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Comparison of the Effectiveness of TENS and Low-Level Laser Therapy Applied to the Sciatic Nerve Region in Chronic Lumbar Radiculopathy

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Abstract

Introduction: This study was carried out to assess and compare the efficacies of transcutaneous electrical nerve stimulation (TENS) and low-level laser therapy (LLLT) applied to sciatic Valleix points to reduce sciatica in patients with chronic lumbar radiculopathy.

Materials and Methods: The study population consisted of 164 patients with chronic radicular pain caused by LDH. The remaining 75 patients were studied in three groups. TENS and hotpack were applied to the lower back region of all patients. In addition, group 1 (n=24), group 2 (n=25), and group 3 (n=26) received LLLT (4 J/cm^2 for each point), TENS, and sham LLLT, respectively, on sciatic Valleix points five days a week, for three weeks (15 sessions). Outcomes were assessed at the beginning of the treatment, after completion of 3 weeks of treatment, and after three months (follow-up).

Results: Post-treatment assessments indicated that all parameters investigated within the scope of the study improved in all three groups, except for the VAS leg pain (VASLP) score in group 3. Post-treatment VASLP and DN4 scores of group 1 were significantly superior to those of group 2 (P<0.001). Follow-up assessments revealed an improvement only in the VASLP score and in group 1. The VASLP, DN-4, and ODI scores of groups 1 and 2 were significantly superior to those of group 3. There was no significant difference between the groups in the PSQI score and lumbar ROM value.

Conclusion: Both LLLT and TENS were found to be effective in treating the sciatic nerve associated with lumbar disk herniation with radiculopathy. LLLT was found to be more effective than TENS in reducing leg and neuropathic pains. Follow-up assessments revealed that the only lasting effect of the treatments, which continued into the third month, was the improvement in leg pain.

Keywords: Lumbar radiculopathy; Low-Level Laser therapy, Transcutaneous Electric Nerve Stimulation.

Introduction

Lumbosacral radiculopathy, characterized by lower back and leg pains, is one of the most common disorders physiatrists encounter. The etiology of lumbosacral radiculopathy usually involves nerve root compression, which causes dysfunction in one or more lumbosacral nerve roots.[1] Its symptoms can range from temporary radicular pain to severe chronic pathologies leading to permanent disability and motor deficit. The most commonly involved nerve root in lumbosacral radiculopathy is L5 (48%), followed by S1 (30%), L4 (17%), L3 (5%), S2 (4%), and L2 (3%) nerve roots, respectively.[1,2]

Currently available treatment options for lumbosacral radiculopathy are generally classified under four categories: pharmacological, conservative, interventional, and surgical treatments. Given the controversy surrounding the results of risk-benefit analyses of invasive approaches, American Pain Society guidelines recommend primarily using conventional methods to achieve functional improvement in pain control and treatment.[3]

Laser therapy has been widely used as a reliable method for treating various painful conditions, especially soft tissue injuries, in the last 40 years. Laser therapies involve monochromatic and coherent, directional, non-ionizing electromagnetic radiation.[4] Low-level laser therapy (LLLT), a treatment method that involves a light source, acts through photochemical reactions without thermal

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effects. Studies have shown that laser therapies can increase collagen production and DNA synthesis and improve damaged neurological tissue function.[4,5] It has been reported that LLLT can be moderately effective in pain reduction and functional improvement in patients with subacute or chronic lower back pain.[6]

Transcutaneous electrical nerve stimulation (TENS) is a well-established, effective method used for pain control. However, a comprehensive theory explaining its analgesic effect has yet to be developed. TENS involves producing a transcutaneous pulse electrical current and carrying impulses to afferent nerves with large diameters. It is speculated that TENS controls pain by stimulating the release of endorphins and other neurotransmitters and causing presynaptic inhibition in delta-A and C fibers that carry pain sensation to the substantia gelatinosa.[7]

Previous studies investigating the use of LLLT in treating lumbar radiculopathy were limited only to the lumbar region.[8,9] To our knowledge, no study has been conducted to compare LLLT and TENS applied to sciatic Valleix points. On the other hand, several studies demonstrated the efficacy of using high-intensity laser therapy (HILT) in the lumbar region to treat lumbar radiculopathy. However, considering that LLLT has fewer side effects and is easily accessible compared to HILT, there is a need to prove the effectiveness of its application to sciatic Valleix points.[10,11] In addition, a thorough literature review revealed that the studies conducted in this field involved short follow-up periods, such as four weeks. For these reasons, we aimed to investigate the long-term effects of LLLT and TENS applied to the sciatic Valleix points in patients with lumbar disc herniation (LDH) and radiculopathy. In our study, we aimed to introduce a different way of using LLLT, which is easily accessible in practice, such as TENS, by proving the effectiveness of its application to sciatic vallex points in lumbar chronic radiculopathy.

