Electronic publication,
Published on January 29th, 2025.
https://doi.org/10.33700/jhrs.3.2.119
eISSN: 2820-5480

Alma Mater Europaea University – ECM
Journal of Health and Rehabilitation Sciences, 2025 Jan 29; 3(2), 1–11
Rehabilitation Research

The Effectiveness of High-Intensity Laser Therapy on Pain Management in Tendinopathy – A Systematic Review

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Received: 25-Sep-2024
Revised: 20-Oct-2024
Accepted: 26-Oct-2024
Online first: 27-Oct-2024

Review article

Abstract

Introduction: High-intensity laser therapies (HILT) have gained significant attention in therapeutic pain treatment. The aim of this systematic review was to determine the effectiveness of HILT therapies in the management of different types of tendinopathy-related pain, and the long-term benefits associated with treatment process.

Methodology: A systematic literature review of prospective randomized controlled trials from electronic databases: Google Scholar, Pub Med, Embase, Science Direct, and ProQuest, using relevant key words, was performed. Randomized trials that included HILT, patients with tendinopathy, pain management, and at least one single clinically pertinent attribute were selected. Standard PRISMA protocols were followed when completing the assessment.

Results: The physical, demographic, and theoretical insights from various studies suggest that HILT is a highly promising approach for managing pain in patients with tendinopathy. The most common body parts for treating tendinopathy using this method were the shoulder, elbow, ankle, and knee. Various attributes and parameters, such as Hand function evaluated by Quick Disabilities of Arm, Shoulder and Hand Questionnaire (QDASH) and Handgrip Strength; pain assessed by the visual analogue score (VAS) during rest or activity, 36-item short-form health survey (SF-36) for physical and mental health, and the shoulder pain and Disability Index (SPADI) for shoulder and elbow assessment, were frequently significant across studies.

Conclusion: HILT could be recommended as a treatment of choice for reducing pain and improving function in patients with tendinopathy, with potential benefits when combined with other physical therapy treatments. Further studies are needed to clarify optimal treatment protocols and long- term outcomes.

Keywords: Tendinopathy, high-intensity laser therapy (HILT), Laser therapy, tendon, pain

Citation: Berčič, T., & Bracic, M. The Effectiveness of high-intensity laser therapy on pain in tendinopathy: A systematic review. Journal of Health and Rehabilitation Sciences, 2025 Jan 29; 3(2), 1–11. https://doi.org/10.33700/jhrs.3.2.119

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1. Introduction

The U.S. Food and Drug Administration officially recognized high-intensity laser therapy (HILT) in 2002, allowing it to be used for evaluating its potential positive effects on tissue regeneration and pain relief (Monici et al., 2008). Among HILT's various applications, the most substantial body of case studies has focused on pain recovery in tendinopathy (Elsodany et al., 2018). Tendinopathy involves changes that lead to damaged tendons, causing pain, swelling, loss of tissue integrity, and restricted muscle function. This condition is accompanied by structural and cellular malfunctions within the tendon. During sports-related activities, repetitive movements and increased speed create substantial mechanical forces on the tendons, leading to greater demands on tendon capacity (Millar et al., 2021). Tendon injuries can result from overuse or excessive strain, especially in older adults, which can lead to lower extremity tendinopathy, resulting in swelling, pain, and a decrease in tissue integrity and function (Riel et al., 2019). The most common tendinopathies affect the Achilles tendon, shoulder (rotator cuff tendon), elbow (medial and lateral epicondyles), ankle (tibialis posterior tendon), and knee (patellar tendon) (Riel et al., 2019; Millar et al., 2021).The frequency and incidence of tendinopathy have increased globally since the 2000s, often resulting in long-term or permanent deficiencies, particularly in athletes (Hopkins et al., 2016). Additionally, the prevalence of tendinopathy varies by age, sex, sport, physical activity level, underlying health conditions, and body region affected. The likelihood of tendinopathy increases with age, and females may have a higher predisposition than males (Riel et al., 2019). Causes of tendinopathy pain include muscle tissue damage, trauma, postural strain, repetitive movement, overuse, and prolonged immobilization. Laser therapy, specifically HILT, has emerged as a non-invasive treatment option for managing musculoskeletal disorders (Song et al., 2018). Studies have also affirmed HILT's advantages over low-intensity laser therapy (LILT), as high-intensity laser beams treat larger surface areas and penetrate deeper tissues. The primary difference between HILT and LILT is the high-power beam of HILT (power > 500 mW), which delivers a significant amount of energy in a short timeframe. The protocols for HILT and LILT differ in terms of application methods, costs, and exposure times (Kheshie et al., 2014).

HILT has been shown to alleviate pain and improve functional capacity in patients with musculoskeletal conditions. Studies have demonstrated that HILT provides better pain relief and functional improvement than control groups (Song et al., 2018; Verma et al., 2022; Chen et al., 2020). Previous medical studies have highlighted HILT's complementary effects on tendon recovery and pain reduction (Evangelos et al., 2018; Haslerud et al., 2015). For example, Kaydok et al. (2020) evaluated 60 patients with lateral epicondylitis (tennis elbow) and found that both HILT and lower-intensity laser treatments were effective. However, HILT provided greater improvements in handgrip strength, the Pain Catastrophizing Scale (PCS), and Quick Disabilities of the Arm, Shoulder, and Hand Questionnaire (QDASH) scores ($p < 0.05$). These findings strongly indicate that HILT is highly effective for various types of pain management. Figure 1 illustrates the significant benefits of HILT in patient treatment, as confirmed by multiple studies.

