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A COMPARATIVE STUDY OF LASER THERAPY AND KINESIOTAPING FOR FUNCTIONAL RECOVERY IN ANKLE SPRAIN

Original Research

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ABSTRACT

Background: Ankle sprains are among the most common musculoskeletal injuries, often leading to chronic instability and impaired function. Conservative interventions such as kinesio taping (KT) and low-level laser therapy (LLLT) are increasingly used to manage pain, reduce inflammation, and support joint recovery. Their comparative effectiveness, however, remains under-evaluated in clinical rehabilitation. Understanding their impact on functional recovery may help optimize treatment strategies for ankle sprain management.

Objective: To determine the comparative effect of low-level laser therapy and kinesio taping on pain reduction and functional recovery in patients with ankle sprain.

Methods: This randomized clinical trial included 70 patients previously diagnosed with unilateral ankle sprain, recruited from Nishtar Hospital Multan using purposive sampling. Participants were randomly allocated into two groups (n=35 each). Group 1 received low-level laser therapy, and Group 2 received kinesio taping. The intervention lasted four weeks with three sessions per week. Outcome measures included the Numeric Pain Rating Scale (NPRS) and the Foot and Ankle Ability Measure (FAAM), assessed both pre- and post-intervention. Data normality was assessed using the Kolmogorov-Smirnov test, and paired and independent t-tests were applied using SPSS version 25. A p-value <0.05 was considered statistically significant.

Results: Post-treatment NPRS scores significantly decreased in both groups: from 3.22±0.426 to 1.05±0.235 in the laser group ($p=0.000$), and from 3.171±0.382 to 1.371±0.490 in the KT group ($p=0.002$). FAAM scores increased from 69.17±5.527 to 84.08±5.746 in the laser group ($p=0.000$), and from 68.65±4.37 to 80.02±3.80 in the KT group ($p=0.001$). Between-group comparison showed significantly better outcomes in the laser group for both NPRS ($p=0.000$) and FAAM ($p=0.001$).

Conclusion: Both kinesio taping and laser therapy were effective in improving functional recovery and reducing pain in ankle sprain patients. However, laser therapy demonstrated superior outcomes, making it a more effective option for early rehabilitation.

Keywords: Ankle injuries, Ankle joint, Inflammation, Kinesiology taping, Laser therapy, Pain management, Physical therapy modalities.

INTRODUCTION

Ankle sprains are among the most prevalent musculoskeletal injuries, especially common in athletes and physically active individuals, yet they can affect individuals across all age groups and activity levels. Defined as partial or complete tears in the ligaments supporting the ankle joint, ankle sprains most often result from excessive inversion of a weight-bearing, plantarflexed foot. The lateral ligaments, particularly the anterior talofibular ligament, are more susceptible to injury due to their relative structural weakness compared to the medial ligaments and their limited ability to resist inversion forces (1). While acute ankle sprains are typically managed with conservative interventions, a substantial proportion—estimated at 40–70%—progress to chronic ankle instability, leading to recurrent sprains and other joint pathologies (2). Chronic ankle sprain is characterized by persistent pain during weight-bearing activities, restricted ankle mobility, and instability, particularly on uneven surfaces (3). If not effectively managed, these conditions can significantly impair quality of life and may predispose individuals to early-onset osteoarthritis of the ankle joint, representing not only a personal health burden but also an economic concern (4). Conservative treatments remain the first line of management, incorporating physiotherapy, acupuncture, manipulation, Chinese herbal fumigation, and other non-surgical methods. However, surgical reconstruction of ligaments may become necessary when conservative measures fail to restore stability and function (5).

Understanding the anatomical and biomechanical complexity of the ankle and foot is essential to grasp the challenges involved in treating ankle sprains. The ankle joint—comprising the tibia, fibula, and talus—is stabilized by tibiofibular ligaments forming a mortise that allows for efficient weight transfer and joint movement (6). Below the talocrural joint lies the subtalar joint, which facilitates pronation and supination through intricate articulations between the talus and calcaneus. This structure allows torque transmission between the lower leg and the foot, playing a critical role in dynamic movements and balance (7). Ankle sprains frequently occur in high-demand activities involving sudden directional changes such as running, jumping, or contact sports like basketball and soccer. Mechanisms of injury often involve rapid inversion or eversion movements that overstretch or rupture the ligaments stabilizing the ankle (8). Among emerging adjunct therapies for ankle rehabilitation, low-level laser therapy (LLLT) has gained attention for its ability to modulate inflammation, reduce pain, and accelerate tissue healing without generating heat—thereby termed "cold laser therapy" (9). In contrast, high-power laser therapy (HPLT) generates thermal effects due to higher output but is less commonly used in conservative management of ankle sprains due to safety concerns and specific indications (9).