Materials and Methods

Study Design

The research protocol (Reference: 31032016-7) received approval from the Ethics Committee of Ufuk University's Faculty of Medicine, ensuring compliance with the ethical standards as delineated in the Declaration of Helsinki.

Population and Sample

The study population consisted of 164 patients aged between 18 and 75 who were diagnosed with radiculopathy related to L4-5 and L5-S1 disc herniation, as indicated by magnetic resonance imaging (MRI) findings and confirmed by electroneuromyography (EMG) findings. Patient information such as age, height, weight, onset and duration of complaints, localization and prevalence of waist and leg pain, paresthesia, and medication used for the pains was recorded. All patients underwent routine biochemistry hemogram and sedimentation tests, complete urinalysis, brucella analysis, and serological ((antistreptolysin O, rheumatoid factor and C-reactive protein) tests. While patients with a visual analogue scale (VAS) score of 5 and above and low back pain due to lumbar discopathy and associated leg pain in the form of sciatica for more than three months were included in the study, patients with significant pathology, including rheumatological disease, patients who received physical therapy in the same area within six months before the onset of the disease, patients with cognitive dysfunction that may interfere with assessments, patients with a history of lumbar surgery, patients with a history of cancer, patients with peripheral neuropathy as indicated by EMG findings, patients with a possible neurological disease accompanied by neuropathic pain, patients with metabolic disorders such as diabetes mellitus and thyroid dysfunction, and patients with spinal stenosis were excluded from the study.

Of the 164 patients, 65 did not meet the inclusion criteria of the study, and 18 did not consent to participate. The remaining 81 patients were randomized into three groups, group 1 (n = 26), group 2 (n = 26), and group 3 (n = 29), using sealed envelopes representing the treatments to be applied to each group. A total of 2 patients in group 2 and group 3 could not complete the treatment. A total of 4 patients, two patients in group 1 and two patients in group 3, could not be reached during follow-up. In the end, the study sample consisted of 75 patients analyzed in three groups: group 1 (n = 24), group 2 (n = 25), and group 3 (n = 26) (Figure 1).

Treatment Procedure

In this investigation, three distinct patient groups were assigned different interventions. Group 1 underwent LLLT with an energy output of 4 J/cm^2 at each treatment point, while group 2 was treated with TENS. Group 3 received sham LLLT on the sciatic nerve, administered 5 days a week for a period of 3 weeks, amounting to 15 sessions in total. It is important to note that all patients were blinded to the specific treatment assigned, whereas the physiotherapist administering the treatments was fully cognizant of the treatment details.

For the LLLT regimen, group 1 received treatment at six specific sciatic nerve Valleix points: these included the bilateral middle point of the gluteus maximus, the middle point of the gluteal sulcus, the middle and posterior points of the thigh, the popliteal fossa, the middle and posterior points of the cruris, and the middle point of the Achilles tendon.[12] In each session, a continuous laser mode was applied for 40 seconds at each point, with a dosage of 4 J/cm^2 per Valleix point. This amounted to a total dose of 24 J across the six points per session. This treatment was consistently applied by the same physiotherapist using a gallium-aluminum-arsenide (GaAlAs) diode laser device

