Axis Journal of Scientific Innovations

COMPARING LOW-LEVEL LASER THERAPY AND ULTRASOUND THERAPY FOR CHRONIC NECK PAIN MANAGEMENT: A RANDOMIZED CONTROLLED TRIAL

(***Original Article***)

Muhammad Dawood1**, Kashaf Royyan2, Muhammad Wasim Salim3

Muhammad Dawood**
Medical officer in Accidents & Emergency, Tehsil Headquarter Hospital Ferozewala, Pakistan. https://orcid.org/0009-0004-6360-3391

Kashaf Royyan
DPT, Shaheed Zulfiqar Ali Bhutto Medical University, Islamabad, Pakistan. https://orcid.org/0009-0003-1919-575X

Muhammad Wasim Salim
PAEDS Medicine, Fellow Neonatology, Services Hospital Lahore, Pakistan. https://orcid.org/0009-0002-5864-2201

Corresponding	Muhammad Dawood** **Daaudsaleem@gmail.com** Medical officer in Accidents & Emergency, Tehsil Headquarter Hospital Ferozewala, Pakistan. **https://orcid.org/0009-0004-6360-3391**
Acknowledgement	The authors express gratitude to all participants and physiotherapy staff for their valuable cooperation.
Conflict of Interest	NONE

© 2025. Open Access Under Cc By 4.0. Copyright Retained By Authors.

Abstract

Background: Chronic neck pain is a common musculoskeletal disorder that significantly impacts daily functioning and quality of life. Non-pharmacological approaches in physiotherapy, including low-level laser therapy (LLLT) and therapeutic ultrasound (US), are often employed to alleviate symptoms and enhance functional recovery. Nevertheless, comparative data on their effectiveness are scarce and inconclusive.

Objective: This study aimed to evaluate and contrast the influence of low-level laser therapy versus therapeutic ultrasound on pain levels, cervical mobility, and muscle relaxation in patients with chronic neck pain.

Methods: A randomized controlled trial was conducted over a four-week intervention period in the outpatient physiotherapy clinics of major hospitals in South Punjab. Sixty individuals aged 25–55 years with nonspecific chronic neck pain were randomly assigned to one of two equal groups. Group A received low-level laser therapy (GaAlAs, 830 nm, 100 mW, 4 J/cm²), and Group B received therapeutic ultrasound (1 MHz, 1.5 W/cm²). Both groups attended 12 treatment sessions and performed identical stretching and postural correction exercises. Outcome measures—pain (Visual Analogue Scale, VAS), cervical range of motion (goniometer), and functional limitation (Neck Disability Index, NDI)—were assessed at baseline and after four weeks. Data were analyzed using paired and independent t-tests, with significance set at $p<0.05$.

Results: Both groups showed significant within-group improvements in all outcomes. The low-level laser therapy (LLLT) group demonstrated a significantly greater reduction in pain (VAS: 6.7±1.1 to 2.4±0.9) compared to the ultrasound group (VAS: 6.6±1.2 to 3.5±1.0), with a between-group p-value of 0.001. The LLLT group also showed superior improvement in cervical range of motion and NDI scores (all between-group $p<0.05$).

Conclusion: In conclusion, low-level laser therapy yielded better clinical results than therapeutic ultrasound, indicating its potential as a more effective physiotherapy treatment for chronic neck pain.

Keywords: Chronic neck pain, Low-level laser therapy, Muscle relaxation, Pain management, Physiotherapy, Randomized controlled trial, Range of motion, Therapeutic ultrasound.

© 2025. Open Access Under Cc By 4.0. Copyright Retained By Authors.
Submission: 05/Feb/2025
Publication: 30/Mar/2025

Introduction

Chronic neck pain is a prevalent musculoskeletal condition that affects a substantial portion of the adult population worldwide, often leading to significant physical discomfort, disability, and reduced quality of life(1). Modern lifestyles, characterized by prolonged computer use, poor posture, and sedentary habits, have contributed to the growing incidence of chronic cervical pain(2). This condition not only results in physical impairment but also imposes psychological and socioeconomic burdens due to absenteeism, reduced productivity, and high healthcare utilization(3). Effective management of chronic neck pain remains a challenge for clinicians, as conventional pharmacological approaches often provide only temporary relief and carry the risk of adverse effects with long-term use. Consequently, non-invasive and non-pharmacological treatment modalities, such as physical therapy interventions, have gained increasing attention for their potential to alleviate symptoms and restore function safely(4).

