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Efficiency of low-intensity laser therapy in the treatment of lateral epicondylitis

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ABSTRACT

Aim: Lateral epicondylitis is the most common cause of lateral elbow pain and dysfunction, mainly caused by repetitive gripping or wrist extension during various activities. Although also known as tennis elbow, lateral epicondylitis often develops as a work-related condition and therefore poses an important public health concern. The aim of this study was to investigate the efficacy of laser in the treatment of patients diagnosed with lateral epicondylitis.

Material and Method: Patients who received low-intensity laser therapy (LILT) treatment and patients who received placebo LILT while waiting for extracorporeal shock wave therapy (ESWT) treatment with the same diagnosis were included in the study. A total of 60 patients in two groups of 30 were included in the study. The patients who received LILT treatment constituted the treatment group (n=30), and the patients receiving placebo LILT constituted the control group (n=30). VAS for resting and resisted wrist extension, HAQ, PRTEE-T pain, function, and total scales were used to measure patients' pain status and response to treatment. Results were compared by analyzing patient files and recorded data.

Results: A total of 48 (80%) subjects were female and 12 (20%) were male. The mean age of the control group was 47.8±7.4 years, and the mean age of the treatment group was 45.7±8.5 years. There was no significant difference between the two groups in terms of age, gender, and occupational distribution ($p>0.05$). In our study, the group treated with LILT showed statistically significant improvement in all parameters (VAS, HAQ, PRTEE) we investigated compared to the control group ($p<0.05$).

Conclusion: We concluded that LILT therapy has positive effects on symptoms and clinical findings in the conservative treatment of lateral epicondylitis. Further research is necessary to solidify the results and determine the optimal use of LILT for this condition.

Keywords: Lateral epicondylitis, ESWT, elbow pain

INTRODUCTION

Lateral epicondylitis (LE), commonly known as tennis elbow, is a musculoskeletal disorder affecting 1-3% of the population, particularly individuals aged 35-50 and women (1). The dominant elbow is more frequently affected by activities that cause repetitive and forceful wrist extension and supination. Symptoms usually associated with LE present with lateral elbow pain provoked by wrist extension and weak grip strength (2). Although "epicondylitis" literally means an inflammatory condition, studies have shown that no inflammatory cells are detected in or around the painful area (3). Instead, the cause of the condition is attributed to the rise in fibroblasts that results from tendon damage. This results in an alteration in the arrangement of collagen and an increase in vascular tissue at the extensor carpi radialis brevis origin. Therefore, lateral epicondylitis is characterized as a tendinosis caused by fibroblastic and vascular responses to angio-fibroblastic injuries, rather than an inflammatory condition (4).

To achieve a successful outcome in treating lateral epicondylitis, several factors including the patient's age, gender, duration of symptoms, triggering factors, and location of the lesion, are important to consider for recovery (5). A wide range of treatments have been studied for lateral epicondylitis, including protective ergonomic measures, kinesiotaping, acupuncture therapy, medical conservative and surgical treatments, and restriction of triggering activities in daily life. Physical therapy (PT) agents, such as laser, transcutaneous electrical nerve stimulation, and shock wave therapy (ESWT), are also commonly used (6-8).

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Laser therapy is a noninvasive, painless treatment that is often used in physical medicine and rehabilitation (PM&R) clinics. Recent studies have highlighted the efficacy of high-intensity laser therapy (HILT) in managing a range of athletic injuries, including tendon damage, bruises, and muscle cramps (9-12). However, the outcomes of utilizing low-intensity laser therapy (LILT) for the management of LE have been conflicting. The aim of this study is to examine the effectiveness of LILT in treating LE and contribute to the existing literature.

MATERIAL AND METHOD

The study was carried out with the permission of the İstanbul Training and Research Hospital Clinical Researches Ethics Committee (Date: 27.10.2011, Decision No: 05). All procedures were conducted in accordance with ethical guidelines and the principles of the Declaration of Helsinki.