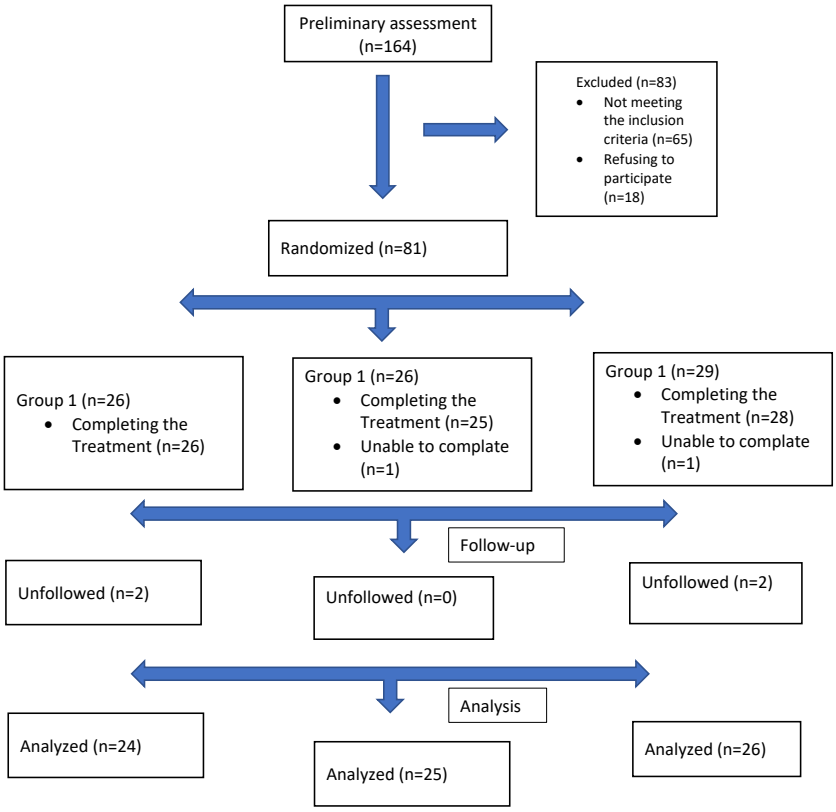

Figure 1. Allocation and Randomization Process

with an infrared continuous wave. The device, provided by Chattanooga Group from Vista, California, USA, features an 850 nm wavelength (invisible spectrum), a power output of 100 mV, and a spot size of 0.07 cm^2. Additionally, for group 3, the device was turned off to provide a sham treatment at the patients' sciatic Valleix points

Group 2 received TENS treatment on the same six sciatic nerve Valleix points for 20 minutes using an Intelect® Legend Stimulator (DJO, LLC, Vista, CA, USA). Accordingly, TENS treatment was administered by the use of four medium-sized cutaneous electrode pads (each measuring 2.5 cm). These pads were strategically positioned in a dermatomal arrangement, specifically at the midpoint of the gluteal sulcus, the mid and posterior points of the thigh, the middle and posterior points of the cruris, and the midpoint of the Achilles tendon. The operational parameters for these electrodes were set at a frequency of 4 Hz and a pulse duration of 0.1 seconds. The intensity level of the electrical stimulation was carefully adjusted to each patient's maximum tolerance threshold, ensuring it was strong enough without inducing muscle contractions.[13]

Group 3 received a sham laser to the same six sciatic nerve Valleix points with the device turned off. The patients and the treating physical therapist wore safety glasses during each LLLT and sham LLLT session.

All the patients received treatment 5 working days a week for 3 weeks, for 15 sessions. TENS and hotpack were applied to the lower back region of all patients. TENS was applied paravertebrally for 20 minutes at a current intensity of approximately 20-30 mA in conventional modulation with dual channels, along with hotpack application. For the intervention, four self-adhesive surface electrodes, each measuring 5×5 cm, were strategically positioned on the patients' lumbar region. Two of these electrodes were placed at the level of the first lumbar vertebrae (L1) paravertebrally, and the other two at the second sacral vertebrae (S2) paravertebral level. Prior to initiating the treatment, all participants were instructed by the same physiotherapist in specific lumbar isometric exercises. These exercises included pelvic tilt routines, hamstring stretching, and a modified form of straight leg raises. The patients were advised to perform these exercises for 20 minutes daily, maintaining a frequency of at least five days per week. This exercise regimen was introduced at the conclusion of the first week of the treatment protocol. Additionally, the patients were educated about certain behaviors and activities that might exacerbate lower back pain, emphasizing the importance of avoiding these to mitigate potential discomfort.

Assessment Parameters

In all the patients, the lumbar region was visualized by using direct radiography and MRI. EMG was performed on all the patients for the diagnosis of radiculopathy.

The locomotor examination included assessing lumbar lordosis, scoliosis, joint range of motion (ROM), fingertip-to-floor distance, Valleix point tenderness, deep tendon reflexes, in addition to modified Schöber test (MST), sensory examination, muscle strength, and straight leg lift tests.

Additionally, the VAS was used to assess low back and leg pain, the Oswestry disability index (ODI) to assess disease-specific functional status, the Pittsburgh Sleep Quality Index (PSQI) to assess sleep quality, and the neuropathic pain diagnostic questionnaire (Douleur Neuropathique 4-DN4) to assess neuropathic leg pain. The assessments were made at three endpoints: at the beginning of the treatment (baseline), after completion of 3 weeks of treatment (post-treatment), and after three months (follow-up), and they were compared both within and between the study groups.

The severity of low back and leg pain was assessed using the VAS at rest, in motion, and at night. In this context, the patients were asked to mark the severity of their lower back pain on a 10 cm-long line, where 0 points indicate the absence of pain and 10 points indicate the maximum pain. Then, the distance between the marked point and the 0 points was measured with the help of a ruler.