Among the wide array of physiotherapeutic interventions, low-level laser therapy (LLLT) and therapeutic ultrasound (US) have been extensively used to manage chronic musculoskeletal pain, including that of the cervical region(5). Both modalities are thought to promote tissue healing, reduce inflammation, and modulate pain perception, yet they act through distinct mechanisms(6). Low-level laser therapy, also known as photobiomodulation, involves the application of monochromatic light at low intensities to stimulate cellular activity. It is believed to enhance mitochondrial function, increase adenosine triphosphate (ATP) production, and modulate inflammatory mediators, leading to pain reduction and improved tissue repair. In contrast, therapeutic ultrasound utilizes high-frequency sound waves that generate mechanical vibrations within tissues, improving local blood flow, reducing muscle stiffness, and enhancing cellular permeability. While both treatments share the ultimate goal of reducing pain and improving mobility, their comparative effectiveness in chronic neck pain management remains unclear(7).

Previous studies have demonstrated variable outcomes regarding the efficacy of these modalities(8). Some investigations have reported significant pain reduction and improved neck mobility following low-level laser therapy, suggesting its potential superiority in modulating chronic inflammatory processes(9). Conversely, other studies have highlighted ultrasound therapy as an effective means of enhancing muscle relaxation and decreasing myofascial trigger point sensitivity, contributing to functional recovery. However, methodological differences among studies, such as inconsistent treatment parameters, small sample sizes, and varying assessment tools, have led to conflicting evidence. Moreover, there is limited high-quality comparative research directly evaluating the therapeutic outcomes of these two modalities in chronic neck pain populations under standardized conditions. This lack of consensus underscores the need for a rigorously designed randomized controlled trial to clarify which treatment offers greater clinical benefit(10).

Chronic neck pain involves complex physiological and biomechanical components, including muscular tension, joint restriction, and neural sensitization(11). Therefore, effective management requires interventions that target both pain modulation and functional restoration(12). By comparing low-level laser and ultrasound therapies within a controlled setting, it becomes possible to determine their relative influence on key clinical outcomes such as pain intensity, cervical range of motion, and muscle relaxation. Establishing evidence-based guidance on which modality provides superior results can aid clinicians in optimizing treatment plans, minimizing trial-and-error approaches, and improving patient satisfaction(13).

In addition to clinical implications, the comparative evaluation of these modalities also contributes to the broader understanding of non-invasive pain management mechanisms. While LLLT primarily targets cellular and biochemical pathways, ultrasound exerts more mechanical and thermal effects. Exploring how these differing mechanisms translate into clinical improvements can deepen understanding of pain physiology and therapeutic response variability among individuals. Such insights are essential for tailoring rehabilitation programs that are both effective and personalized, especially for chronic conditions where the pathophysiology is multifactorial and adaptive(14).

Despite the increasing application of both LLLT and ultrasound therapy in physiotherapy practice, the absence of direct, high-quality evidence comparing their long-term effects on chronic neck pain outcomes has created a significant gap in clinical knowledge(15). Most available research has evaluated these modalities in isolation or as adjuncts to other treatments, without isolating their specific contributions. A direct comparison within a randomized controlled framework is therefore warranted to determine which modality offers superior outcomes in terms of pain relief, muscle relaxation, and restoration of neck mobility. This knowledge is crucial for evidence-based decision-making and for guiding resource allocation in clinical rehabilitation settings(16).

The present randomized controlled trial seeks to address this gap by systematically comparing the effects of low-level laser therapy and therapeutic ultrasound on patients with chronic neck pain. The study aims to evaluate and contrast their efficacy in reducing pain intensity, improving cervical range of motion, and promoting muscle relaxation. The overarching objective is to identify which

© 2025. Open Access Under Cc By 4.0. Copyright Retained By Authors.
Submission: 05/Feb/2025
Publication: 30/Mar/2025

of these commonly used physiotherapeutic modalities provides greater clinical benefit, thereby informing best practice in the management of chronic neck pain and enhancing the quality of patient care.