This clinical trial included 60 patients (44 female and 16 male) who were followed up for 1 month at our PM&R outpatient clinic. The participants had unilateral elbow pain and an average age of 46.75±6.6 (ranging from 18 to 65). The same physician evaluated both the LILT treatment group and the placebo group before and one month post-treatment. Both groups were prohibited from taking pain relievers, except for paracetamol, and the control group was given only paracetamol and physical activity restriction. The physician evaluating the patients was blinded to group allocation. Individuals who didn't meet the following criteria were excluded from the study: a diagnosis of fibromyalgia, previous treatment for LE, on the same side, significant Rheumatoid Arthritis or inflammatory joint disease affecting the elbow or wrist, cervical radiculopathy, carpal or cubital tunnel syndrome, prior surgery on the elbow, prior radius or ulna fractures causing deformities in the affected limb, other elbow conditions, neurological issues in the affected arm, systemic metabolic diseases, disorders in the cervical or shoulder region, and bilateral elbow pain. The participants underwent a comprehensive patient history review and complete blood count and routine biochemistry tests. Clinical diagnoses were made using Mill's, Cozen's, resistant middle finger extension, and Thomsen's tests. The examination included assessment of pain in the elbow and forearm, pain on palpation of the lateral epicondyle, and pain during forced wrist extension. Participants who had a history of systemic inflammatory rheumatic disease, common infections, malignancy, heart failure, pregnancy, bursitis in the elbow, pacemaker, chronic respiratory disorders, epilepsy, neurological pathology in the upper extremity, recent arm or cervical surgery, local injections or physiotherapy to the elbow, or complaints in both elbows, cervical vertebrae, or other upper extremity problems were excluded from the study.

The study group received a total of 10 sessions of laser therapy applied to the affected elbow. A Class 1 type BF LED Gallium-Aluminum-Arsenide diode laser device with a wavelength of 808 nm and output of 1.6 W (made by Elettronica Pagani in Italy) was used at a dose of 3 Joule/cm^2 with a pulse rate of 3500 Hz and full contact technique at a right angle for six-minute treatment sessions, five days a week. For the control group, the same treatment process was followed as for the treatment group, but the laser device was not activated during the treatments. Symptoms and signs were assessed using the Visual Analog Scale (VAS) for wrist extension pain at rest and with resistance, the Health Assessment Questionnaire (HAQ) for general health status, and Patient Rated Tennis Elbow Evaluation (PRTEE-T) for lateral epicondylitis, including pain, special activities, and activities of daily living subgroups.

Statistical Analysis

The data analysis was conducted using SPSS version 25.0, developed by IBM Inc located in Chicago, USA. The descriptive statistics, including the frequency, proportion, mean, and standard deviation, were calculated. The Kolmogorov-Smirnov test was used to examine the distribution of the data. Comparison of independent samples were evaluated using independent sample T-test and Mann-Whitney U test. To assess repeated measurements, the paired sample T test and Wilcoxon test were employed. Chi-square test was used for proportional data analysis, while Fischer test was applied if Chi-square test was not suitable. The study has established a p-value of less than 0.05 as the threshold for statistical significance.

RESULTS

The study recruited a total of 60 participants, of whom 48 (80%) were female and 12 (20%) were male. The gender distribution of both groups showed no significant difference, with a p-value greater than 0.05. The ages of those in the control group averaged 47.8±7.4 years, while the mean age of the treatment group was 45.7 ± 8.5 years, with no significant difference in age distribution between groups. The initial patient demographics and clinical features are displayed in **Table 1**.

There was no statistically significant disparity in occupational distribution between the control group (with 2 civil servants, 14 housewives, 6 workers, and 8 retirees) and the treatment group (with 2 civil servants, 20 housewives, 7 workers, and 1 retiree), as determined by a p-value greater than 0.05.