The Turkish version of ODI, the validity studies of which have been completed, was used in the study. ODI includes 10 items regarding pain intensity, personal care, weight lifting, walking, sitting, standing, sleeping, social life, travel, and change in pain over time. These ten items are answered by selecting 1 of 6 response options per item. The patients were asked to choose the option that best described their condition and grade it between 0 and 5 points. In this way, the highest score that can be obtained from ODI is 50 points. While higher ODI scores indicate increased functional limitation, lower ODI scores indicate increased functional level.[14]

The PSQI was developed to assess patients' sleep quality over one month.[15] The validity and reliability studies of the Turkish version of PSQI were performed by Ağargün et al.[16] The PSQI consists of 24 items in total. Nineteen of these items are self-assessment items. The remaining five items are directed at the patient's roommate or spouse. Each of the seven components of PSQI is scored between 0 and 3 points. The sum of the scores assigned to these seven components equals the total PSQI score, which varies between 0-21. PSQI scores of 5 or less indicate "good" sleep quality, whereas PSQI scores above 5 indicate "poor" sleep quality.[15]

The DN4 questionnaire is an easy-to-score assessment tool developed to assess neuropathic pain.[17] The DN4 consists of 4 items. The first two items are about pain characteristics, and the last two are about sensory examination findings. DN4 scores of 4 or more out of 10 indicate neuropathic pain with 83% sensitivity and 90% specificity. The validity and reliability studies of the Turkish version of DN4 were performed by Çelik et al.[18]

Statistical Analysis

Data analysis in this study was performed by utilizing SPSS 23.0 software (Statistical Product and Service Solutions for Windows, Version 23.0, IBM Corp., Armonk, NY, US, 2015). The normality of distribution for the variables under investigation was assessed by the Shapiro-Wilk test. For comparing categorical variables across different groups, Pearson's chi-square test was employed. When variables were found to adhere to a normal distribution, their differences were examined by the one-way analysis of variance (ANOVA). Conversely, the Kruskal-Wallis H-test was applied to evaluate variables not conforming to normal distribution. In instances of multiple comparisons, Dunn's test was utilized. The statistical outcomes were reported as frequencies (percentages) for categorical variables, and as means ± standard deviations, along with median (minimum–maximum) values, for quantitative variables. A probability (P value) of less than 0.05 was considered statistically significant. To determine the required sample size, G*Power v.3.1.9.2 software was used. Based on this analysis, it was ascertained that a minimum of 54 patients (18 patients per group) would be necessary to detect a minimum difference of ± 20 points in the ODI scores among all groups, with an alpha error level of 0.05 and a power of 0.80.

Results

The study sample consisted of 75 patients analyzed in three groups: Group 1 (n = 24), group 2 (n = 24), and group 3 (n = 26). The median age of groups 1, 2, and 3 was 54, 46, and 56, respectively. There was no significant difference between the groups in median age ($P = 0.641$). The mean body mass index (BMI) values of groups 1, 2, and 3 were 26.07, 26.46, and 28.01, respectively. There was no significant difference in BMI value between the groups ($P = 0.142$). The median duration of low back pain was 24 months in all groups. Accordingly, there was no significant difference between the groups in the duration of low back pain ($P = 0.793$). The median duration of leg pain was 15 months in groups 1 and 2 and 20 months in group 3. Accordingly, there was no significant difference between the groups in leg pain duration (p = 0.766). There was also no significant difference between the groups in gender, profession, education level, and medications used ($P > 0.050$) (Table 1).

The analysis of the differences between baseline and post-treatment assessments revealed statistically significant differences between the groups. Lumbar VAS changes before and after treatment are shown in Figure 2. The median difference between the VAS leg pains at rest scores was 6.5 in group 1, 4 in group 2, and 0 in group 3. Accordingly, there was a significant difference between the groups in the median difference between the VAS

Table 1. Comparison of Demographic and Clinical Characteristics According to Groups