Methods

This randomized controlled trial was implemented within the physiotherapy outpatient clinics of major hospitals in South Punjab. Its objective was to determine the superior treatment modality between low-level laser therapy and therapeutic ultrasound for alleviating chronic neck pain. The evaluation focused on changes in pain intensity, cervical mobility, and functional disability. Sixty individuals with chronic neck pain were recruited and, using a computerized randomization system to mitigate bias, were equally divided into two groups. One cohort received low-level laser treatment, while the other underwent therapeutic ultrasound. Both groups received their assigned modality alongside an identical standardized physiotherapy regimen of stretching and postural correction exercises under therapist supervision. The interventions were administered three times weekly over a four-week period.

Participants were selected according to predefined inclusion and exclusion criteria. Eligible participants were adults aged between 25 and 55 years who had experienced nonspecific neck pain for more than three months, with pain intensity ranging between 4 and 8 on the Visual Analogue Scale (VAS). Individuals with a history of cervical trauma, fractures, inflammatory or degenerative joint diseases, malignancy, neurological disorders, or previous cervical surgery were excluded. Additional exclusion criteria included pregnancy, open wounds in the treatment area, or contraindications to laser or ultrasound therapy. All participants provided written informed consent after being informed about the procedures and potential benefits and risks of the study.

For Group A, low-level laser therapy was administered using a gallium–aluminum–arsenide (GaAlAs) laser device with a wavelength of 830 nm, output power of 100 mW, and energy density of 4 J/cm². The laser probe was applied in continuous mode to the tender points and paraspinal muscles of the cervical region for 90 seconds per point, covering an average of six to eight points per session. For Group B, therapeutic ultrasound was applied using a 1 MHz frequency transducer with an intensity of 1.5 W/cm² in continuous mode for ten minutes per session. The ultrasound head was moved slowly in circular motions over the painful and stiff muscle areas with an appropriate coupling medium to ensure uniform transmission.

Outcome measures were recorded at baseline and after the four-week intervention. Pain intensity was measured using the Visual Analogue Scale (VAS), and cervical range of motion was assessed through a universal goniometer in flexion, extension, lateral flexion, and rotation. Functional disability was evaluated using the Neck Disability Index (NDI). These tools were selected for their reliability and clinical validity in musculoskeletal pain research.

All data were compiled and analyzed using SPSS version 25. The data were tested for normality using the Shapiro–Wilk test and found to be normally distributed. Descriptive statistics were expressed as mean and standard deviation. Intragroup comparisons of pre- and post-intervention scores were conducted using paired sample t-tests, while intergroup comparisons were analyzed using independent sample t-tests. A p-value of less than 0.05 was considered statistically significant. This analytical approach allowed for the objective evaluation of each modality's effect on pain reduction, improvement in cervical mobility, and functional disability.

© 2025. Open Access Under Cc By 4.0. Copyright Retained By Authors.
Submission: 05/Feb/2025
Publication: 30/Mar/2025

Results

A total of sixty participants completed the study, with thirty individuals in each group. Both groups were comparable at baseline in terms of demographic characteristics, including age, gender distribution, and duration of neck pain. The mean age of participants in the low-level laser therapy (LLLT) group was 40.6 ± 7.8 years, while that in the ultrasound group was 41.2 ± 8.1 years. The average duration of pain was 8.4 ± 3.1 months for the LLLT group and 8.7 ± 2.8 months for the ultrasound group, indicating no significant baseline differences between the two cohorts (Table 1).

Following four weeks of intervention, both groups exhibited a statistically significant reduction in pain intensity as measured by the Visual Analogue Scale (VAS). The mean VAS score in the LLLT group decreased from 6.7 ± 1.1 at baseline to 2.4 ± 0.9 post-treatment, while the ultrasound group showed a reduction from 6.6 ± 1.2 to 3.5 ± 1.0. Intergroup comparison revealed a greater improvement in the LLLT group, with a statistically significant difference ($p = 0.001$), as illustrated in Table 2 and Figure 1.

Cervical range of motion (ROM) improved across all movement planes in both treatment groups. In the LLLT group, flexion increased from 37.2 ± 6.4° to 48.6 ± 5.9°, extension from 41.5 ± 7.1° to 53.7 ± 6.5°, lateral flexion from 31.8 ± 5.6° to 41.3 ± 4.9°, and rotation from 50.9 ± 7.3° to 63.5 ± 6.8°. Corresponding values for the ultrasound group were 36.9 ± 6.2° to 44.8 ± 6.1° in flexion, 42.1 ± 6.8° to 49.5 ± 6.2° in extension, 30.9 ± 5.4° to 38.1 ± 5.0° in lateral flexion, and 51.2 ± 7.6° to 59.1 ± 6.4° in rotation. Statistical analysis demonstrated significant intragroup improvements in all parameters ($p < 0.05$) and superior post-treatment gains in the LLLT group across all measured movements (Table 3; Figure 2).