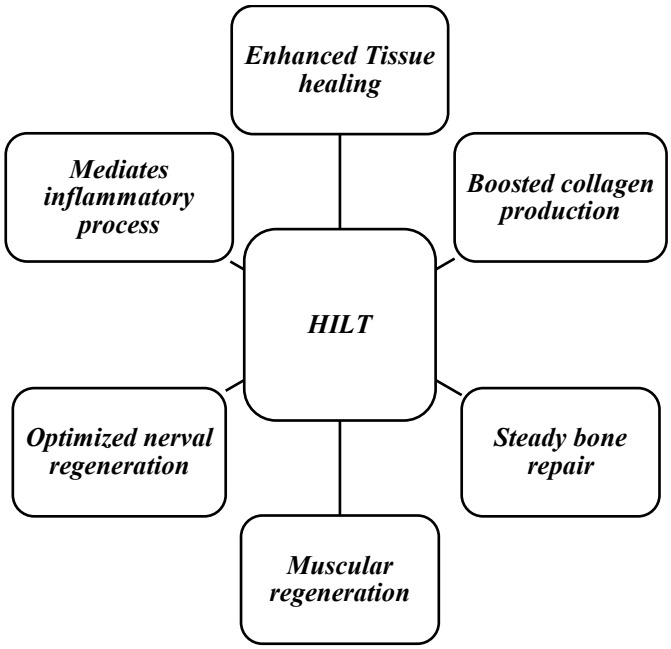

Fig. 1: Benefits of high-intensity laser treatment in humans (illustrated by the author)

An assessment of grade I tendinopathy (mild discomfort with minimal pain) confirmed that HILT is a highly effective therapeutic approach for reducing pain and enhancing the quality of life in patients with persistent symptoms of lateral epicondylitis (Elmelgie et al., 2023).

Systematic reviews and meta-analyses are available on the effectiveness of low-level laser-based treatments for patients with tendinopathy (Haslerud et al., 2015; Eslamian et al., 2012). While fewer studies have focused specifically on the efficacy of HILT for pain recovery in tendinopathy patients, this review has gathered the most relevant and accurate data aligned with our research objectives. The goal was to identify further opportunities to optimize HILT for treating different types of tendinopathies and addressing challenges faced by both patients and practitioners.

Given HILT's high efficacy and the limited treatment options available to many practitioners and surgeons, HILT represents a promising option for patients with severe pain, providing relief with minimal disruption to overall health. HILT focuses on effective pain management and clinical efficacy, potentially reducing the need for frequent clinical visits.

However, further investigation is needed to clarify the duration of pain relief, quality of life improvements, and long-term effectiveness. This review emphasizes the positive impacts of HILT therapies in delivering effective pain relief for tendinopathy.

1.1 Research Objectives

The current assessment focused on evidence regarding the following key points in a broad spectrum and compared the studies based on the success rate of HILT-based treatments:

- Assessment of pain reduction in patients
- Considering the various types of tendinopathies
- Prolonged effects of HILT therapies

2. Material and methods

This assessment was completed following the protocol of Preferred Reporting Items in Systematic Reviews and Meta-analyses (PRISMA), along with revised PRISMA guidelines (PRISMA-P) (Page et al., 2021). A comprehensive and in-depth investigation of existing literature proceeded using the following steps.

2.1 Data Sources

To compile the initial literature review, we utilized several databases: Science Direct (246), Google Scholar (161), PubMed (9), Embase (8), and ProQuest (70). These sources were used to extract key articles highlighting the effectiveness of HILT therapy in managing pain associated with tendinopathy. We collected and scrutinized high-quality research articles from reputable journals.

An integrative bibliometric analysis was conducted to identify the most relevant outputs aligned with our research objectives.

2.2 Research Strategy

A legitimate and well-structured research strategy is essential for conducting results-oriented systematic reviews. Identifying and implementing key terms is a crucial strategy for enlisting and categorizing relevant data. The primary keywords used in this assessment for online research included Tendinopathy, RCTs, High-Intensity Laser Therapy (HILT), Tendon, Tendon Pain, and Pain. All relevant studies were selected based on exclusion criteria and were published online between 2000 and 2024.

2.3 Study Selection Criteria

All the significant literature was refined through the below-mentioned takeaways for their representation in the final review section. These generalized eligibility criteria are readily applicable to a diverse range of research investigations and literature reviews listed below in Table 1.

2.4 Data Extraction and Analysis

All articles, publications, and relevant data were examined individually for their specific relevance to our subject title. Each study was analyzed separately by the authors using pre-made extraction tables, which included elements such as the author and publication year, titles, aims/objectives, and key takeaways. A detailed PRISMA framework was employed to screen outcomes in alignment with our key perspectives. To create a comprehensive database of identified and scrutinized articles, we conducted a thorough review of titles, abstracts, and key findings from the selected studies. Dominant fields, categories, and selections were highlighted for further clarification.

We utilized Covidence, a free online web-based application (https://www.covidence.org/), to organize relevant studies and eliminate duplicates. A quality assessment table was also provided, along with a summary table of key studies included at the end, serving as a valuable tool for evaluating the quality and reliability of the literature in relation to our research objectives. The generalized framework and detailed flow diagram of the methodology based on PRISMA guidelines (Page et al., 2021) are presented in Figure 2.

