EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 12
Issue: 7
Year: 2025

EFFECTS OF HIGH VERSUS LOW LEVEL LASER THERAPY IN PATIENTS OF LUMBAR RADICULOPATHY

Fazila Bashir[1]*, Binash Afzal[2], Fizza Pervez[3], Mariam Tariq[4], Abeer Shaukat[5] and Aqsa Arif[6]

[1]Lecture and Clinical Physiotherapist, Indepndent College of Physical Therapy, Independent Medical College, Faisalabad, Punjab, Pakistan.
[2]Assistant Professor, Faculty of Rehabilitation & Allied Health Sciences, Riphah International University, Lahore, Punjab, Pakistan.
[3]Physiotherapist, Department of Physical Therapy, Paraplegic Center, Government Samanabad Hospital Lahore, Punjab, Pakistan.
[4]Assistant Professor, Head of Department, Indepndent College of Physical Therapy, Independent Medical College, Faisalabad, Punjab, Pakistan.
[5]Department of Physical Therapy, Aziz Fatima Medical and Dental College, Faisalabad, Punjab, Pakistan.
[6]Senior Lecturer, Department of Physical Therapy, Sialkot Institute of Science and Technology, Sialkot, Punjab, Pakistan.

***Corresponding Author: Fazila Bashir**
Lecture and Clinical Physiotherapist, Indepndent College of Physical Therapy, Independent Medical College, Faisalabad, Punjab, Pakistan. **Email ID:**

Article Received on 06/05/2025 **Article Revised on 26/05/2025** **Article Accepted on 16/06/2025**

ABSTRACT
The purpose of this study was to investigate the differential effects of high-level laser therapy (HLLT) and low-level laser therapy (LLLT) in patients with lumbar radiculopathy. 38 participants diagnosed with lumbar radiculopathy were randomly allocated into, HLLT or LLLT Groups. The HLLT Group received laser therapy at higher power intensity (950nm,500mW) for 5 minutes, while the LLLT Group received at lower power intensity (660nm,100mW) for 10 minutes on 2cm laterally from spinous processes of L1-L5 for 6 weeks. The pre and post treatment outcomes were assessed by using Visual Analogue Scale (VAS), Straight Leg Raise Test (SLR), Oswerty Disability Index and Health Questionnaire EuroQol-5D-5L. Both HLLT & LLLT Groups demonstrated significant difference ($P < 0.005$) in pain level, straight leg raise of both leg and EuroQol pain level dimension and no significant difference was found in other dimensions. Within Group results were highly significant ($P < 0.005$) in both HLLT & LLLT Group but according to the means LLLT Group showed more improvement than HLLT in VAS (mean changes 6.47 to 2.83 in low level and 6.63 to 4.17 in high level laser therapy), SLR right and left, and EuroQol pain level dimension ($P<0.001$).

KEYWORDS: Biomechanics, Neuropathic Pain, Quality of Life, Rehabilitation, Sciatica.

INTRODUCTION
Lumbar radiculopathy is defined as pathological illness that affects the lumbar nerve roots. Radiculopathy symptoms include pain, anesthesia, weakness, changes in reflexes, and mild interference with the activities of daily life.[1] "Sciatica" is a term also used alternatively for lumbar radiculopathy.[2] Sciatica symptoms differ according to the location along the nerve route. Common symptoms include burning sensations in your legs, tingling in one side of your buttock area, numbness or weakness in one leg, and acute shooting pains that go from your lower back down to your feet. Some people are unable to walk due to severe sciatica pain.[3] Males and women are equally affected by lumbar radiculopathy, which affects 3-5% of the population. However, males are more likely to experience symptoms in their 40s, while women are more likely to experience them in their 50s and 60s. Ten to twenty-five percent of patients with this illness experience symptoms that last longer than six weeks.[4] Lumbar region pain ranked 6th in terms of total load (years of life adjusted for disability) and highest in terms of disability (years lived with disability) among the 291 illnesses that the Global Burden of Disease 2010 Study evaluated.[5]