Another supportive intervention gaining clinical traction is kinesiology taping (KT). Unlike rigid sports tape, KT tape is elastic and dynamically supports muscle function, proprioception, and lymphatic drainage. By lifting the skin microscopically, KT tape increases interstitial space, thereby improving circulation and decreasing pressure on pain receptors and inflamed tissues (10). Physiotherapists employ KT tape not only for its mechanical support but also for its neuromuscular and psychological effects, such as enhancing joint stability, promoting proper biomechanics, and reducing recurrence of injury (11). Proper skin preparation and tape application technique are crucial to maximize therapeutic benefits and minimize irritation or allergic responses (12). Despite advances in conservative management, recurrence rates of ankle sprains remain high, and evidence remains varied regarding the most effective intervention protocols. Given the multifactorial nature of chronic ankle instability and the promising yet underexplored role of modalities such as LLLT and KT in promoting recovery, further investigation is warranted. Therefore, this study aims to evaluate the comparative efficacy of low-level laser therapy and kinesiology taping in improving functional outcomes and reducing pain in individuals with chronic ankle sprain.

METHODS

This randomized clinical trial (RCT) was conducted to compare the effects of low-level laser therapy and kinesio taping on functional recovery in individuals with lateral ankle sprain. A total of seventy participants were recruited using a non-probability purposive sampling technique based on specific eligibility criteria. Participants were included if they were between 18 and 35 years of age, had a unilateral Grade I or II lateral ankle sprain diagnosed within the past four weeks, and had no history of ankle surgery, fractures, or systemic musculoskeletal or neurological disorders. Individuals with hypersensitivity to tape or laser, open wounds, dermatologic conditions at the treatment site, or who were undergoing other therapeutic interventions during the study period were excluded (3,4).

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After obtaining informed written consent from all participants, the study was approved by the Institutional Review Board. Participants were randomly allocated into two equal groups (n=35 per group) using a computer-generated randomization method to reduce selection bias and ensure allocation concealment. Group 1 received low-level laser therapy (LLLT), while Group 2 received kinesio taping (KT). Both interventions were administered by qualified physiotherapists following standardized treatment protocols.

The intervention period spanned four weeks, during which each participant received three treatment sessions per week, totaling twelve sessions. The LLLT protocol involved the application of a therapeutic low-level laser device conforming to established parameters for musculoskeletal conditions. The KT intervention followed clinically recognized taping techniques designed to reduce pain, enhance proprioception, and support joint stability. Participants were instructed to retain the tape for three to five days per application, with tape reapplied as needed throughout the study period. Outcome measures included the Numeric Pain Rating Scale (NPRS) to assess pain intensity and the Foot and Ankle Ability Measure (FAAM) to evaluate functional status. Both scales were administered at baseline and at the end of the four-week intervention period. Data collection was standardized, and all assessments were performed by a blinded assessor to minimize bias.

Data analysis was conducted using IBM SPSS Statistics version 25. Descriptive statistics were used to summarize demographic characteristics, with means and standard deviations calculated for continuous variables and frequencies and percentages for categorical variables. The Kolmogorov-Smirnov test was applied to assess the normality of data distribution. For normally distributed data, paired sample t-tests were used for within-group comparisons (pre- and post-intervention), while independent sample t-tests were employed for between-group comparisons. A p-value of less than 0.05 was considered statistically significant. The methodology ensured rigorous control over participant selection, randomization, intervention delivery, and statistical analysis, enhancing the reliability and validity of the study outcomes. The study adhered to ethical research practices, ensuring participant safety and confidentiality throughout the trial.