3. Results

This comprehensive study examines the outcomes of High-Intensity Laser Therapy (HILT) for pain management, presenting several valuable insights. The research focused on the treatment of various body parts, including the shoulder, knee, and foot. Ahi and Sirzai (2023) evaluated the short-term effects of HILT in patients with de Quervain tenosynovitis, characterized by pain in the thumb area, which ultimately affects the hand tendons. They engaged with over 64 patients and conducted follow-up assessments. The results indicated that after three treatments per week for four to five weeks, there was a significant improvement in handgrip strength and Visual Analog Scale (VAS)

scores. Consequently, HILT was recommended for the recovery of patients with de Quervain tenosynovitis. HILT is regarded as a non-invasive, effective, and reliable approach for addressing pain related to muscular activities. Similarly, Dundar et al. (2015) studied three groups: a brace group, a sham therapy (placebo HILT treatment) group, and an HILT group, all aimed at treating lateral epicondylitis pain in 93 patients. Their findings demonstrated that HILT outperformed the other two methods across various evaluation parameters. Significant improvements were observed in the Disability Index, Quality of Life, General Health Survey, and VAS pain scores for patients receiving HILT compared to those in the other groups, underscoring the effectiveness and reliability of HILT therapies. In another study by Ali et al. (2021), lateral epicondylitis was treated using both individual and combined applications of HILT and ultrasound therapies on 45 patients. The results revealed significant improvements in VAS pain scores, the Disabilities of the Arm, Shoulder, and Hand (DASH) scale, and grip strength across all three groups after the treatment sessions ($p < 0.0001$). The combined HILT and ultrasound group demonstrated superior outcomes compared to each treatment used alone, with statistically significant differences in VAS ($p < 0.0001$) and DASH scores ($p < 0.001$). Verma et al. (2022) investigated the effects of HILT therapy on athletes with proximal hamstring tendinopathy and concluded that HILT is an effective method for reducing pain. However, they emphasized the need for an integrated approach to enhance pain management. The benefits of HILT therapies are apparent across all regions of the body, including the upper, lower, and middle sections. In a study by Chen et al. (2020), the immediate effects of HILT treatments were assessed in twenty patients with Subacromial Impingement Syndrome (SAIS) in the shoulder. Comparative results from VAS, Range of Motion (ROM), and Constant-Murley Scale (CMS) assessments before and after treatment showed a significant reduction in pain levels, allowing for improved shoulder movement during various activities. Therefore, patients and athletes experiencing flexion issues or tendon-related pain are advised to consider optimized HILT therapies for enhanced results and improved quality of life. Pain associated with the shoulder and elbow joints is common among athletes and individuals engaged in heavy physical work. Atan and Bahar (2021) demonstrated that HILT therapies, when compared with therapeutic sessions, resulted in significant differences in VAS pain, the Shoulder Pain and Disability Index (SPADI), and SF-36 scores (subgroups of energy/fatigue, pain, and general health). Furthermore, patients with shoulder joint pain (adhesive capsulitis) experienced a notable reduction in pain. Tendinopathy can also be effectively managed using innovative approaches involving the same equipment, such as varying wavelengths, exposure times, and other parameters. Notarnicola et al. (2023) analyzed thirty patients diagnosed with rotator cuff tendinopathy using a combination of wavelengths (650, 810, 980, and 1064 nm) compared to a single wavelength (1064 nm). Pain-related indices were assessed before the intervention and at two follow-up periods, one month and six months later. Group A received a HILT therapy protocol using a single wavelength (1064 nm), while Group B was treated with four wavelengths (650, 810, 980, and 1064 nm). Both protocols resulted in improvements in pain (VAS), function (ASES), and disability (DASH) over time, with no statistically significant differences between the two groups. However, Group B, which received the four-wavelength treatment, showed a trend towards greater pain reduction that approached statistical significance. Beyrami et al. (2023) investigated the combined effects of Transcutaneous Electrical Nerve Stimulation (TENS), ultrasound, hot packs, and exercises in a control group (n=16) and a treatment group (n=16) that received routine physiotherapy alongside HILT in the painful area of the shoulder over twelve sessions. The combination of HILT and routine physiotherapy improved both clinical outcomes and sonographic findings, including supraspinatus tendon thickness and the accumulation of sub-acromial fluid in patients with rotator cuff tendinopathy, compared to the control group. Brandl et al. (2023) examined microcirculatory changes in the patellar tendon and skin temperature as a result of HILT therapies. This investigation involved 21 healthy volunteers, and microcirculation was measured non-invasively using laser Doppler and white light spectroscopy before and after HILT treatment, as well as ten minutes post-treatment. The results indicated significant improvements in blood flow and oxygen saturation following HILT, effects that were still measurable ten minutes later. Conversely, there was a notable decrease in the relative amount of hemoglobin, suggesting an acceleration of blood flow. Salli et al. (2016) explored the effects of HILT therapies combined with a lateral epicondylitis bandage in 65 patients, reporting considerable improvements in disability, quality of life parameters, and handgrip strength following four sessions (75 seconds at 4W, 6J/cm²) followed by six sessions (12 minutes and 30 seconds at 6W, 100-150J/cm²). In another study, Mardh and Lund (2016) examined the effects of HILT therapies on Achilles tendon pain over six sessions during a three to four-week period, with follow-up assessments conducted eight to ten weeks later. The results indicated significant improvements within groups, with the HILT group demonstrating a more pronounced reduction in pain levels compared to the placebo HILT group. Therefore, HILT can be considered a promising treatment for tendinosis-related pain issues. Further studies investigating the long-term effects of HILT could enhance our understanding of this treatment modality. Table 3 provides a brief summary of the studies included in this research.