Various treatment approaches have been employed to manage this condition, including conservative therapies, medications, and surgical interventions.[6] Acute cervical and lumbar radiculopathy caused by disc herniation are commonly treated without surgical methods such as

physical therapy and non-steroidal anti-inflammatory drugs (NSAIDs). These work well for reducing extreme pain, but those who are damaged neurologically, or who does not improve with traditional care should consult a surgeon promptly. Second-line therapies for individuals whose symptoms have not been relieved for at least 4 to 6 weeks and who are not improving with traditional care include trans laminar epidural injections and selective nerve root block.[7] Selective nerve root blockage is also a way to tart the pain in lumbar radiculopathy. Sethuraman et al. provide evidence about the efficacy of selective nerve root blockage to postpone the surgery.[8]

One emerging modality that has gained attention in recent years is high and low level laser therapy. These non-invasive techniques involve the application of laser energy to target tissues, aiming to alleviate pain and promote tissue healing.[6] Although interest in using lasers has been increasing for lumbar radiculopathy, the scientific evidence supporting its efficacy and comparing the effects of LLLT and HLLT is limited. Randomized controlled trials (RCTs) play an important role in evaluating the effectiveness of medical interventions, providing reliable and unbiased results. Therefore, conducting a well-designed RCT to investigate the comparative outcomes of LLLT and HLLT in patients with lumbar radiculopathy is essential.[9] Light Amplification from Stimulated Emission of Radiation is referred to as LASER. A certain mechanism inside the laser device produces laser, which is an induced controlled emission of radiation in the form of light. A laser typically emits a single color and a narrow beam.[10] Physiotherapists use lasers to reduce inflammation, speed up healing, and relieve pain. Low Level Laser Therapy (LLLT) is defined as having an output power of less than 0.5 Watts (class III in the USA). On the other hand, High Power Laser Therapy (HPLT) refers to lasers with power of more than 500mW or 0.5 Watts. Because HPLT have a greater power density (irradiance), they cause heat to be produced on the skin's surface. Due to the fact that LLLT treatments do not provide a heating sensation, they are sometimes referred to as "Cold Lasers".[11]

Low-level laser therapy is another painless, non-invasive technique that promotes connective tissue healing and has analgesic properties. Therefore, by promoting endorphin release, boosting blood flow, and decreasing edema, high and low intensity laser therapy can aid in the reduction of pain and inflammation. By encouraging cell development, boosting collagen synthesis, and stimulating circulation, it can also hasten the healing of wounds. By boosting blood circulation, it enhances nerve regeneration in cases of sciatic nerve injury. Thus, the purpose of this study was to determine how high and low level laser therapy may enhance the straight leg raise, pain, disability, and quality of life in individuals with lumbar radiculopathy.

Previous literature suggests the effectiveness of high-level laser therapy (HLLT) in various conditions, including lumbar radiculopathy, chronic discogenic sciatica, and chronic low back pain. Similarly, low-level laser therapy (LLLT) has shown efficacy in conditions like postpartum sciatica, discogenic lumbar radiculopathy, and spinal cord injury. Comparative studies have evaluated the effects of HLLT and LLLT in patients with non-specific low back pain. However, there is a lack of evidence regarding the comparative effects of HLLT and LLLT specifically in patients with lumbar radiculopathy. This randomized clinical trial fills the gap in the literature by directly comparing the effects of HLLT and LLLT in patients with lumbar radiculopathy. By providing valuable evidence on the differential effects of these modalities, this study aims to guide clinical practice and improve patient outcomes in the management of lumbar radiculopathy.

MATERIALS AND METHODS

Participants

Following randomization, each participant remained in their assigned treatment Group for the duration of the study. Written informed consent was obtained from the participants prior to participation. The trial was registered at ClinicalTrials.gov (NCT06240845). This trial followed the Consolidated Standards of Reporting Trials (CONSORT) reporting guideline.

38 Participants were recruited from Independent University Hospital and Faiq Medical Complex in Faisalabad, Pakistan. The sampling technique employed in this study was non-probability convenience sampling. A randomized clinical trial, utilizing a parallel Group trial design, with a 6 weeks followup including 18 sessions of treatment was employed. Final assessment was done after 6 weeks. “Fig. 1”