	Groups			*P*
	Group 1 (n=24)	**Group 2 (n=25)**	**Group 3 (n=26)**	
Age	52.5±13.49[a] 54 (31-74)[b]	50.16±15.73[a] 46 (29-76)[b]	54.04±14.88[a] 56 (31-75)[b]	0.641*
BMI	26.07±3.5[a] 25.79 (19.83-35.38)[b]	26.46±4.17[a] 26.85 (17.36-36)[b]	28.01±3.21[a] 28.29 (21.72-33.56)[b]	0.142**
Low back pain duration	27.96±17.23[a] 24 (6-72)[b]	32.92±20.84[a] 24 (6-72)[b]	31.27±19.3[a] 24 (6-72)[b]	0.793*
Leg pain duration	20.46±13.87[a] 15 (6-60)[b]	23.48±17.2[a] 15 (6-60)[b]	23.77±15.65[a] 20 (6-60)[b]	0.766*
Gender, No. (%)				
Woman	13 (54.2)	16 (64)	16 (61.5)	0.766***
Male	11 (45.8)	9 (36)	10 (38.5)	
Job, No. (%)				
Working	6 (25)	7 (28)	7 (26.9)	0.987***
Not working	7 (29.2)	8 (32)	9 (34.6)	
Retired	11 (45.8)	10 (40)	10 (38.5)	
Education, No. (%)				
Primary school	4 (16.7)	5 (20)	5 (19.2)	0.978***
Middle school	7 (29.2)	5 (20)	8 (30.8)	
High school	7 (29.2)	8 (32)	8 (30.8)	
University	6 (25)	7 (28)	5 (19.2)	
Medication used, No. (%)				
Yes	17 (70.8)	15 (60)	18 (69.2)	0.682***
No	7 (29.2)	10 (40)	8 (30.8)	

BMI, body mass index; SD, standard deviation.
*Kruskal-Wallis test; **One-way ANOVA; ***Pearson chi-square test; [a] Mean±standard deviation; [b] Median (minimum–maximum).

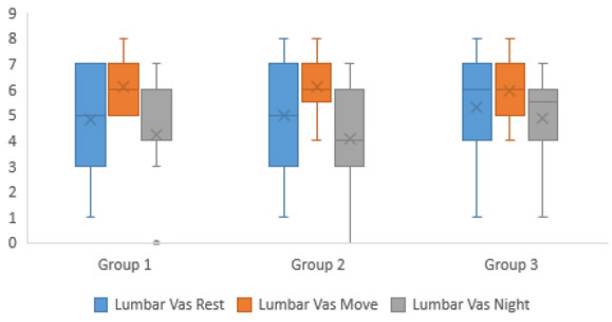

Figure 2. Lumber VAS Difference Values According to Groups (Pre-treatment-post-treatment)

leg pain at rest scores ($P<0.001$). The median difference between the VAS leg pain in motion scores was 6 in group 1, 4 in group 2, and 0 in group 3. Accordingly, there was a significant difference between the groups in the median difference between the VAS leg pain in motion scores ($P<0.001$). Additionally, the median difference between the VAS leg pain at night scores was 5.5 in group 1, 3 in group 2, and 0 in group 3. Accordingly, there was a significant difference between the groups in the median difference between the VAS leg pain at night scores ($P<0.001$). Leg VAS changes before and after treatment are shown in Figure 3. The median difference between the DN4 scores was 6 in group 1, 4 in group 2, and 2 in group 3. Accordingly, there was a significant difference between groups 1 and 2 and group 3 in the median difference between the DN4 scores ($P<0.001$). The median difference between the ODI scores was 69.5 in group 1, 65 in group 2, and 50 in group 3. Accordingly, there was a significant difference between groups 1 and 2 and group 3 in the median difference between the ODI scores ($P<0.001$). There was no significant difference between the groups in other parameters investigated within the scope of the study ($P>0.050$) (Table 2).

The analysis of the differences between baseline and follow-up assessments revealed statistically significant differences between the groups. Lumbar VAS changes before and 3 months after treatment are shown in Figure 4. The median difference between the VAS leg pains at rest scores was 7 in group 1, 4 in group 2, and 0 in group 3. Accordingly, there was a significant difference between the groups in the median difference between the VAS leg pain at rest scores ($P<0.001$). The median difference between the VAS leg pain in motion scores was 7 in group

1, 4 in group 2, and 0 in group 3. Accordingly, there was a significant difference between the groups in the median difference between the VAS leg pain in motion scores ($P<0.001$). Additionally, the median difference between the VAS leg pain at night scores was 5 in group 1, 3 in group 2, and 0 in group 3. Accordingly, there was a significant difference between the groups in the median difference between the VAS leg pain at night scores ($P<0.001$). Leg VAS changes before and 3 months after treatment are shown in Figure 5. The median difference between the DN4 scores was 6 in group 1, 5 in group 2, and 3 in group 3. Accordingly, there was a significant difference between groups 1 and 2 and group 3 in the median difference between the DN4 scores ($P<0.001$). The median difference between the ODI scores was 69 in group 1, 66 in group 2, and 52 in group 3. Accordingly, there was a significant difference between groups 1 and 2 and group 3 in the median difference between the ODI scores ($P<0.001$). There was no significant difference between the groups in other parameters investigated within the scope of the study ($P>0.050$). (Table 3)

