

** Protocol: Pulsed ultrasound, friction massage, strengthening, stretching, and a specific exercise program.

† TESS - Total Elbow Scoring System

‡ORI - TETS - Orthopedic Research Institute Tennis Elbow Testing System

¶PFQ - Pain Free Function Questionnaire

Grade B Recommendations

Short Term Interventions (≤ 6 mo):

- Extracorporeal shockwave treatment was effective for pain reduction and increased upper extremity function.¹²
- Ultrasound shockwave did not prove to be more effective than the shockwave placebo.¹³
- A physical therapy exercise program consisting of slow progressive wrist exercises proved more effective than Cyriax physical therapy and Bioptron light therapy.¹⁴
- Cyriax physical therapy is more effective than Bioptron light therapy.¹⁴
- Glyceryl trinitrate transdermal patch was more effective than a placebo patch.²
- Iontophoresis with sodium diclofenac is more effective than iontophoresis with sodium salicylate.¹⁵
- Wrist manipulation showed better results than a combination of ultrasound, friction massage, and muscle strengthening.¹⁶
- Lateral tangential focus of extracorporeal shockwave therapy was no more effective than using a back tangential focus.¹⁶

Discussion

Within the reviewed studies, several interventions were compared. Shockwave therapy was the only intervention that had contradictory outcomes. Four different studies measured the performance of shockwave therapy.^{9,11–13} The strongest results came from the studies by Pettrone and Rompe.^{9,12} Pettrone's study was level I and met full scientific rigor.⁹ Rompe's study also met full scientific rigor, but was level II.¹² However, the study had 78 subjects, which makes it a strong level II study. Haake's study was level I, but it lacked reliability and validity.¹¹ Chung's study was level II and lacked reliability.¹³ Therefore, the results of Haake and Chung lacked merit. The discrepancy between these four results could be attributed to differences in the application protocol of the shockwave, subject populations, and control of confounding variables.

There are several possible physical therapy interventions for lateral epicondylitis; however, extensive analysis of the relevant literature offered a limited source of studies containing strong evidence and full scientific rigor. Several modalities were studied, but the results lacked full credibility. Many results were found and previously summarized; however, caution must be used when basing treatment upon these findings.

Even though each of these interventions has been proven successful, the application of treatment needs to be specific to each individual since there is not one intervention that can be applied to the entire population. Variable factors that affect the success rate of the reviewed interventions include age, prior intervention(s), activity level of the participants, multiple pathologies, severity of the pathology, and motivation. To optimize the success rate of future studies, these variables would need to be controlled.

Many of the experiments lacked an assessment of reliability and validity and only three provided full scientific rigor. Therefore, caution must be taken when following the recommendations of this study.

The studies reviewed provided many recommendations involving short-term treatment for lateral epicondylitis. There was very little evidence of successful long-term interventions, however. It is highly recommended that continuous research is performed that will focus on long term outcomes. Subsequent experiments should be completed with full use of scientific rigor.

Conclusions

Based on the analysis of the studies classified at higher levels of evidence, meeting at least five of the scientific rigor criteria, the following short-term recommendations were concluded:

- Shockwave therapy is effective for treatment of lateral epicondylitis.^{9,12,13}
- Corticosteroid injection is more effective than Cyriax physical therapy and physical therapy consisting of elbow manipulation.^{1,10}
- Cyriax physical therapy and a physical therapy exercise program consisting of slow progressive eccentric exercises and static stretching exercises of the wrist are both more effective treatments than is Biopton light therapy. Moreover, the Cyriax physical therapy program was more effective than both the physical therapy exercise program and the Biopton light therapy.¹⁴

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