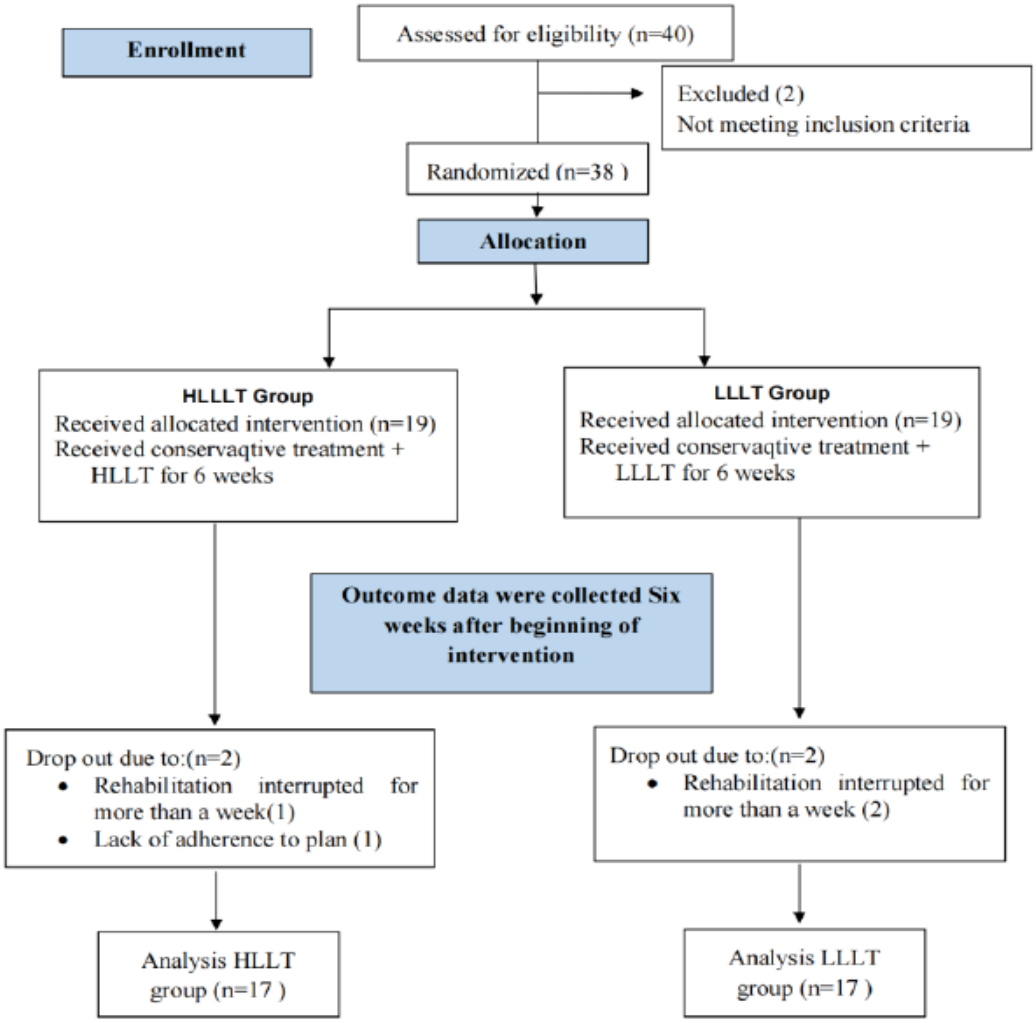

Figure 1: Study flow diagram.

For sample selection, inclusion criteria were established, encompassing[1] both male and female patients,[2] aged 40-65 years experiencing lumbar radiculopathy,[3] Confirmed diagnosis by physicians and physiotherapists using criteria such as positive results on the Straight Leg Raise[30-70] degrees of range considered positive),[4] a history of radicular leg pain, and/or numbness or tingling sensation,[5] patients who exhibit pain limiting functional ability with scores on the visual analogue scale ranging from 5 to 10, indicating moderate to worst pain,[6] patients should not have received any treatment for lumbar radiculopathy within the past 3 months.

On the other hand, exclusion criteria were established, excluding patients with[1] a history of spinal surgery in the last 2 years or spinal deformity,[2] a history of lumbar spine fracture or dislocation,[3] a diagnosis of any other neurological disorder or neuropathy,[4] pregnancy or breastfeeding,[5] any other medical condition, such as inflammatory rheumatic disease or cardiac pacemaker, that could interfere with the study outcomes or put patients at risk. After screening and getting informed consent, a computer-generated randomization programme was used to allocate the patients into 2 Groups i.e., HLLT & LLLT Groups. The sealed envelope approach hid allocation by splitting participants into HLLT and LLLT groups. To guarantee unbiased outcome evaluation, a single-blind technique was used, with the 10 year experienced physiotherapist assessor being uninformed of treatment allocations. The study was approved by the Research & Ethics Committee of Riphah College of Rehabilitation and Allied Sciences, Riphah International University, Lahore Pakistan, with the approval number REC/RCR & AHS/23/0239.