RESULTS

The results of the study included a total of seventy participants, with 35 individuals allocated to the laser therapy group and 35 to the kinesio taping group. Descriptive statistics revealed that in the laser group, 57.1% (n=20) were aged between 20–27 years, and 42.9% (n=15) were between 28–35 years, with a mean age of 1.428 ± 0.502. In the kinesio taping group, 48.6% (n=17) were aged 20–27 years, and 51.4% (n=18) were between 28–35 years, with a mean age of 1.514 ± 0.507. Gender distribution in the laser group showed 51.4% (n=18) males and 48.6% (n=17) females, whereas the kinesio taping group consisted of 22.9% (n=8) males and 77.1% (n=27) females. Normality testing using the Kolmogorov-Smirnov test confirmed that all variables—pre- and post-intervention scores for both NPRS and FAAM—were normally distributed, as all p-values exceeded 0.05. Therefore, parametric tests were applied in subsequent analyses.

Within-group comparisons using paired sample t-tests indicated statistically significant improvements in both groups. For the laser therapy group, the mean NPRS score decreased from 3.22 ± 0.426 at baseline to 1.05 ± 0.235 post-treatment ($p<0.001$). Simultaneously, the mean FAAM score increased from 69.17 ± 5.527 to 84.08 ± 5.746 ($p<0.001$). In the kinesio taping group, NPRS scores reduced from 3.171 ± 0.382 to 1.371 ± 0.490 ($p=0.002$), and FAAM scores increased from 68.65 ± 4.37 to 80.02 ± 3.80 ($p=0.001$). These findings indicated that both interventions were effective in reducing pain and improving ankle function. When comparing outcomes between the two groups using independent sample t-tests, the post-treatment NPRS scores were significantly lower in the laser therapy group (1.05 ± 0.235) than in the kinesio taping group (1.371 ± 0.490), with a p-value of 0.000. Similarly, post-treatment FAAM scores were significantly higher in the laser group (84.08 ± 5.746) compared to the kinesio taping group (80.02 ± 3.80), also with a p-value of 0.001. These between-group differences suggest that while both therapies yielded clinical improvement, laser therapy demonstrated superior outcomes in pain reduction and functional recovery.

A clear comparative effect of low-level laser therapy (LLLT) and kinesio taping (KT) on pain reduction and functional recovery in individuals with ankle sprain can be determined using the post-intervention values of the NPRS (pain intensity) and FAAM (functional ability) scores. From the within-group analysis, both interventions showed statistically significant improvements from pre- to post-treatment, Laser therapy group reduced NPRS from 3.22 ± 0.426 to 1.05 ± 0.235 and improved FAAM from 69.17 ± 5.527 to 84.08 ± 5.746, both with p-values < 0.001. Kinesio taping group reduced NPRS from 3.171 ± 0.382 to 1.371 ± 0.490 and improved FAAM from 68.65 ± 4.37 to 80.02 ± 3.80, also with statistically significant p-values (0.002 and 0.001, respectively). In the between-group analysis, LLLT demonstrated superior results. Post-treatment NPRS was significantly lower in the laser group (1.05 ± 0.235) than in the KT group (1.371 ± 0.490), with a p-value of 0.000. Post-treatment FAAM was significantly higher in the laser group (84.08 ± 5.746) than in the

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KT group (80.02 ± 3.80), with a p-value of 0.001. These findings suggest that while both therapies are effective, laser therapy showed a more substantial reduction in pain intensity and greater improvement in ankle function over the short-term intervention period.

Table 1: Descriptive Statistics of Age

Group	Age	Frequency	Percentage	Mean	SD
Laser Therapy	20-27	20	57.1	1.428	.502
	28-35	15	42.9		
Total	35		100.0		
KT	20-27	17	48.6	1.514	.507
	28-35	18	51.4		
Total	35		100.0		

Table 2: Descriptive statistics of gender

Gender	Groups	
	Laser	KT
Male	18	8
	51.4%	22.9%
Female	17	27
	48.6%	77.1%
Total	35	35
	100.0%	100.0%

Table 3: Test of Normality

	Statistic	Df	Sig.
Pre NPRS	0.490	70	0.448
Post NPRS	0.484	70	0.059
Pre FAAM	0.071	70	0.200
Post FAAM	0.109	70	.0.078