The dominant hand distribution between the two groups did not yield any significant differences, with the majority being right-handed (27 in control group, 29 in treatment

group) and only a few being left-handed (3 in control group, 1 in treatment group) (p>0.05). The duration of complaints was 6.5 ± 5.6 months in the control group and 5.8±4.2 months in the treatment group. No statistically significant variations were seen regarding the two groups (p>0.05). Additionally, no statistically significant disparities were found in the frequency of reported traumas, repetitive movements, additional illnesses, or drug use between the two groups (p>0.05) as shown in **Table 1**.

Table 1. Socio-demographic and clinical characteristics of the participants

	Control group (mean±SD/n (%)	LILT group (mean±SD/n (%)	p value
Age (years)	47.8±7.4	45.7±8.5	0.319
Sex			1
Female	24 (80%)	24 (80%)	
Male	6 (20%)	6 (20%)	
Occupation housewife	14 (46.7%)	20 (66.7%)	>0,05
Retired	8 (26.7%)	1 (3.3%)	
Worker	6 (20.0%)	7 (23.3%)	
Official	2 (6.7%)	2 (6.7%)	
Duration of symptoms (months)	6.5±5.6	5.8±4.2	0.098
Dominant arm			0.612
Right	27 (90%)	29 (96.7%)	
Left	3 (10%)	1 (3.3%)	
Arm Affected			0.190
Right	20 (66.7%)	15 (50%)	
Left	10 (33.3%)	15 (50%)	
Trauma	0	0	-
Repetitive movement	5 (16.7%)	6 (20%)	0.573
Additional diseases	10 (26.7%)	8 (23.3%)	0.766

LILT: Low-intensity laser therapy, SD: Standard deviation (Chi-squared test)

The results revealed that VAS resting scores in the control group increased significantly compared to baseline (p<0.05), while VAS rest scores in the treatment group showed a significant decrease (p<0.05) after treatment compared to baseline. When the differences between the groups' initial and post-treatment VAS resting scores were compared, the difference was found to be statistically significant (p<0.05) (**Table 2**).

In the control group, the VAS-resistant wrist extension scores showed a rise after treatment compared to the baseline. However, the treatment group showed a significant reduction in VAS-resistant wrist extension scores (p<0.05) after treatment. The comparison of VAS-resistant wrist extension scores between the treatment and control groups showed a significant difference (p<0.05) post-treatment, with the treatment group exhibiting a decrease while the control group showed an increase (**Table 2**).

Our findings showed that the control group exhibited a rise in HAQ scores (p<0.05) post-treatment compared to pre-treatment, whereas the treatment group demonstrated a decrease in HAQ scores (p<0.05) post-treatment. The comparison of HAQ scores between the two groups showed a significant difference (p<0.05) in favor of the treatment group. The results also indicated that there was a significant difference (p<0.05) in HAQ scores after treatment in the treatment group compared to the control group, where there was an increase in the latter but a decrease in the former (**Table 2**).

In comparison, the PRTEE-T Questionnaire Pain Score showed a significant difference (p<0.05) between the two groups post-treatment, with a rise in the control group and a significant decrease in the treatment group. The difference was statistically significant (p<0.05) in the treatment group as seen in **Table 2**.

The findings demonstrated that the PRTEE-T Questionnaire Functional Score increased in the control group compared to pretreatment (p<0.05). Meanwhile, the treatment group showed a significant decrease (p<0.05) in the PRTEE-T Questionnaire Functional Score post-treatment. A notable discrepancy between the two groups was identified in **Table 2** and found to be statistically significant. significant (p<0.05) After treatment, the PRTEE-T Questionnaire Total Score in the control group increased significantly (p<0.05). In contrast, it significantly decreased (p<0.05) in the treatment group. **Table 2** highlights the significant difference (p<0.05) between the two groups in the PRTEE-T Questionnaire Total Score.