Measures and Procedures

Individuals of both Groups received conventional physiotherapy treatment[15] that included basic modalities i.e., TENS and heating pad. TENS applied in a conventional mode for 15 min at a high frequency of 70 Hz and wavelength of 100 microseconds, attached two 40 × 40 mm electrode sets cross arranged on each side of the lumbar spine.[16] Mild stretching of tight muscles including Glute Bridge Lying, Knee-to-Chest Stretch, Clamshell Cobra Stretch, holding 5 to 30 seconds each stretch then lower slowly. That's one repetition. 10-15 reps for each 3 times a week or in 3 sessions.

The participants of both Groups received conventional treatment 1st then HLLT or LLLT was applied. The patients were asked to lay prone comfortably and expose lumbar region. Therapist targeted the spinous process of lumbar vertebrae numbered L1-L5 and held the laser probe paravertebrally. Patient and the therapist had to wear polarized black glasses. Both HLLT and LLLT was applied by putting the laser probe paravertebrally near to the inter-vertebral foramen for a total of 5 points with a total time 5 minutes (every point received one minute). The Infrared radiation emitted by the Omega bio therapy laser (Integrated High-power laser device, made in United Kingdom, manufactured by Omega Universal Technologies Ltd.) was used to heat tissue topically in order to elevate its temperature. The laser light of 950nm,500mW was used as high level laser therapy for HLLT Group and the laser light 660nm ,100mW was used as low level laser therapy[17] for LLLT Group. The laser points were 2cm laterally from spinous process at L1, L2, L3, L4 and L5 (both R/L).[18] "Fig. 2"

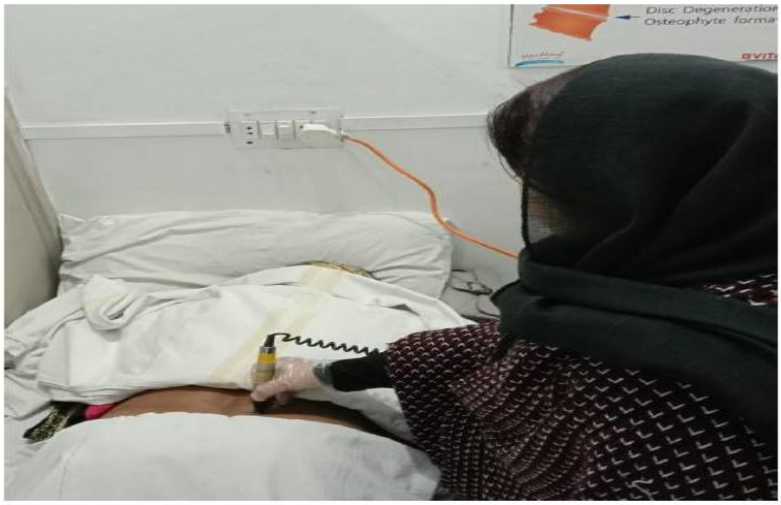

Figure 2: Application of laser therapy.

Blinded raters evaluated the results both prior to randomization (baseline) and following four weeks of training. The primary outcome measures were the following: Visual Analogue Scale (VAS) for the assessment of pain, Oswestry Disability Index (ODI) for the assessment of disability, Straight Leg Raise (SLR) to measure the range of motion and Health Questionnaire (EQ-5D-5L) to measure the quality of life.

Statistical analysis

Version 23 of SPSS (Statistical Package for Social Science) was used to analyze the data and P = 0. 05 was used as the statistical significance level. The data distribution normality was assessed using the Shapiro-Wilk test a non-normal distribution was indicated by a P value of less than 0.05. As data was not normally distributed except straight leg raise (SLR) left leg, non parametric test was used. Mann-Whitney test that is a non parametric test has been used to determine differences between both Groups. Within Group comparison (pre and post intervention) was done by using Wilcoxion Signed Rank test, for normally distributed data analysis like straight leg raise of left leg, t-test and paired t-tests were applied.