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Table 4: Within-Group Comparison of NPRS and FAAM Scores Before and After Intervention in Laser Therapy and Kinesio Taping Groups (Paired Sample t-test)

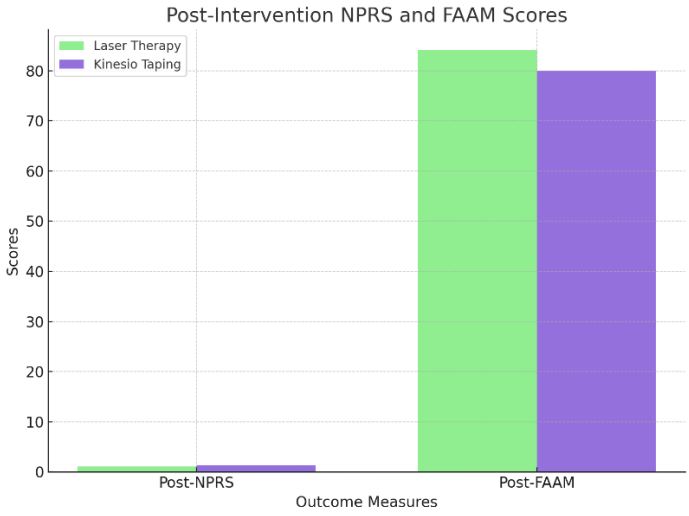
Outcome Measure	Laser Therapy (Mean ± SD)	p-value	Kinesio Taping (Mean ± SD)	p-value
Pre-NPRS	3.22 ± 0.426	0.361	3.171 ± 0.382	0.361
Post-NPRS	1.05 ± 0.235	0.000	1.371 ± 0.490	0.002
Pre-FAAM	69.17 ± 5.527	0.489	68.65 ± 4.37	0.489
Post-FAAM	84.08 ± 5.746	0.000	80.02 ± 3.80	0.001

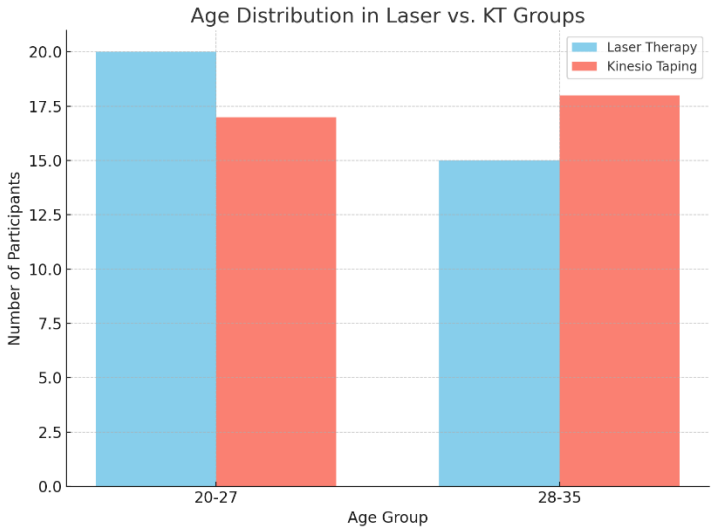
Table 5: NPRS and FAAM across groups Comparison (Independent Sample t-test)

	Mean ± S.D LASER	Mean ± S.D KT
Post NPRS	1.05±.235	1.371±.490
Post FAAM	84.08±5.746	80.02±3.80
P-value NPRS	0.000	0.002
P-value FAAM	0.000	0.001

Table 6: Comparative Effect of Laser Therapy and Kinesio Taping on Pain and Function in Ankle Sprain

Outcome Measure	Laser Therapy (Mean ± SD)	Kinesio Taping (Mean ± SD)	p-value	Interpretation
Post NPRS Score	1.05 ± 0.235	1.371 ± 0.490	0.000	Laser therapy resulted in greater pain reduction
Post FAAM Score	84.08 ± 5.746	80.02 ± 3.80	0.001	Laser therapy led to better functional recovery