Table 2. Comparison of VAS, HAQ, and PRTEE scores of the groups before and after treatment

Outcome measure	Control Group			LILT group			p-value Between groups
	Baseline mean±SD	PT mean±SD	Difference	Baseline mean±SD	PT mean±SD	Difference	
VAS-R	5.0±1.9	6.3±1.9	+1.30±1.15	5.2±1.8	3.2±1.7	-2.20±1.69	p<0.00
VAS-RWE	6.0±2.4	7.4±2.2	+1.4±1.22	7.1±1.9	4.0±1.7	-3.13±1.5	p<0.00
HAQ	2.2±0.9	2.6±0.9	+0.47±0.42	3.0±1.1	1.6±0.8	-1.33±0.78	p<0.00
PRTEE-P	32.6±6.9	36.7±5.7	+4.03±4.9	35.2±5.6	22.8±7.1	-12.4±6.07	p<0.00
PRTEE-F	27.5±7.5	31.5±7.4	+4.03±4.4	35.3±7.1	21.8±6.7	-13.5±7.5	p<0.00
PRTEE-T	60.1±13.3	68.2±12.1	+8.07±9.01	70.6±11.6	44.6±13.5	-25.9±12.5	p<0.00

LILT: Low-intensity laser therapy, VAS-R: Visual Analog Scale resting pain, VAS-RWE: Visual Analog Scale resistant wrist extension pain, PRTEE Patient-Rated Tennis Elbow Evaluation Questionnaire, PRTEE-P: PRTEE pain score, PRTEE-F: PRTEE function score, PRTEE-T: PRTEE total score, SD: Standard deviation

DISCUSSION

Tennis elbow, or lateral epicondylitis, is a medical condition characterized by discomfort and pain in the elbow and arm, which originates from the lateral epicondyle of the forearm. It is aggravated by activities that require grasping, elbow extension during supination and pronation. Despite its name, tennis elbow affects individuals who are not involved in sports. Several treatments have been proposed for this condition, including local inections (steroids, PRP, dextrose prolotherapy) nonsteroidal anti-inflammatory drugs, splints, education, exercises, and ESWT, but a standart treatment with a clear consensus has not yet been established (13,14). In recent years, low-intensity laser therapy, a physiotherapy method, has been widely used for the treatment of LE, however, its efficacy continues to be disputed in the literature. The objective of this research is to assess the efficacy of LILT in treating LE, and to add to the existing knowledge base on the topic.

In our study, we examined the demographic characteristics of the groups, factors in the etiology of the disease, duration of symptoms, general health status, and treatment results in terms of pain and functional status. The incidence of lateral epicondylitis increases in females and between the ages of 30 and 60 (15,16) The mean age of participants in the control group in the study was 47.8±7.4 years, while it was 45.7±8.5 years in the treatment group. No significant age difference was observed between the two groups ($p>0.05$). These results match up with the findings from previous research in the field (17,18).

Stasinopoulos et al. (19) found that the disease was more prolonged and severe in women in their studies. Considering the gender distribution of our cases, 48 were female and 12 were male. In both groups, the gender distribution was 24 females and 6 males. Our study findings support the literature that the female gender ratio is high in LE cases.

The dominant arm is mostly affected in LE and may rarely be bilateral (20-22). In our research, we discovered that the majority of individuals with LE had their dominant side affected. The right side was dominant in 56 patients (93.33%) in the study, and the dominant side involvement was present in 39 patients (65%). The non-dominant extremity was involved in 21 patients (35%). This suggests that the dominant side is more at risk in daily life activities, but it can also be protected by keeping it on the non-dominant side to a large extent.

As reported in the literature, LE is commonly associated with excessive use of wrist extensors (23,24). Our study showed that the majority (80%) of individuals with this disorder were housewives. The conclusion aligns with previous studies, given that these occupational groups are known to frequently use wrist extensors.

In our study, all individuals with LE tested positive for the resistant wrist extension test (Cozen's Test). Additionally, the patients' pain levels during this test were evaluated using the VAS. The study found that those in the LILT treatment group had a significant improvement in various evaluation parameters, compared to the control group, including VAS rest and VAS resistant wrist extension, pain, functional, and total scores of the PRTEE-T questionnaire, and HAQ scores.