Table 1: Eligibility considerations for the current systematic review

Criteria	*Inclusion*	*Exclusion*
Study design	Modern comparable methodologies or reviews based on study selection, and systematic review.	Weak/old study designs, articles with fewer studies reviewed, incomplete designs, lower sample population
Publication Type	Original peer-reviewed full publications available (including observational, experimental, case reports, conference proceedings, editorials, review articles, full-text available articles, and original primary research publications).	Incomplete abstracts, commentaries, short papers, posters, presentations, and news articles.
Key organizations	Material from research institutes, medical diagnostic centres, clinics, private sector research institutes, and government office reports.	Non-reputed institutes and un-certified study centres.
Key takeaways	Qualitative methodologies, reliability of approaches; well-organized.	Limited refrained methods and incomplete studies.
Other medically related guidelines	Only studies related to human body pain studies, including HILT therapies and RCT studies.	Low-intensity laser therapies, animal-based studies, non-RCTs.
Language	Articles in English only or easily translatable to English.	Any other language articles.
Time frame	2000-2024.	

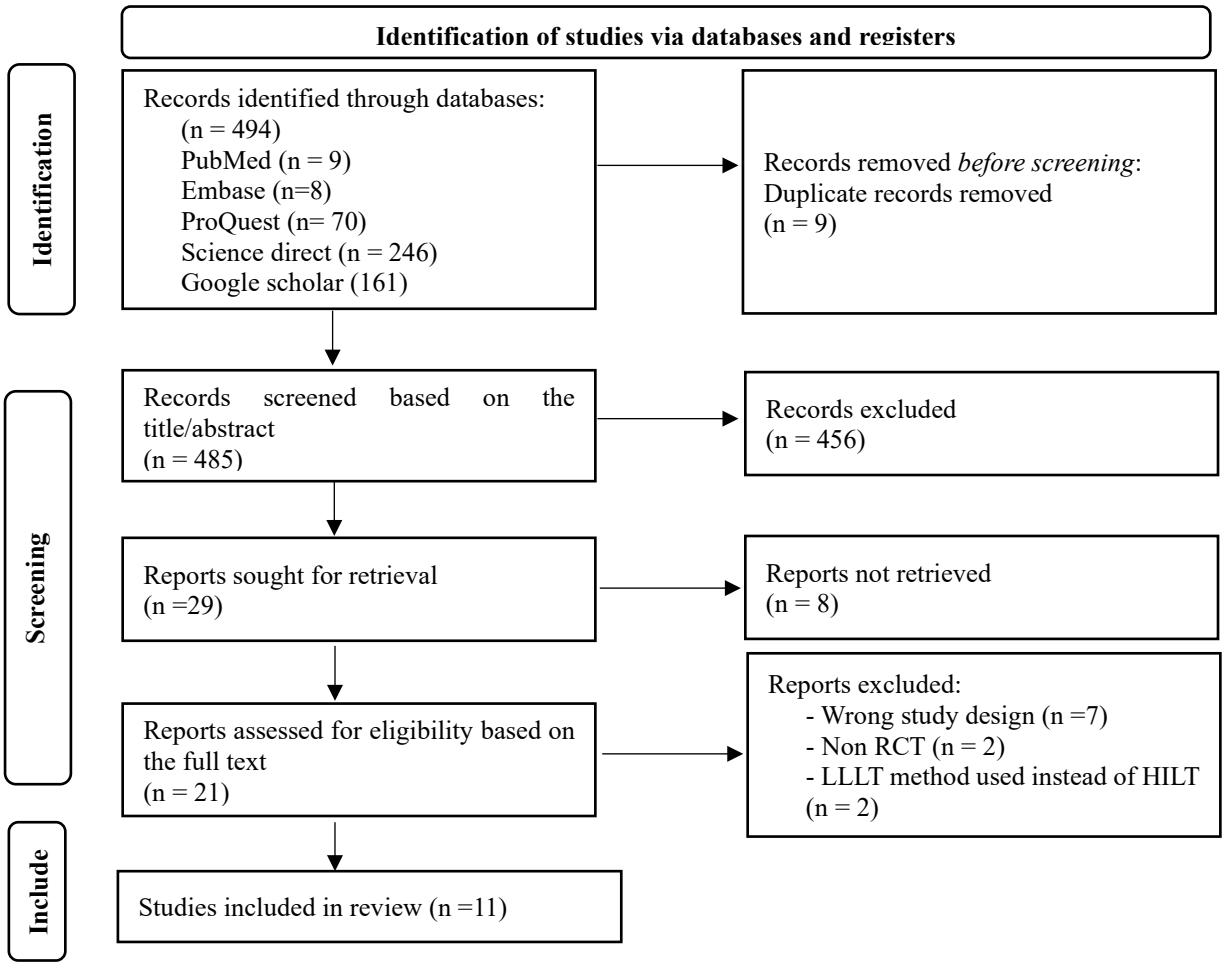

Fig. 2: Flow chart indicating the scrutiny research strategy following PRISMA guidelines

3.1 Quality Matrix

The trust matrix serves as a significant tool for indexing the strength of the cited literature, as ranked by authors Miles and Huberman (1994). By assessing the quality of evidence and considering the cumulative effects, the authors can address the research questions and provide informed recommendations. In our study, we identified 11 studies with high-quality evidence regarding the effectiveness of HILT therapies.