DISCUSSION

This study aimed to evaluate and compare the effects of low-level laser therapy and kinesio taping on functional recovery following an ankle sprain. The outcomes demonstrated that both interventions significantly improved pain levels and functional ability as assessed through the NPRS and FAAM scales, with laser therapy showing a more pronounced impact (13). Post-treatment scores in the laser therapy group were notably superior in both pain reduction and functional gain, suggesting that laser therapy may have a stronger therapeutic influence in the acute management of lateral ankle sprains. The findings aligned with existing literature indicating that laser therapy contributes to improved joint mobility and pain modulation (14). Previous research comparing laser therapy with conventional methods like the PRICE protocol highlighted greater improvement in joint range of motion and pain reduction when laser was integrated with mobilization strategies (15). These results reinforce the clinical relevance of incorporating laser therapy into rehabilitation programs for soft tissue injuries. Additionally, high-intensity laser therapy combined with kinesio taping and manual therapy has been shown to enhance functional recovery and decrease pain levels, further supporting the efficacy of laser-based interventions in musculoskeletal rehabilitation (16,17).

The current results also echo findings from studies where kinesio taping was utilized either independently or in conjunction with exercise. Improvements in muscle function, joint range, and pain were commonly observed among subjects receiving KT. In this study, kinesio taping resulted in meaningful clinical improvements, as evidenced by a significant reduction in NPRS and enhancement in FAAM scores post-treatment. Moreover, other investigations have identified reductions in peroneal muscle activation amplitude and mediolateral sway following KT application, indicating that kinesio taping not only assists with symptom relief but may also positively influence proprioception and neuromuscular control (18). Despite the demonstrated efficacy of both interventions, laser therapy exhibited a superior comparative effect. This may be attributed to its physiological action at the cellular level, including enhanced mitochondrial activity, modulation of inflammatory mediators, and promotion of tissue repair. The analgesic effect of laser therapy has been further validated in studies exploring its impact on inflammatory hyperalgesia, where pain modulation occurred independently of peripheral opioid receptor mechanisms. Such mechanisms offer a promising explanation for the observed clinical benefit in pain attenuation and mobility restoration (19).

While these findings contribute meaningfully to existing evidence, the study also presents several limitations. The short-term nature of the intervention restricted the ability to assess long-term outcomes, and the absence of follow-up data limits conclusions regarding the sustainability of treatment effects. Additionally, the lack of control over the duration of injury prior to intervention and the non-reporting of treatment adherence reduce internal validity. Gender imbalance between groups may have influenced results, given the higher proportion of females in the kinesio taping group. Furthermore, although randomization was conducted, baseline equivalence in injury severity and physical activity levels was not controlled, which could have introduced confounding variables. The study's strengths

include its randomized controlled design, use of validated outcome measures, and consistent treatment protocols delivered by qualified professionals. The comparison of two commonly used conservative modalities in ankle rehabilitation adds clinical value, especially in guiding evidence-based decision-making in physiotherapy practice (20). However, future studies should consider larger sample sizes, gender-balanced cohorts, extended follow-up periods, and the inclusion of adherence monitoring and injury chronicity. Furthermore, exploring the combined effect of laser therapy and kinesio taping could reveal potential synergistic benefits that might surpass the efficacy of each modality alone. In conclusion, both low-level laser therapy and kinesio taping were effective in promoting functional recovery and reducing pain in individuals with lateral ankle sprain. Nevertheless, laser therapy demonstrated a greater therapeutic advantage, supporting its integration into early-stage rehabilitation strategies for such injuries. More comprehensive investigations are required to validate these outcomes and to optimize conservative treatment protocols in musculoskeletal rehabilitation.

CONCLUSION

This study concluded that both kinesio taping and low-level laser therapy are effective conservative interventions for managing ankle sprain, contributing to pain relief and functional improvement. However, laser therapy demonstrated comparatively greater benefits in enhancing recovery by more effectively reducing pain intensity, inflammation, and improving joint function. These findings highlight the clinical value of incorporating laser therapy into rehabilitation protocols for ankle sprain, especially during the early phases of recovery. The study reinforces the importance of evidence-based physiotherapeutic approaches and supports the prioritization of laser therapy as a superior modality when aiming for faster and more efficient functional outcomes in musculoskeletal injuries.

Author Contributions

Author	Contribution
Saima Yasin	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Aqsa Lakhani	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
Fatima Aslam	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Jalal	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Neha Khalid Hafiza	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
M Behzad Ali*	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Sana Muneeb	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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