Discussion

In this study, we investigated the efficacies of LLLT and TENS methods applied to the sciatic Valleix points in terms of reducing pain and improving the functionality

Table 2. Comparison of the Differences Between Pre-treatment and Post-treatment Values of Parameters According to Groups

		Group			*P*
		Group 1	Group 2	Group 3	
Lumbar VAS rest	Mean ± standard deviation	4.79 ± 1.84	5 ± 1.91	5.31 ± 2.05	0.524*
	Median (minimum–maximum)	5 (1-7)	5 (1-8)	6 (1-8)	
Lumbar VAS move	Mean ± standard deviation	6.13 ± 0.9	6.12 ± 0.93	5.96 ± 1.04	0.836*
	Median (minimum–maximum)	6 (5-8)	6 (4-8)	6 (4-8)	
Lumbar VAS might	Mean ± standard deviation	4.25 ± 2.03	4.08 ± 2.14	4.85 ± 2.05	0.262*
	Median (minimum–maximum)	4 (0-7)	4 (0-7)	5.5 (0-7)	
LEG VAS rest	Mean ± standard deviation	6.29 ± 1.37	3.96 ± 1.79	0.12 ± 0.52	<0.001*
	Median (minimum–maximum)	6.5 (3-8)[c]	4 (-1-6)[b]	0 (-1-2)[a]	
LEG VAS move	Mean ± standard deviation	6.25 ± 1.19	4.32 ± 1.14	0.69 ± 1.12	<0.001*
	Median (minimum–maximum)	6 (4-8)[c]	4 (2-6)[b]	0 (0-4)[a]	
LEG VAS night	Mean ± standard deviation	4.83 ± 2.43	2.52 ± 2.71	-0.08 ± 0.39	<0.001*
	Median (minimum–maximum)	5.5 (0-8)[c]	3 (-4-5)[b]	0 (-2-0)[a]	
DN4	Mean ± standard deviation	5.54 ± 1.56	4.56 ± 1.33	2.65 ± 1.62	<0.001*
	Median (minimum–maximum)	6 (3-9)[b]	4 (3-8)[b]	2 (0-6)[a]	
LUMBAREXT	Mean ± standard deviation	-32.13 ± 6.23	-30.48 ± 8.88	-31.31 ± 6.64	0.737**
	Median (minimum–maximum)	-33.5 (-45--16)	-30 (-46--13)	-30.5 (-46--20)	
ODS	Mean ± standard deviation	67.46 ± 9.14	62.76 ± 11.42	50.62 ± 12.46	<0.001*
	Median (minimum–maximum)	69.5 (48-80)[b]	65 (44-82)[b]	50 (22-75)[a]	
PSQI	Mean ± standard deviation	7.5 ± 3.92	7.72 ± 2.65	7.35 ± 3.79	0.868*
	Median (minimum–maximum)	7 (0-14)	8 (0-12)	8 (0-16)	

VAS, visual analog scale, DN4, Doleur Neuropathique 4 Questionnaire; ODS: Oswestry Disability Scale, PSQI: Pittsburg Sleep Quality Index.
*Kruskal-Wallis test; **One-way ANOVA.
[a-c] There is no difference between groups with the same letter.

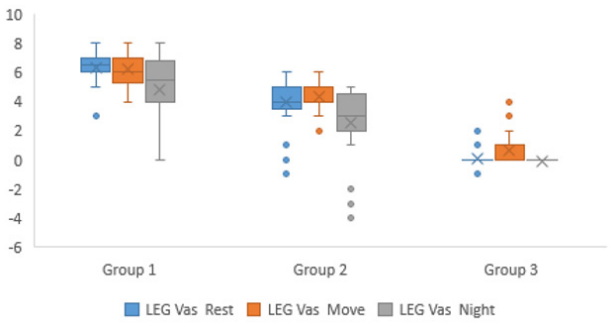

Figure 3. LEG VAS Difference Values According to Groups (Pre-treatment-post-treatment)

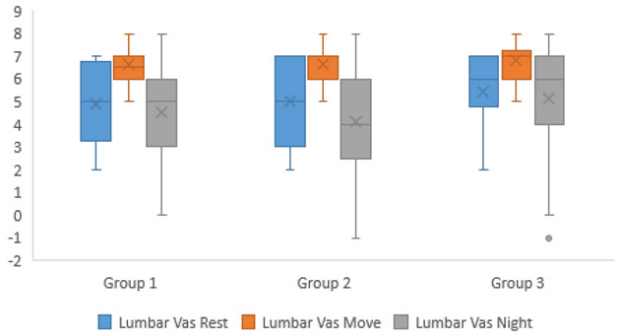

Figure 4. Lumber VAS Difference Values According to Groups (pre-treatment-3rd month)

and quality of life in patients with sciatica related to chronic LDH, both after the treatment and in the follow-up period. Consequently, we determined that both methods significantly reduced pain and disability. Both LLLT and TENS methods applied to the sciatic Valleix points significantly improved VAS, DN4, and ODI scores. However, between the two methods, we determined that LLLT provided better results than TENS did.