RESULTS

Table 1 shows the baseline demographic data and clinical characteristics of the participants. Results showed that out of 38 participants (mean [SD] age of HLLT Group, 47.36 (7.12) years, LLLT Group 47.36 (7.12); 8 male [42.1%] & 11 female [57.9%] in HLLT Group and 7 male [36.8%] & 12 female [63.2]), 19 were randomized to HLLT and 19 to LLLT Group. The LLLT Group showed a higher mean Duration of Illness 8.31 (4.85) compared to the HLLT Group 7.63 (5.55). The BMI was also documented for both Groups.

Table 1: Baseline Demographic and Clinical Characteristics of Participants (N = 38).

Variable	HLLT Group (n = 19)	LLLT Group (n = 19)	Total (N = 38)
Age (years)	47.36 ± 7.12	47.36 ± 7.12	48.61 ± 7.13
Gender			
- Male	8 (42.1%)	7 (36.8%)	15 (39.5%)
- Female	11 (57.9%)	12 (63.2%)	23 (60.5%)
BMI (kg/m²)	N/R	N/R	26.64 ± 4.27
Duration of Illness (years)	7.63 ± 5.55	8.31 ± 4.85	7.97 ± 5.16

Table 2 shows the baseline clinical characteristics as well as difference between HLLT and LLLT Group for both baseline and post treatment data, both Groups are compared using Mann-Whitney U test and t-test. T-test

was applied for straight leg raise of left leg because its data was normally distributed according to Shapiro-Wilk test. The p values are larger than 0.005 (P > 0.05) it means no significant difference exist in both Groups. But significant values in VAS, SLR right and left leg, Oswestry disability index, Mobility and VAS dimensions of 5D-5L scale show significant values P< 0.005 it mean there was significant difference between Group.

Table 2: Baseline clinical Characteristics and Between group comparison of HLLT and LLLT group.

Variable		HLLT group (n=17) mean ± SD	LLLT group (n=17) mean ± SD	Mean difference (95% CI)	P-value (between groups)
Visual Analogue Scale	Pre-Intervention	6.63±1.06	6.47±1.02	-0.68(6.21-6.89)	0.000
	Post-Intervention	4.17±0.80	2.82±0.88		
SLR right leg	Pre-Intervention	43.68±11.76	51.31±9.97	-7.51(43.74-51.25)	0.001
	Post-Intervention	69.11±7.75	77.64±4.71		
SLR left leg	Pre-Intervention	43.68±11.76	51.31±9.97	-7.66(45.77-53.43)	0.001
	Post-Intervention	69.11±7.75	77.64±4.71		
Oswestry disability index	Pre-Intervention	21.94±5.88	22.15±5.23	-3.61(20.24-23.85)	0.065
	Post-Intervention	6.58±2.47	5.05±1.88		
Mobility Dimention of EQ-5D-5L	Pre-Intervention	3.10±0.56	3.10±0.73	-0.42(2.89-3.31)	0.082
	Post-Intervention	1.52±0.51	1.23±0.43		
Self-care Dimention of EQ-5D-5L	Pre-Intervention	2.57±0.76	2.73±0.45	-0.41(2.45-2.86)	0.210
	Post-Intervention	1.29±0.46	1.11±0.33		
Usual activity Dimention of EQ-5D-5L	Pre-Intervention	2.73±0.65	2.42±0.50	-0.39(2.38-2.77)	0.633
	Post-Intervention	1.17±0.39	1.11±0.33		
Pain / Discomfort Dimention of EQ-5D-5L	Pre-Intervention	3.10±0.73	3.05±0.62	-0.45(2.85-3.30)	0.138
	Post-Intervention	1.41±0.50	1.17±0.39		
Anxiety / depression Dimention of EQ-5D-5L	Pre-Intervention	2.84±0.60	2.63±0.49	-0.36(2.55-2.91)	0.551
	Post-Intervention	1.11±0.33	1.05±0.24		
VAS Dimention of EQ-5D-5L	Pre-Intervention	70.58±7.47	44.73±11.23	-7.12(41.96-49.08)	0.032
	Post-Intervention	70.58±7.47	75.88±5.07		

Table 3 shows the within Group comparison of both pre-intervention and post-intervention assessment by using Wilcoxon signed ranked test. Both the HLLT and LLLT Group indicated significant difference within Groups (P <0.001) between pre-intervention and post-intervention assessment through analysis by Wilcoxon signed ranked test. But by comparing means LLLT Group shows more improvement in pain level in VAS and VAS distention in EQ-5D-5L.