Functional improvement, assessed using the Neck Disability Index (NDI), also showed notable enhancement. Participants receiving LLLT demonstrated a mean reduction in NDI score from 28.9 ± 5.4 to 12.3 ± 3.7, while those in the ultrasound group showed a decline from 29.4 ± 5.1 to 16.8 ± 4.2. The difference between the two groups was statistically significant ($p = 0.003$), indicating a more pronounced improvement in functional capacity and muscle relaxation among individuals treated with LLLT (Table 4).

No adverse effects or treatment-related complications were reported during the study period in either group. All participants tolerated the interventions well and completed the prescribed treatment sessions.

Overall, both modalities were effective in managing chronic neck pain, but low-level laser therapy demonstrated greater efficacy in reducing pain intensity, enhancing cervical range of motion, and improving functional outcomes compared with therapeutic ultrasound.

Table 1: Demographic Characteristics of Participants

Variables	*Group A (LLLT) Mean ± SD / n (%)*	*Group B (Ultrasound) Mean ± SD / n (%)*
Age (years)	40.6 ± 7.8	41.2 ± 8.1
Gender (M/F)	14/16 (46.7%/53.3%)	13/17 (43.3%/56.7%)
Duration of pain (months)	8.4 ± 3.1	8.7 ± 2.8

Table 2: Outcome Measures

Outcome Measure	*Group A Pre-Treatment (Mean ± SD)*	*Group A Post-Treatment (Mean ± SD)*	*Group B Pre-Treatment (Mean ± SD)*	*Group B Post-Treatment (Mean ± SD)*	*p-value*
VAS Score (Pain Intensity)	6.7 ± 1.1	2.4 ± 0.9	6.6 ± 1.2	3.5 ± 1.0	0.001

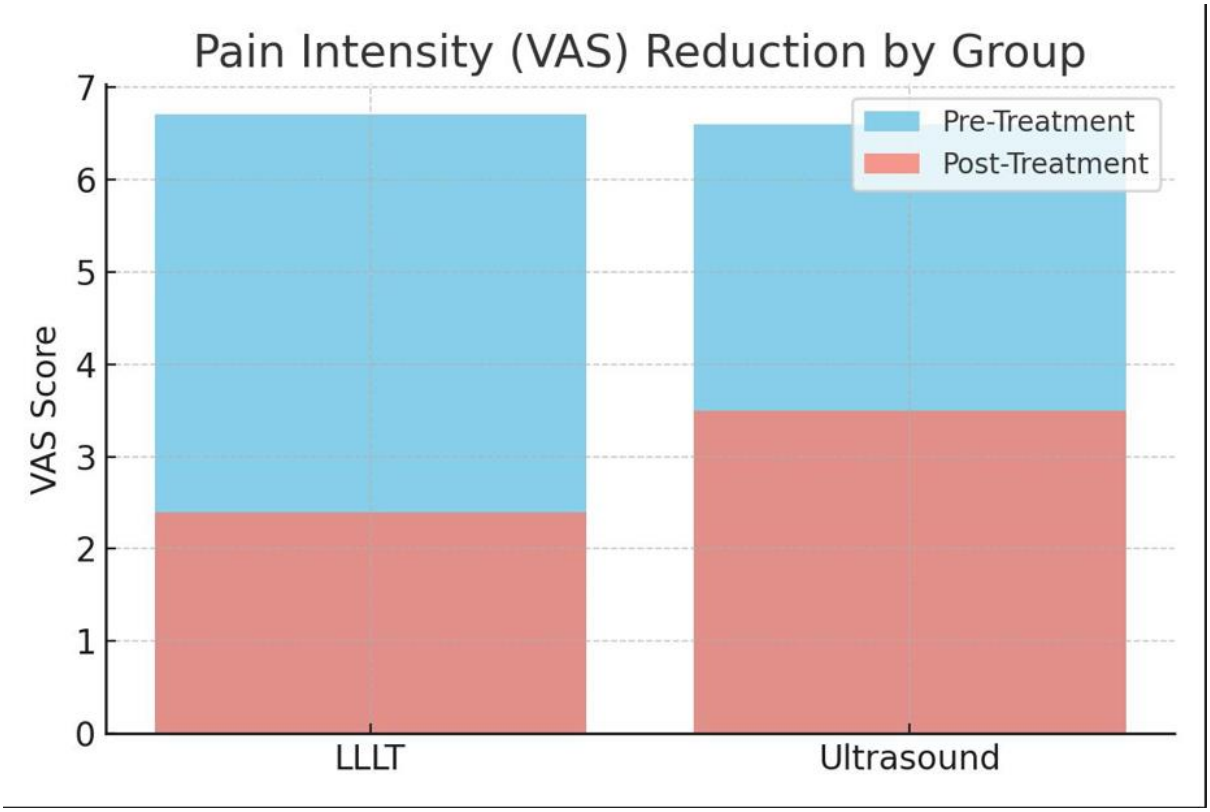
© 2025. Open Access Under Cc By 4.0. Copyright Retained By Authors.
Submission: 05/Feb/2025
Publication: 30/Mar/2025