These studies were categorized by the authors to illustrate their relevance, attachment, authenticity, and alignment with the objectives set for this assessment, as shown in Table 2 below.

Table 2: Quality of evidence table for cited literature

Body part studies	***Citations***	***Effect of HILT***	***Scoring***	***Quality of evidence***
Elbow, shoulder	*Dundar et al., (2015); Akkurt et al., (2016); Chen et al., (2020); Notarnicola et al., (2023); Atan & Bahar, (2021); Beyrami et al., (2023); Ali et al., (2021)*	Significant	9/10	High
Hand	*Ahi & Sirzai, (2023)*	Significant	8.5/10	High
Foot	*Mardh & Lund, (2016)*	Significant	8.5/10	High
Knee	*Brandl et al., (2023)*	Significant	8.5/10	High
Lower gluteal	*Verma et al., (2022)*	Significant	8.5/10	High

4. Discussion

Laser therapy, which stands for light amplification by stimulated emission of radiation, has been recommended for treating a wide variety of conditions, such as wound healing, bone repair, spinal cord injury, tendinopathy, postoperative recovery, and peripheral nerve regeneration (Notarnicola et al., 2023).

Recent studies have shown that both low-energy and high-intensity laser therapy (HILT) are effective for clinical and functional recovery in various tendon pathologies; HILT, however, demonstrates superior results due to its greater ability to reach and stimulate deeper and wider areas (Notarnicola et al., 2023). The analgesic effect of HILT is based on multiple mechanisms, including its ability to slow the transmission of pain stimuli and increase the production of morphine-mimetic substances in the body (Dundar et al., 2015).

The pain-relieving effects of HILT lasers are related to delays in pain signal transmission along pain-related nerve fibers and to an increase in the release of enkephalins and endorphins.

Additionally, HILT directly affects nerve structures, accelerating nerve recovery and improving blood circulation, thereby aiding nerve repair (Beyrami et al., 2023). Tendinopathy is a complex pain condition often accompanied by swelling and is challenging to manage, as most patients seek rapid pain relief. Recently, laser therapies, including HILT, have been used in the treatment of tendinopathy. HILT therapies are widely recognized for their ability to provide quick pain relief without affecting surrounding tissues, using a precise and targeted approach to address pain points. Significant changes in blood flow have been observed following HILT treatments, exceeding minimal detectable changes, suggesting effects beyond simple vasodilation by enhancing the flow properties of erythrocytes and platelets. Consequently, HILT may be a valuable option for clinicians managing tendinopathy with impaired microcirculation and may help prevent sports-related tendon overload associated with reduced blood flow (Brandl et al., 2023).

On a larger scale, most studies reviewed affirm the effectiveness and reliability of HILT for managing pain in tendinopathy. Conditions such as tennis elbow, lateral epicondylitis, and shoulder stiffness respond well to HILT without negatively impacting surrounding tissues or overall physical health (Ali et al., 2021; Kaydok et al., 2020; Dundar et al., 2015). Other body areas, including the hand, knee, ankle, and hamstrings, have also shown positive responses to HILT in a variety of patients and athletes, as documented in the current literature (Ahi & Sirzai, 2023; Mardh & Lund, 2016). Korkmaz et al. (2021) also investigated the effects of HILT on hemiplegic shoulder pain, comparing multiple sessions of HILT combined with therapeutic exercises. The results showed positive changes in the VAS, BRS, PTRCT, SPADI, and other indicators, confirming the benefits of HILT when used alongside therapeutic exercise. Globally, HILT is used to manage pain in the shoulder, knee, elbow, and Achilles tendon. Its physiological effects inhibit pain through various chemical mechanisms at targeted pain points, leading to rapid recovery and pain relief. Nervous paralysis—natural repair of damaged nerve endings—also aids in pain reduction (Ebid et al., 2013).