Table 3: Within group comparison of HLLT and LLLT group.

Variable		Wilcoxon Signed Rank Test		P-value (within groups)
		Pre-intervention	Post-intervention	
Visual Analogue Scale	HLLT Group	6.63±1.06	4.17±0.80	<0.001
	LLLT Group	6.47±1.02	2.82±0.88	<0.001
SLR right leg	HLLT Group	43.68±11.76	69.11±7.75	<0.001
	LLLT Group	51.31±9.97	77.64±4.71	<0.001
SLR left leg	HLLT Group	50.29±11.24	73.23±6.10	<0.001
	LLLT Group	50.29±12.43	78.52±5.23	<0.001
Oswestry disability Index	HLLT Group	21.94±5.88	6.58±2.47	<0.001
	LLLT Group	22.15±5.23	5.05±1.88	<0.001
Mobility Dimention of EQ-5D-5L	HLLT Group	3.10±0.56	1.52±0.51	<0.001

	LLLT Group	3.10±0.73	2.57±0.76	<0.001
Self-care Dimention of EQ-5D-5L	HLLT Group	2.57±0.76	1.29±0.46	<0.001
	LLLT Group	2.73±0.451	1.11±0.33	<0.001
Usual activity Dimention of EQ-5D-5L	HLLT Group	2.73±0.65	1.17±0.39	<0.001
	LLLT Group	2.42±0.50	1.11±0.33	<0.001
Pain / Discomfort Dimention of EQ-5D-5L	HLLT Group	3.10±0.73	1.41±0.50	<0.001
	LLLT Group	3.05±0.62	1.17±0.39	<0.001
Anxiety / depression Dimention of EQ-5D-5L	HLLT Group	2.84±0.60	1.11±0.33	<0.001
	LLLT Group	2.63±0.49	1.05±0.24	<0.001
VAS Dimention of EQ-5D-5L	HLLT Group	70.58±7.47	70.58±7.47	<0.001
	LLLT Group	44.73±11.23	75.88±5.07	<0.001

DISCUSSION

The aim of this study was to asses the effects of high versus low level laser therapy in patients of lumbar radiculopathy. The intervention used in both Groups i.e HLLT and LLLT show significant results on Visual Analogue Scale, SLR, Oswestry disability index and EuroQol 5D-5L.But statistically there is not significant result obtain between the Groups because both Groups improve pain, disability, ROM and quality of life as assess with visual analogue scale, straight leg raise, oswestry disability index and EuroQol 5D-5L health questionnaire respectively. Hence, no statistically difference was seen in HLLT and LLLT Group, but statically significant values and mean ± SD show that LLLT has slightly more significant than HLLT in visual Analogue Scale ,Straight Leg Raise and VAS dimension of EuroQol 5D-5L.However high and low level laser therapy should be a treatment option for lumbar radiculopathy.

The results of present study came in agreement with the finding of the study in which clinical effectiveness of high level laser therapy was demonstrated by Youyi Huang and Daxin Gao, in which they assessed the effectiveness of high intensity laser therapy in patients of lumbar disc herniation. In the primary care context, laser therapy is a type of non-invasive, painless treatment that readily controlled for a wide range of illnesses. The goal of this study was to evaluate the effectiveness and safety of ultrasonography and HILT in LDH patients Furthermore, Ishaq Ahmed et al. used the low-level laser therapy which used an 830nm wavelength and a 3 J/point dose, significantly improved local trunk movements, pain intensity, and related functional disability in acute lower back pain with discogenic lumbar radiculopathy.[12] The research offered in the literature suggest that LLLT holds promise within the treatment of neuropathic pain, with special wavelengths of lasers demonstrating significant increase in analgesia. The antioxidant and bio-modulation results of lasers have been particularly explored within the context of diabetic neuropathy, emphasizing the capacity of LLLT as a healing approach for this specific neuropathic condition. The modulation of inflammatory techniques, alteration of neuronal excitation, and secretion of endorphins are most of the mechanisms in which LLLT is usually recommended to offer pain relief. A note able point of discussion revolves around the numerous mechanisms associated with LLLT in neuropathic pain relief. Studies advocate that LLLT may modulate the inflammatory process, reducing bradykinin levels and contributing to pain therapy. Additionally, the secondary motion of LLLT in promoting the expression of β-endorphins further highlights its capability analgesic outcomes.[10] Walid Kamal Abdelbasset et al. (2020) directly compared the effects of LLLT and HILT in patients with chronic non-specific lower back pain. Both LLLT and HILT, when combined with convention home plan, resulted in significant improvements in pain scores, functional outcomes, and quality of life. The study highlights the potential of laser therapy, irrespective of intensity, as treatment protocol for chronic non-specific lower back pain.[13]