Physical therapy methods are frequently used to provide relief from the lumbar radicular pain. In a study conducted with 14 lumbar radicular pain patients, Ariel et al administered four treatments consecutively for 10 minutes each: TENS, interferential current therapy (ICT), pulsed ultrasound, and combined therapy with pulsed ultrasound and interferential current (CTPI). It has been argued whether a single session of TENS, ICT, or CTPI would be sufficient to improve the ROM and degree of radicular pain associated with LDH.[19] In our study, we administered LLLT and TENS for 15 sessions and observed that the positive effects of the treatments continued throughout the 12-week follow-up period.

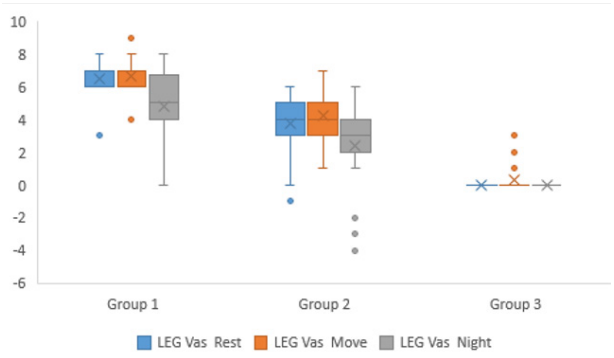

Figure 5. LEG VAS Difference Values According to Groups (pre-treatment-3rd month)

In physical therapy practice, TENS is often applied to the sciatic Valleix points outside the lumbar region in patients with lumbar radicular pain. There is a controversy surrounding the efficacy of TENS in chronic low back pain. Burcmüller et al. found that TENS applied to the lumbar region in patients with chronic radicular pain had no functional effect.[20] In contrast, we found that TENS applied to the lumbar and sciatic Valleix points improved pain and disability scores. However, we argue that LLLT applied to the sciatic Valleix points is more effective than TENS.

Our study is the first to assess the efficacy of LLLT applied to sciatic Valleix points. In a recent study, Ahmed et al applied LLLT (830 nm, 0.67 W/cm^2 or 300 mW/cm^2) 2.5 and 3.5 cm lateral to the spinous process of the involved nerve root (L4 or L5 or S1) and a distal level segment. They concluded that LLLT can be an effective

Table 3. Comparison of the Differences Between Pre-Treatment and 3rd-Month Values of Parameters According to Groups

		Group			*P*
		Group 1	Group 2	Group 3	
Lumbar VAS rest	Mean ± standard deviation	4.88 ± 1.68	5.04 ± 1.72	5.46 ± 1.7	0.410*
	Median (minimum–maximum)	5 (2-7)	5 (2-7)	6 (2-7)	
Lumbar VAS move	Mean ± standard deviation	6.63 ± 0.92	6.64 ± 0.81	6.85 ± 0.83	0.557*
	Median (minimum–maximum)	6.5 (5-8)	7 (5-8)	7 (5-8)	
Lumbar VAS night	Mean ± standard deviation	4.54 ± 2.28	4.12 ± 2.54	5.15 ± 2.29	0.238*
	Median (minimum–maximum)	5 (0-8)	4 (-1-8)	6 (-1-8)	
LEG VAS rest	Mean ± standard deviation	6.5 ± 1.25	3.76 ± 1.85	0 ± 0	<0.001*
	Median (minimum–maximum)	7 (3-8)[c]	4 (-1-6)[b]	0 (0-0)[a]	
LEG VAS move	Mean ± standard deviation	6.67 ± 0.96	4.2 ± 1.26	0.31 ± 0.79	<0.001*
	Median (minimum–maximum)	7 (4-9)[c]	4 (1-7)[b]	0 (0-3)[a]	
LEG VAS night	Mean ± standard deviation	4.79 ± 2.41	2.36 ± 2.78	0 ± 0	<0.001*
	Median (minimum–maximum)	5 (0-8)[c]	3 (-4-6)[b]	0 (0-0)[a]	
DN4	Mean ± standard deviation	5.79 ± 1.44	5.16 ± 1.31	2.96 ± 1.89	<0.001*
	Median (minimum–maximum)	6 (2-8)[b]	5 (3-8)[b]	3 (0-6)[a]	
LUMBAREXT	Mean ± standard deviation	-31.71 ± 6.96	-32.52 ± 8.22	-33.73 ± 5.47	0.171**
	Median (minimum–maximum)	-31.5 (-44--15)	-32 (-49--16)	-32.5 (-46--25)	
ODS	Mean ± standard deviation	67.88 ± 8.57	66.2 ± 9.93	53.12 ± 10.27	<0.001*
	Median (minimum–maximum)	69 (52-85)[b]	66 (50-85)[b]	52 (36-75)[a]	
PSQI	Mean ± standard deviation	8.08 ± 3.88	8.96 ± 3.4	8.35 ± 4.18	0.652*
	Median (minimum–maximum)	8.5 (0-14)	10 (0-13)	10 (0-17)	