Table 3: Outcome Measures

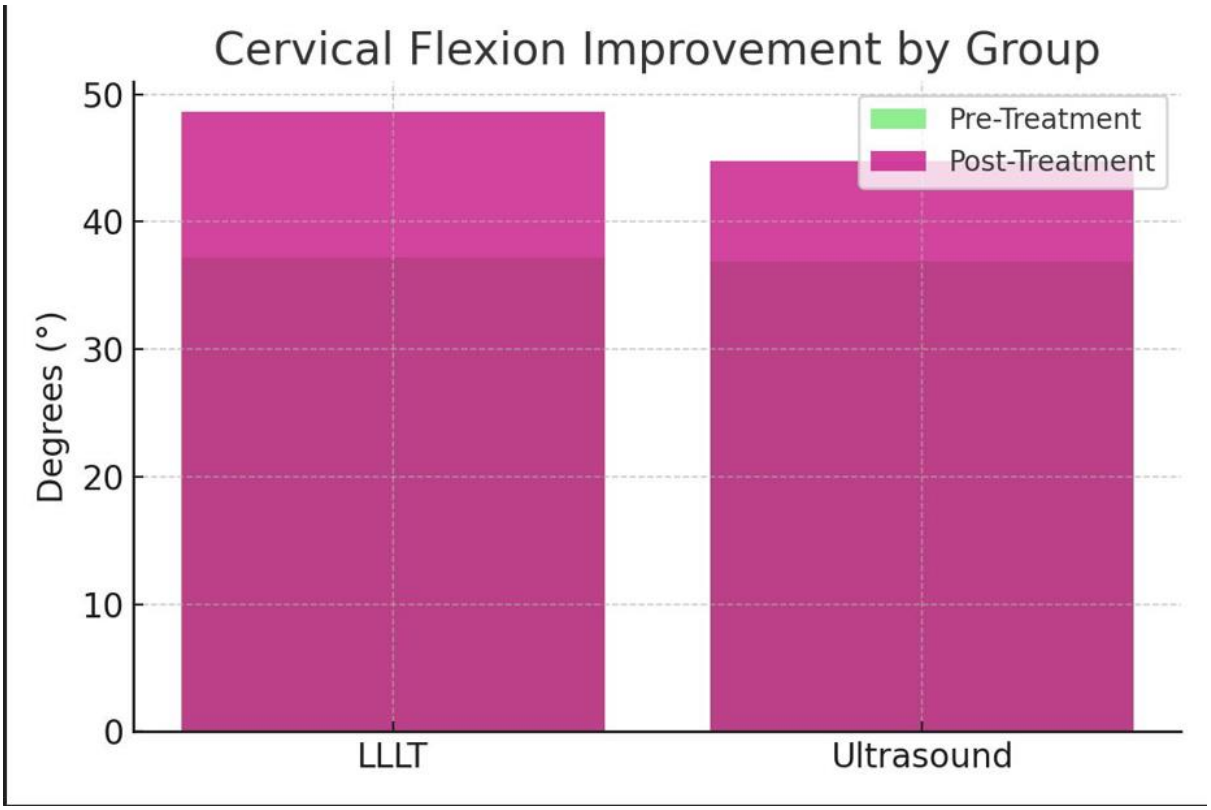
Outcome Measure	*Group A Pre (Mean ± SD)*	*Group A Post (Mean ± SD)*	*Group B Pre (Mean ± SD)*	*Group B Post (Mean ± SD)*	*p-value*
Cervical Flexion (°)	37.2 ± 6.4	48.6 ± 5.9	36.9 ± 6.2	44.8 ± 6.1	0.012
Cervical Extension (°)	41.5 ± 7.1	53.7 ± 6.5	42.1 ± 6.8	49.5 ± 6.2	0.021
Lateral Flexion (°)	31.8 ± 5.6	41.3 ± 4.9	30.9 ± 5.4	38.1 ± 5.0	0.019
Rotation (°)	50.9 ± 7.3	63.5 ± 6.8	51.2 ± 7.6	59.1 ± 6.4	0.027