Moreover, in contrast of our study Sara N. Sedek et al. sixty women who was suffering from postpartum sciatica were included in the study. For a duration of 12 weeks, Group (A) had three sessions of pulsed ultrasound treatment, lasting 20 minutes each, along with flexibility exercises targeted at the back and abdominal muscles. While Group (B) underwent low level laser therapy 3 times/week for a duration of 12 weeks, in addition to performing the flexibility exercises as Group (A), they also received this treatment. A visual analogue scale was used to measure pain severity and hip range of motion in both Groups before to and during the treatment program. there findings suggest that ultrasound therapy had more effects than low level laser therapy.[14]

The results of the study suggested that significant changes were seen in the VAS (low back with unilateral leg pain) and ODI ratings in two Groups. After the two-week intervention, those in Group-1 had a noticeably higher reduction in pain compared to those in Group-2. Four weeks following treatment sessions, individuals in the TENS with Us therapy Group showed statistically significant changes in pain variation and functioning (VAS and ODI) as compared to those in the HILT Group. In the line of these results our study also suggest that high level laser therapy improve VAS and decrease ODI.

The generalize ability of findings are limited as representative sample did not include other age Groups except 40-65 year of patients. However the repeatability and applicability of study is very high because its

noninvasive procedure and have less side effects if it's used with proper preparation according to World Association for Laser Therapy (WALT).

These were the limitations faced by the researchers during this study. The assessment of pain, disability, quality of life was subjective and depended on the patient's perception which can be a potential source of bias. The medications taken by patients for comorbidities and supplements prescribed by physicians were not discontinued during the study which may have influenced the results. The planned intention to treat analysis was not performed as odds for non-adherence were not identified.

The authors recommend that in order to improve the accuracy of treatment response analysis in high-level versus low-level laser therapy for neuropathic pain, future research should use stratified randomization and take baseline disability, symptom duration, and pertinent physical and psycho social characteristics into account. A large sample size and multiple centers with patients from different geographic areas can be incorporated into the study. Long-term, comparative studies are necessary to assess both therapies' effects over time and provide insight into any potential negative effects as well as their long-term advantages.

CONCLUSION

Both high and low level laser therapy are effective in patients of lumbar radiculopathy, in reducing pain intensity, decrease level of disability, increase straight leg raise and improve quality of life. However, in comparison there are slight difference in the effectiveness of high and low level laser therapy as low level laser therapy according to there means show more improvement in reducing pain intensity and enhancing range of straight leg raise. This study indicates that both high and low level Laser therapy are treatment of choice for improving symptoms in patients with lumbar radiculopathy.

ACKNOWLEDGEMENTS

We gratefully acknowledge the patients, hospital staff, physiotherapists, and Ms. Tayyaba Zaman for her insightful input and assistance in research planning and manuscript development.

Disclosure statement

No potential conflict of interests were reported by the authors.

Source(s) of support

This study received no external funding.