Table 3: Summary of case studies included

Sr no.	Authors	Research design	Sample size	Age group (mean)	Laser power	Exposure rate	Body part focused	Follow-up (after)	Pain assessment parameters	Key takeaways
1	*Ahi & Sirzai, (2023)*	RCT	64	37.8±8.3 y	7 sessions (1064 nm -100 sec – 10 W – 250 J) + 8 sessions (1064 nm -30 sec – 6 W – 150 J)	3 sessions per week – 5 weeks	De Quervain tenosynovitis (DQT) (hand)	5 weeks	Hand grip strength levels were higher in the HILT group, and pain VAS levels were lower.	HILT is a non-invasive and reliable method that increases grip strength and decreases pain in DQT.
2	*Dundar et al., (2015)*	RCT	93	32.6±10.9 33.4±11.2 33.6±9.8 y	1064 nm -10.5 W -1275 J	Once a day for 15 days – 15 sessions	Lateral epicondylitis (elbow)	0, 4 and 12 weeks	Positive results of pain scores, disability scores, physical functioning scores, and general health.	HILT and splinting are effective physical therapy modalities for patients with LE in reducing pain and improving disability, quality of life, and grip strength.
3	*Chen et al., (2020)*	RCT	20	50.5±6.6 y	830 nm – 150 J	15-minute single session	Subacromial Impingement Syndrome (SAIS) (shoulder)	3 months	VAS, shoulder ROM, and CMS indicated significant improvements.	HILT can immediately reduce pain and disability and improve shoulder flexion ROM in patients with SAIS.
4	*Notarnicola et al., (2023)*	RCT	30	60.7±10.4 y 61.7±13.5 y	650/810/ 980/1064 nm	5 minutes session / 6 sessions in 3 weeks	Rotator cuff tendinopathy (shoulder)	1 and 6 months	Functional recovery, QDASH, and pain score VAS indicated better values.	The HILT proved to be an effective therapy for the treatment of rotator cuff tendinopathy.
5	*Verma et al., (2022)*	RCT	36	22.61±1.68 22.39±1.81 y	980/810 nm	6 minutes session/ 3 per week/ 3 weeks	Proximal hamstring tendinopathy	3 weeks	Declined pain scores and increased IPT in athletes.	HILT for 3 weeks was found to be effective in improving pain; no significant difference was found between HILT and conventional physiotherapy in improving the IPT of the hamstring muscle; further long-term studies are warranted

6	*Atan & Bahar, (2021)*	RCT	36	56.0±11.63 60.8±8.32 58.5±7.29 y	1064 nm -15 W max – 15 min per session	5 sessions per week – 3 weeks	Adhesive capsulitis (shoulder)	12 weeks	Significant improvements in SPADI, VAS-pain, ROM shoulder, and SF-36 values.	Fifteen sessions of HILT are superior to improve pain and quality of life but not superior in terms of disability or function in patients with adhesive capsulitis.
7	*Mardh & Lund, (2016)*	RCT	40	47.4±8.1 41±8.3 y	980 nm	6 sessions in 3-4 weeks	Achilles tendinosis	8 and 12 weeks	FAOS subscale and pain threshold compared.	HILT may provide a future option for treatment of Achilles tendinosis related pain, but further studies are warranted
8	*Brandl et al., (2023)*	RCT	21	22.1±4.3 y	800 J (100J/cm^2)	10 minutes session only	Patellar tendon (knee)	NA	BP and blood circulation improved.	HILT may be a useful therapeutic option for tendon pathologies with impaired microcirculation, but further high-quality studies are needed to validate these experimental results.
9	*Salli et al., (2016)*	RCT	65	46.5±8.1 y	4 sessions (75 sec – 4W – 6J/cm^2) + 6 sessions (12 min30sec – 6W – 100-150J/cm^2)	10 sessions in 2 weeks	Lateral epicondylitis (elbow)	6 weeks	Handgrip strength, pain VAS, quality of life and disability score compared.	Significant improvements in handgrip strength, pain, disability and quality of life parameters in HILT and LE bandage groups. HILT was more effective in resting VAS and SF-36 physical component subscale scores compared to LE bandage.
10	*Beyrami et al., (2023)*	RCT	32	46±8.53 39±8.68 y	808 nm	3 sessions per 4 weeks of 12 minutes each (12 sessions)	Rotator cuff tendinitis (shoulder)	NA	Pain score VAS, ROM, and disability index compared, and subacromial liquid were measured.	HILT combined with the routine physiotherapy improve the clinical (pain, ROM, function) as well as sonography findings including supraspinatus tendon thickness and accumulation of sub-acromial fluid in people with rotator cuff tendinitis.
11	*Ali et al., (2021)*	RCT	45 Male = 21 Female = 24	44.9±7.3 y	915/808 nm - 3.2 W – 5 min	12 sessions	Lateral epicondylitis (elbow)	0 weeks	Significant improvement in the VAS-pain, DASH and grip-strength.	Combined HILT and ultrasound therapy is potentially more effective in treating lateral epicondylitis.

HILT, high intensity laser treatments; RCT, randomized controlled trials; VAS, visual analog scale; QDASH, disabilities of arm, shoulder, and hand questionnaire; SF-36, special form 36; ROM, range of motion; CMS, constant-murley scale; IPT, isokinetic peak torque; SPADI, shoulder pain and disability index; FAOS, foot and ankle outcome score; BP, blood pressure

HILT has many clinical benefits, both as a standalone therapy and when combined with strength or range-of-motion (ROM) exercises (Fiore et al., 2013; Chow et al., 2011). Additionally, HILT's effectiveness depends on wavelength strength, dosage, and penetration depth at the pain site. Dosage profiles show that high-powered wavelengths penetrate more deeply and speed up pain relief (Nussbaum et al., 2007). Pellegrino et al. (2022) compared HILT and hyaluronic acid injections in nearly 80 patients, finding that combining these treatments effectively reduced pain short-term; however, the long-term effects of this approach need further investigation. A randomized trial by Akkurt et al. (2016) on elbow pain found that HILT significantly improved VAS, DASH, and HGST scores over a 6-month follow-up. SF-36 scores also showed significant improvements in mental and physical health, supporting HILT's effectiveness for both short- and long-term relief of lateral epicondylitis symptoms.