Table 4: Outcome Measures

Outcome Measure	*Group A Pre-Treatment (Mean ± SD)*	*Group A Post-Treatment (Mean ± SD)*	*Group B Pre-Treatment (Mean ± SD)*	*Group B Post-Treatment (Mean ± SD)*	*p-value*
NDI Score (Disability Index)	28.9 ± 5.4	12.3 ± 3.7	29.4 ± 5.1	16.8 ± 4.2	0.003



© 2025. Open Access Under Cc By 4.0. Copyright Retained By Authors.
Submission: 05/Feb/2025
Publication: 30/Mar/2025



Discussion

The findings of this randomized controlled trial demonstrated that both low-level laser therapy (LLLT) and therapeutic ultrasound were effective in reducing pain intensity, improving cervical range of motion, and enhancing muscle relaxation in individuals with chronic neck pain(17). However, low-level laser therapy produced greater improvements across all evaluated parameters, suggesting its superior therapeutic potential for managing chronic musculoskeletal neck disorders. These outcomes reinforce the growing recognition of LLLT as a promising non-invasive modality for chronic pain management, offering physiological benefits that extend beyond symptomatic relief(18).

The significant reduction in pain intensity observed in both groups aligns with the established understanding that non-pharmacological modalities can effectively modulate nociceptive responses and improve patient comfort(19). The more pronounced effect seen in the LLLT group may be attributed to its cellular-level mechanisms of action, including enhanced mitochondrial activity, increased ATP synthesis, and modulation of inflammatory mediators such as prostaglandins and cytokines(20). These biological processes collectively contribute to the attenuation of pain perception and tissue healing. In contrast, therapeutic ultrasound primarily exerts its effect through mechanical vibration and mild thermal stimulation, improving local circulation and soft tissue extensibility(21). While these effects facilitate muscle relaxation and tissue repair, they may not be as profound in altering the biochemical environment responsible for chronic pain persistence, which could explain the lesser magnitude of improvement compared with laser therapy(22).

Improvement in cervical range of motion was a notable finding in this study, with both groups exhibiting statistically significant gains. Participants receiving LLLT demonstrated greater increases across all movement planes—flexion, extension, lateral flexion, and rotation—suggesting that photobiomodulation contributed to enhanced tissue elasticity and decreased muscle spasm. The enhanced mobility observed after ultrasound therapy also supports its established role in promoting collagen extensibility and reducing muscle stiffness. Nevertheless, the comparatively higher gains in the LLLT group indicate a more comprehensive effect on both neural and muscular components of chronic neck dysfunction. Enhanced range of motion following LLLT could also be associated with improved local microcirculation and reduction of oxidative stress within the affected tissues.

Functional recovery, as measured by the Neck Disability Index (NDI), revealed significant post-treatment improvement in both groups, again with superior outcomes in the laser-treated participants. The decline in disability scores implies not only pain

© 2025. Open Access Under Cc By 4.0. Copyright Retained By Authors.
Submission: 05/Feb/2025
Publication: 30/Mar/2025

alleviation but also improved daily functioning and muscle efficiency. This outcome strengthens the notion that LLLT provides deeper physiological recovery rather than transient symptomatic improvement. The ability of LLLT to accelerate cellular repair and reduce chronic muscle tension likely contributes to enhanced endurance and reduced mechanical strain, both of which are crucial for long-term rehabilitation of chronic cervical pain(23).

The results of this trial are consistent with previously reported findings that emphasize the therapeutic value of LLLT in musculoskeletal disorders. Earlier investigations have documented that laser therapy facilitates photochemical reactions that influence tissue regeneration and nerve conduction, promoting faster recovery. The current findings complement this evidence, reinforcing the notion that LLLT exerts multidimensional benefits that integrate pain modulation, muscle relaxation, and functional enhancement. Although ultrasound remains a valuable modality, particularly for its mechanical and thermal effects, the present study indicates that its benefits may be more limited in addressing the chronic biochemical and neurogenic aspects of neck pain.