REFERENCES

1. Thoomes E, Falla D, Cleland JA, Fernández-de-Las-Peñas C, Gallina A, de Graaf M. Conservative management for lumbar radiculopathy based on the stage of the disorder: a Delphi study. Disability and rehabilitation, 2023; 45(21): 3539-48.
2. Ostelo RW. Physiotherapy management of sciatica. Journal of physiotherapy, 2020; 66(2): 83-8.
3. Stochkendahl MJ, Kjaer P, Hartvigsen J, Kongsted A, Aaboe J, Andersen M, et al. National Clinical Guidelines for non-surgical treatment of patients with recent onset low back pain or lumbar radiculopathy. European Spine Journal, 2018; 27: 60-75.
4. Kuligowski T, Skrzek A, Cieślik B. Manual therapy in cervical and lumbar radiculopathy: a systematic review of the literature. International journal of environmental research and public health, 2021; 18(11): 6176.
5. Zafar K, Batool N, Ali A, Arshad N, Dar WM, Naeem A. Frequency of Lumber Disc Degenerative Diseases in Patients with and Without Radiculopathy and Low Back Pain Using Magnetic Resonance Imaging. Pakistan BioMedical Journal, 2022; 261-5.
6. Alexander C, Varacallo M. Lumbosacral radiculopathy. StatPearls. StatPearls Publishing, Treasure Island, 2022.
7. Harper R, Klineberg E. The evidence-based approach for surgical complications in the treatment of lumbar disc herniation. International Orthopaedics, 2019; 43: 975-80.
8. Sethuraman JK, Sudhakaran S, Singaravelu M, Mascarenhas J. Efficacy of Selective Lumbar Nerve Root Block for Lumbar Radiculopathy. European Journal of Cardiovascular Medicine, 2023; 13(1).
9. Kostadinović S, Milovanović N, Jovanović J, Tomašević-Todorović S. Efficacy of the lumbar stabilization and thoracic mobilization exercise program on pain intensity and functional disability reduction in chronic low back pain patients with lumbar radiculopathy: A randomized controlled trial. Journal of Back and Musculoskeletal Rehabilitation, 2020; 33(6): 897-907.
10. Mansouri V, Arjmand B, Tavirani MR, Razzaghi M, Rostami-Nejad M, Hamdieh M. Evaluation of efficacy of low-level laser therapy. Journal of Lasers in Medical Sciences, 2020; 11(4): 369.
11. Araujo T, Andreo L, Tobelem DdC, Silva T, Malavazzi TCdS, Martinelli A, et al. Effects of systemic vascular photobiomodulation using LED or laser on sensory–motor recovery following a peripheral nerve injury in Wistar rats. Photochemical & Photobiological Sciences, 2023; 22(3): 567-77.
12. Ahmed I, Bandpei MAM, Gilani SA, Ahmad A, Zaidi F. Effectiveness of Low-Level Laser Therapy in Patients with Discogenic Lumbar Radiculopathy: A Double-Blind Randomized Controlled Trial. Journal of Healthcare Engineering, 2022; 2022.
13. Abdelbasset WK, Nambi G, Alsubaie SF, Abodonya AM, Saleh AK, Ataalla NN, et al. A randomized comparative study between high-intensity and low-level laser therapy in the treatment of chronic

nonspecific low back pain. Evidence-Based Complementary and Alternative Medicine, 2020; 2020.
14. Sedek SN, El Kosery SM, Darwish AM, Hassan ES. Effect of Pulsed Ultrasound Therapy Compared with Low Level Laser Therapy on Postpartum Sciatica: A Randomized Controlled Clinical Trail. The Egyptian Journal of Hospital Medicine, 2022; 89(1): 4410-5.
15. Senol D, Erdem C, Canbolat M, Toy S, Karatas T, Baykara RA, et al. Comparison of the effects of conventional physiotherapy and proprioception exercises on pain and ankle proprioception in patients with lumbar radiculopathy. Journal of Back and Musculoskeletal Rehabilitation, 2022; 35(2): 421-8.
16. Amjad F, Mohseni-Bandpei MA, Gilani SA, Ahmad A, Hanif A. Effects of non-surgical decompression therapy in addition to routine physical therapy on pain, range of motion, endurance, functional disability and quality of life versus routine physical therapy alone in patients with lumbar radiculopathy; a randomized controlled trial. BMC Musculoskeletal Disorders, 2022; 23(1): 255.
17. Barez MM, Tajziehchi M, Heidari MH, Bushehri A, Moayer F, Mansouri N, et al. Stimulation effect of low level laser therapy on sciatic nerve regeneration in rat. Journal of lasers in medical sciences, 2017; 8(1): S32.
18. Sedek SN, El Kosery SM, Darwish AM, Hassan ES. Effect of Pulsed Ultrasound Therapy Compared with Low Level Laser Therapy on Postpartum Sciatica: A Randomized Controlled Clinical Trail. The Egyptian Journal of Hospital Medicine, 2022; 89(1): 4410-5.