Tendinopathy may be triggered by various factors, including medication and biomedical issues (Miller et al., 2021). HILT is used to treat a range of muscular pain conditions in the knee, neck, and arms, particularly among athletes (Song et al., 2018; Kheshie et al., 2014). Santamato et al. (2009) found that HILT significantly reduced pain and improved ROM and hand-grip strength over 10 sessions. Similarly, Kim et al. (2015) reported both short- and long-term benefits of HILT, including improvements in ROM, VAS, and IR measures in patients treated three times weekly. Yilmaz et al. (2022) evaluated HILT combined with targeted exercises for rotator cuff pain and found that patients who also followed a physical therapy program experienced greater pain relief. Known for its photochemical and mechanical effects, HILT supports recovery by improving blood flow, vascular permeability, and metabolism (Angelova & Ilieva, 2016).

5. Conclusion

In conclusion, this focused study on high-intensity laser therapy (HILT) demonstrates its significant effectiveness in managing pain across various types of tendinopathy. Its physiological effects, including promoting blood flow and enhancing metabolism, make it a preferred option for both short-term and long-term recovery. Research on different body areas, such as the shoulder, elbow, knee, hamstrings, and foot, shows that HILT consistently improves pain scores, functionality, and quality of life. It has proven to be a reliable, non-invasive method for reducing pain, improving mobility, and supporting recovery in both acute and chronic conditions.

The main limitations of this study are the relatively small sample size and the lack of long-term follow-up data (beyond 3 months and up to 1 year). While HILT demonstrates both short-term and long-term benefits, further large-scale research is needed to fully understand its long-term effects and to optimize treatment protocols. Based on these studies, we recommend HILT as an effective therapy for a range of tendinopathies and tendinosis. Future studies with varied dosages, combinations of different wavelengths, larger participant samples, and extended follow-up periods are needed to provide more robust data.

Conflict of interests

The author declares no conflicts of interest.

6. References

Ahi, E. D., & Sirzai, H. (2023). Short-term effectiveness of high-intensity Laser therapy in de Quervain tenosynovitis: a prospective, randomized, controlled Study. Medeniyet medical journal, 38(1), 24. https://doi.org/10.4274%2FMMJ.galenos.2023.67279

Akkurt, E., Kucuksen, S., Yılmaz, H., Parlak, S., Sallı, A., & Karaca, G. (2016). Long-term effects of high-intensity laser therapy in lateral epicondylitis patients. Lasers in medical science, 31, 249-253. https://link.springer.com/article/10.1007/s10103-015-1841-3

Ali, E. M., Fekry, O., Obeya, H. E., Darweesh, H., & Moharram, A. (2021). Efficacy of high-intensity laser versus ultrasound therapy in the management of patients with lateral epicondylitis. The Egyptian Rheumatologist, 43(2), 119-123. https://doi.org/10.1016/j.ejr.2020.12.006

Angelova, A., & Ilieva, E. M. (2016). Effectiveness of high-intensity laser therapy for reduction of pain in knee osteoarthritis. Pain Research and Management, 2016. https://doi.org/10.1155/2016/9163618

Atan, T., & Bahar-Ozdemir, Y. (2021). Efficacy of high-intensity laser therapy in patients with adhesive capsulitis: a sham-controlled randomized controlled trial. Lasers in medical science, 36, 207-217.

Beyrami, M., Soltani, A., Eftekharsadat, B., Sarbakhsh, P., Habibi, M., & Oskouei, A. E. (2023). Effects of High-Power Laser Therapy on Clinical and Sonographic Findings in People with Chronic Rotator Cuff Tendinitis. Laser, 11, 12. https://journal.zums.ac.ir/article-1-7065-en.pdf

Brandl, A., Egner, C., Reisser, U., Lingenfelder, C., & Schleip, R. (2023). Influence of high-energy laser therapy to the patellar tendon on its ligamentous microcirculation: An experimental intervention study. PloS one, 18(3), e0275883. https://doi.org/10.1371/journal.pone.0275883

Chen, Y. W., Cheng, Y. Y., Lee, Y., & Chang, S. T. (2020). The immediate effect of high-intensity laser therapy on pain relief and shoulder function in patients with subacromial impingement syndrome. World J Phys Rehabil Med. 2020; 4 (1), 1016.

Chow, R., Armati, P., Laakso, E. L., Bjordal, J. M., & Baxter, G. D. (2011). Inhibitory effects of laser irradiation on peripheral mammalian nerves and relevance to analgesic effects: a systematic review. Photomedicine and laser surgery, 29(6), 365-381.

Dundar, U., Turkmen, U., Toktas, H., Ulasli, A. M., & Solak, O. (2015a). Effectiveness of high-intensity laser therapy and splinting in lateral epicondylitis; a prospective, randomized, controlled study. Lasers in medical science, 30, 1097-1107. https://link.springer.com/article/10.1007/s10103-015-1716-7

Ebid, A. A., El-Kafy, E. M. A., & Alayat, M. S. M. (2013). Effect of pulsed Nd: YAG laser in the treatment of neuropathic foot ulcers in children with spina bifida: a randomized controlled study. Photomedicine and laser surgery, 31(12), 565-570.

ElMeligie, M. M., Gbreel, M. I., Yehia, R. M., & Hanafy, A. F. (2023). Clinical efficacy of high-intensity laser therapy on lateral epicondylitis patients: a systematic review and meta-analysis. American Journal of Physical Medicine & Rehabilitation, 102(1), 64-70.