The implications of these findings are significant for clinical practice. Chronic neck pain management often involves multiple therapeutic modalities, and identifying the most effective approach can help clinicians optimize treatment outcomes and reduce rehabilitation time. Based on the observed outcomes, LLLT may serve as a more efficient primary modality or as a key component of multimodal therapy in physiotherapy settings. Its non-invasive nature, minimal side effects, and capacity for deep tissue stimulation make it particularly suitable for long-term management of chronic pain conditions.

The strengths of this study lie in its randomized controlled design, standardized treatment parameters, and use of validated outcome measures, ensuring the reliability and reproducibility of findings. The inclusion of objective functional assessments, such as goniometric measurements and disability scoring, provided a comprehensive evaluation of clinical improvements beyond subjective pain relief. Moreover, the consistency in treatment frequency and therapist supervision minimized procedural bias, strengthening the internal validity of the study.

However, certain limitations must be acknowledged. The sample size, though adequate for preliminary analysis, may limit the generalizability of findings to larger populations. The follow-up duration was limited to the immediate post-treatment phase, preventing assessment of long-term sustainability of outcomes. Additionally, the study focused solely on nonspecific chronic neck pain, which may not fully represent other subtypes, such as radiculopathy or post-traumatic conditions. Variability in pain perception among participants, despite randomization, could also influence subjective responses. Furthermore, the study did not incorporate advanced imaging or biochemical markers, which might have provided a deeper understanding of tissue-level changes associated with each modality.

Future research should consider larger multicenter trials with extended follow-up periods to evaluate the long-term efficacy and recurrence rates associated with LLLT and ultrasound therapy. Comparative studies integrating combination protocols, such as LLLT with exercise or manual therapy, could also provide insight into synergistic effects. Further exploration into the optimal dosage parameters, wavelength specifications, and treatment durations of laser therapy would enhance clinical standardization and therapeutic precision.

In conclusion, the present study demonstrated that both low-level laser therapy and therapeutic ultrasound are effective modalities for the management of chronic neck pain, with LLLT showing superior improvements in pain reduction, range of motion, and functional outcomes. These findings support the inclusion of low-level laser therapy as a primary physiotherapeutic intervention for chronic neck pain rehabilitation and highlight the need for continued research to refine its clinical applications and long-term benefits.

© 2025. Open Access Under Cc By 4.0. Copyright Retained By Authors.
Submission: 05/Feb/2025
Publication: 30/Mar/2025

Conclusion

The study concluded that both low-level laser therapy and therapeutic ultrasound are effective in alleviating chronic neck pain; however, low-level laser therapy demonstrated superior outcomes in pain reduction, cervical range of motion, and functional improvement. These findings suggest that LLLT offers a more comprehensive and sustained therapeutic benefit, supporting its use as a preferred physiotherapeutic intervention in chronic neck pain management and rehabilitation practice.

AUTHOR CONTRIBUTIONS

Author	Contribution
Muhammad Dawood**	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Kashaf Royyan	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Muhammad Wasim Salim	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

References

1. de la Barra Ortiz HA, Arias M, Liebano REJLiMS. A systematic review and meta-analysis of randomized controlled trials on the effectiveness of high-intensity laser therapy in the management of neck pain. 2024;39(1):124.

2. Shrestha D, Sharma SJRPeF. Comparison of the clinical effectiveness of Class IV Laser therapy and therapeutic ultrasound in patients with chronic neck pain: a randomized controlled trial. 2024;14:e5538-e.

3. de la Barra Ortiz HA, Avila MA, Miranda LG, Liebano REJT. Effect of high-intensity laser therapy in patients with non-specific chronic neck pain: study protocol for a randomized controlled trial. 2023;24(1):563.

4. Ali AAZ, ElBasiouny MS, Morsy MI, Abouamra HS, Elshennawy SJBJoMS. Immediate effects of 850 nm Diode Laser on patients with Cervical Myofascial Pain Syndrome: a Randomized-controlled trial. 2024;23(2):337-44.

5. Foypikul S, Eungpinichpong W. Effects of a combined low-level laser therapy and strengthening exercise program on pain perception and quality of life in office workers with chronic non-specific neck pain.