VAS, visual analog scale, DN4, Doleur Neuropathique 4 Questionnaire; ODS: Oswestry Disability Scale, PSQI: Pittsburg Sleep Quality Index.
*Kruskal-Wallis test; **One-way ANOVA.
[a-c] There is no difference between groups with the same letter.

adjunct therapy.[9] In a study assessing the efficacy of high-intensity laser acupuncture and ultrasound in treating discogenic sciatica, Torad et al concluded that both methods were effective. Still, among the two methods, the effectiveness of high-intensity laser acupuncture was more pronounced than ultrasound.[21] We think that the use of a low-intensity laser is advantageous in terms of reducing the risk of side effects associated with the use of a high-intensity laser. We have demonstrated that injections to the sciatic nerve Valleix points outside the lumbar region reduce pain effectively.

Jovicic et al. administered three different energy doses of LLLT (0.1 J, 1 J, and 4 J laser per point) to patients with lumbar radiculopathy and found that all were effective in reducing low back and leg pain without side effects, with the 4 J laser per point dose being more effective in improving activities of daily living and low back mobility.[22] In a study investigating the efficacy of LLLT in rats with compressed right sciatic nerve, Bertolini et al. observed that the laser applied at a dose of 4 J per point to the sciatic nerve was superior to the placebo. Still, the laser applied at a dose of 8 J per point to the sciatic nerve was not superior to the placebo.[23] In parallel, we found that the laser applied at a dose of 4 J per point to the sciatic Valleix points within the scope of LLLT was effective.

There are a number of studies in the literature on the efficacy of HILT applied to the lumbar region. In one of these studies, Kolu et al compared the efficacies of HILT and TENS + Ultrasound combined therapy in reducing pain and improving functionality. Consequently, they found that both the HILT and the combined method improved the pain and disability scores, with the combined method being more effective.[10] In another study, Abdelbasset et al. compared the efficacies of LLLT and HILT in reducing pain and disability and improving quality of life in patients diagnosed with chronic nonspecific low back pain during a 12-week follow-up period. Consequently, they found that both LLLT and HILT reduced pain and disability associated with chronic nonspecific low back pain compared to the control group, with no significant difference in efficacy between both methods.[11] LLLT is a more accessible and cheaper method with fewer side effects than HILT. In fact, we did not observe any side effects of LLLT applied to the sciatic Valleix points during the 12-week follow-up period.

Limitations of the Study

There were several limitations to this study. The relatively low number of patients in each study group may be considered its primary limitation. Secondly, for ethical reasons, hotpack and TENS were applied only to the lumbar region in the sham group, and exercise therapy was given to all groups.

Conclusion

The findings of the study indicated that 15 sessions of LLLT and TENS effectively reduced leg and neuropathic pain and improved functionality in patients with sciatic nerve associated with LDH with radiculopathy. Nevertheless, LLLT was found to be more effective than TENS in reducing leg and neuropathic pain. Follow-up assessments revealed that the only lasting effect of the treatments, which continued into the third month, was the improvement in leg pain.

Authors' Contribution

Conceptualization: Sevil Karagül, Sibel Kibar, Saime Ay, Deniz Evcik, Süreyya Ergin.
Data curation: Sevil Karagül.
Formal analysis: Saime Ay.
Methodology: Saime Ay, Deniz Evcik.
Supervision: Sibel Kibar, Süreyya Ergin.
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Competing Interests

The authors declare that they have no competing interests.

Data Availability Statement

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Ethical Approval

This research was carried out in Ufuk University Faculty of Medicine, Department of Physical Medicine and Rehabilitation with the approval of Ufuk University Senate Ethics Commission with an approval number 31032015-7. A written informed consent was obtained from the participants.

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