The utilization of LILT was first introduced in the 1960s, primarily for retinal detachment in 1962. Since LILT uses low energy levels, the tissue temperature remains below 1 degree, ruling out thermal effects as an explanation for its observed effects. Instead, nonthermal mechanisms are emphasized (25). There are several explanations for the pain-relieving effects of LILT, including alterations in neurotransmitter release, enhancement of intracellular messengers like ATP and calcium, and facilitation of tendon cell growth and collagen production (21,22). The potential mechanisms of LILT can be explained by preventing oxidative stress, reducing fibrosis in tendons, accelerating healing, and decreasing inflammation and pain in tendons (26,27).

Stergioulas et al. (28) randomly divided 50 patients into two groups to examine the effectiveness of LILT for LE. The laser group received GaAs laser treatment (Wavelength: 904 nm, Dose: 2.4) while the placebo group received fake laser treatment. The treatment protocol for both groups involved receiving 12 sessions over eight weeks, with two sessions per week in the first four weeks, and one session per week in the remaining four weeks. Patients' progress was evaluated before treatment, after eight weeks of treatment, and eight weeks post-treatment. The LILT group showed significant improvement in elbow range of motion, hand grip strength, pain during wrist extension, and rest pain (28). Our study demonstrated the effectiveness of LILT on hand grip strength, pain during wrist extension, and rest pain, which were similar to the findings in this study. However, since the elbow range of motion was not among our evaluation parameters, we could not compare it. Additionally, plyometric exercises were administered in both the control group and LILT groups in the aforementioned study, resulting in better control group scores than baseline levels, unlike in our study.

Lundeberg et al.'s (29) randomly assigned 57 patients to three groups to examine the effectiveness of LILT for LE. The study participants were divided into three groups, with 19 receiving GaAs laser treatment, 19 receiving HeNe laser treatment, and 19 receiving a placebo laser treatment. GaAs laser at 904 nm wavelength, 0.004 Joules/point energy dose, and HeNe laser treatment at 632.8 nm wavelength, 0.1 Joules/point energy dose were administered. A total of 10 treatment sessions were administered over 5-6 weeks, twice a week. Patients were evaluated for resting pain, resistant wrist extension pain, strength test, and hand grip strength. The study found that low-dose laser therapy did not produce a difference between the groups and therefore was not effective(29). However, our study showed that LILT is effective in treating LE, which contradicts the findings of Lundeberg et al. We think this difference may be because Lundeberg et al.'s treatment method did not irradiate the tendon but only targeted acupuncture points.

In a research study on the treatment of LE, the results showed that HILT (1,064 nm) was more effective than LILT (904 nm) in terms of SF-36 score, hand-grip strength, and QDASH scores, with a statistical significance of $p<0.05$. The trial involved 60 patients, with half receiving HILT and half receiving LILT, administered three times a week over a period of three weeks (17). Although HILT treatment was found to be more effective than LILT in that study, both were reported to be effective in the treatment of LE. Since we did not administer HILT treatment to our patients in our study, we could not compare it with LILT. However, the results found in our study were similar to the results regarding the efficacy of LILT in that study.

The short follow-up period and the low number of participants are the limitations of our study. In the literature, the long-term results of the improvement in disease parameters after the end of treatment are controversial.

Our findings align with previous research indicating LILT to be a viable treatment option for LE.

CONCLUSION

Our study found that the group receiving LILT for the conservative treatment of LE experienced a statistically significant improvement in all variables related to pain, functional activities, and activities of daily living. The results demonstrate that LILT is an effective treatment method for the short-term management of LE. Further research with larger participant numbers, extended observation periods, and various dosages and wavelengths is required to bolster these results.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of the İstanbul Training and Research Hospital Clinical Researches Ethics Committee (Date: 27.10.2011, Decision No: 05).

Informed Consent: All patients signed the free and informed consent form.

Referee Evaluation Process: Externally peer-reviewed.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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Author Contributions: All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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