6. Xie Y, Diao Y, Wu D, Liao M, Liao LJFiM. Immediate effects of high-intensity laser therapy for nonspecific neck pain: a double-blind randomized controlled trial. 2025;12:1550047.

7. Ali AAZ, El Basiouny MS, Morsy MI, Abouamra HS, Elshennawy S. Effect Low Level Laser Therapy versus Extracorporeal Shockwave Therapy in the management of pain and function of Cervical Myofascial Pain Syndrome patients: a Randomized-Comparative Study.

8. He P, Fu W, Shao H, Zhang M, Xie Z, Xiao J, et al. The effect of therapeutic physical modalities on pain, function, and quality of life in patients with myofascial pain syndrome: a systematic review. 2023;24(1):376.

9. Hao J, He Z, Huang B, Li Y, Remis A, Yao Z, et al. Comparative effectiveness of six biophysical agents on neck pain rehabilitation: a systematic review and network meta-analysis. 2025:1-18.

© 2025. Open Access Under Cc By 4.0. Copyright Retained By Authors.
Submission: 05/Feb/2025
Publication: 30/Mar/2025

10. de la Barra Ortiz HA, Parizotto NA, Liebano REJLiMS. Effectiveness of high-intensity laser therapy in patients with spinal radiculopathy: a systematic review with meta-analysis. 2025;40(1):328.

11. SHRESTHA D, HUSSAIN MA, BEGUM BARBHUIYA NN, RAHMAN Y, KALITA M, SHARMA SJJoC, et al. An Overview and Implication of High Intensity Laser Therapy in Neck Pain: A Narrative Review. 2023;17(9).

12. Alowaimer HA, Al Shutwi SS, Alsaegh MK, Alruwaili OM, Alrashed AR, AlQahtani SH, et al. Comparative efficacy of non-invasive therapies in Temporomandibular Joint Dysfunction: a systematic review. 2024;16(3).

13. de la Barra Ortiz HA, Arias M, Meyer von Schauensee M, Liebano REJLiMS. Efficacy of High-intensity laser therapy in patients with temporomandibular joint disorders: A systematic review and meta-analysis. 2024;39(1):210.

14. Bhoi S, Koushal D, Manas A, Sidhu R, Shergill NK, Kakkad A, et al. Efficacy of TENS, ultrasound and low level laser in the management of TMJ disorder. 2025;21(5):969.

15. Ranjithkumar N, Paul J, Alagesan J, Viswanathan RJB, Journal P. Comparative Effectiveness of Extracorporeal Shock Wave Therapy, Low-level Laser Therapy, and Ultrasound in the Treatment of Rotator Cuff Tendinopathy. 2025;18(1):849-66.

16. El-Sadany SM, Sayed AA-A, Kamel KM, El-ghitany SIJAiR. High intensity laser therapy versus scapular stabilization exercises on ventilatory function in forward head posture. 2024;38(1).

17. Liu J, Zhang F, Cai Y, Liu YJAMR. Physical therapy in patients with temporomandibular joint disorders. 2025;4(1):1-12.

18. Polonsky MJLiDS. Evaluation of patient-related outcomes following treatment of temporomandibular disorders with a 940-nm diode laser: a retrospective clinical pilot study. 2023;7(2):53-9.

19. Alshammari SS, Amin S, Siddiqui AA, Malik YR, Alshammari AF, Amin J, et al. An evidence-based treatment of myofascial pain and myofascial trigger points in the maxillofacial area: a narrative review. 2023;15(12).

20. Arribas-Pascual M, Hernández-Hernández S, Jiménez-Arranz C, Grande-Alonso M, Angulo-Díaz-Parreño S, La Touche R, et al. Effects of physiotherapy on pain and mouth opening in temporomandibular disorders: an umbrella and mapping systematic review with meta-meta-analysis. 2023;12(3):788.

21. Miller LA, Alves JCJLTiVMP. Musculoskeletal disorders and osteoarthritis. 2025:129-50.

22. Burris BJ, Bavarian R, Shaefer JRJDC. Nonsurgical management of temporomandibular joint arthropathy. 2023;67(1):27-47.

23. Hyppolito JP, Hesham A, Sunavala-Dossabhoy G, Kim DDJOD. Fibrosis, Contractures, and Trismus: Delayed Complications of Treatment of Head and Neck Cancer. 2025.

© 2025. Open Access Under Cc By 4.0. Copyright Retained By Authors.
Submission: 05/Feb/2025
Publication: 30/Mar/2025