Elsodany, A. M., Alayat, M. S. M., Ali, M. M. E., & Khaprani, H. M. (2018). Long-term effect of pulsed Nd: YAG laser in the treatment of patients with rotator cuff tendinopathy: a randomized controlled trial. Photomedicine and laser surgery, 36(9), 506-513. https://doi.org/10.1089/pho.2018.4476

Eslamian, F., Shakouri, S.K., Ghojazadeh, M., Nobari, O.E., & Eftekharsadat, B. (2012). Effects of low-level laser therapy in combination with physiotherapy in the management of rotator cuff tendinitis. Lasers in Medical Science, 27, 951–958.

Evangelos, N. P. T., Anorthosis, P. T., Dimitrios, S., & Lamnisos, D. (2018). Treatment of chronic patellar tendinopathy using an exercise program consisting of eccentric training and static stretching exercises combined with high-intensity light therapy: a pilot study. MOJ Orthop Rheumatol, 10(2), 157-161.

Fiore, P., Panza, F., Cassatella, G., Russo, A., Frisardi, V., Solfrizzi, V., & Santamato, A. (2011). Short-term effects of high-intensity laser therapy versus ultrasound therapy in the treatment of low back pain: a randomized controlled trial. Eur J Phys Rehabil Med, 47(3), 367-73.

Haslerud, S., Magnussen, L. H., Joensen, J., Lopes-Martins, R. A. B., & Bjordal, J. M. (2015). The efficacy of Low-Level laser therapy for shoulder tendinopathy: a systematic review and Meta-Analysis of randomized controlled trials. Physiotherapy Research International, 20(2), 108-125. https://doi.org/10.1002/pri.1606

He, K., Zhou, X., Zheng, F., Ju, X., Fu, S. N., & Wong, A. Y. (2023). Histological, Physiological and Biomechanical Effects of Low-Level Laser Therapy on Tendon Healing in Animals and Humans: A Systematic Review. Annals of Biomedical Engineering, 51(12), 2659-2707. https://link.springer.com/article/10.1007/s10439-023-03364-1

Hopkins, C., Fu, S. C., Chua, E., Hu, X., Rolf, C., Mattila, V. M., ... & Chan, K. M. (2016). Critical review on the socio-economic impact of tendinopathy. Asia-Pacific journal of sports medicine, arthroscopy, rehabilitation and technology, 4, 9-20. https://doi.org/10.1016/j.asmart.2016.01.002

Kaydok, E., Ordahan, B., Solum, S., & Karahan, A. Y. (2020). Short-term efficacy comparison of high-intensity and low-intensity laser therapy in the treatment of lateral epicondylitis: a randomized double-blind clinical study. Archives of Rheumatology, 35(1), 60. https://doi.org/10.5606%2FArchRheumatol.2020.7347

Kheshie, A. R., Alayat, M. S. M., & Ali, M. M. E. (2014). High-intensity versus low-level laser therapy in the treatment of patients with knee osteoarthritis: a randomized controlled trial. Lasers in medical science, 29, 1371-1376. . https://doi.org/10.1007/s10103-014-1529-0

Kim, S. H., Kim, Y. H., Lee, H. R., & Choi, Y. E. (2015). Short-term effects of high-intensity laser therapy on frozen shoulder: a prospective randomized control study. Manual therapy, 20(6), 751-757. https://doi.org/10.1016/j.math.2015.02.009

Korkmaz, N., Gurcay, E., Demir, Y., Tezen, Ö., Korkmaz, İ., Atar, M. Ö., & Yaşar, E. (2022). The effectiveness of high-intensity laser therapy in the treatment of post-stroke patients with hemiplegic shoulder pain: a prospective randomized controlled study. Lasers in Medical Science, 37(1), 645-653. https://link.springer.com/article/10.1007/s10103-021-03316-y

Mårdh, A., & Lund, I. (2016). High-power Laser for treatment of Achilles tendinosis–a single-blind randomized placebo-controlled clinical study. Journal of lasers in medical sciences, 7(2), 92. https://doi.org/10.15171%2Fjlms.2016.16

Miles, M. B., & Huberman, A. M. (1994). Qualitative data analysis: An expanded sourcebook. sage.

Millar, N. L., Silbernagel, K. G., Thorborg, K., Kirwan, P. D., Galatz, L. M., Abrams, G. D., & Rodeo, S. A. (2021). Tendinopathy. Nature reviews Disease primers, 7(1), 1. https://www.nature.com/articles/s41572-020-00234-1

Monici, M., Cialdai, F., Fusi, F., Romano, G., & Pratesi, R. (2008). Effects of pulsed Nd: YAG laser at molecular and cellular level. A study based on Hilterapia. Energy Health, 3, 27-33.

Notarnicola, A., Covelli, I., Macchiarola, D., Bianchi, F. P., Cassano, G. D., & Moretti, B. (2023). The efficacy of temperature-controlled high-energy polymodal laser therapy in tendinopathy of the shoulder. Journal of Clinical Medicine, 12(7), 2583. https://doi.org/10.3390/jcm12072583

Nussbaum, E. L., Van Zuylen, J., & Jing, F. (2007). Transmission of light through human skin folds during phototherapy: effects of physical characteristics, irradiation wavelength, and skin-diode coupling. Physiotherapy Canada, 59(3), 194-207.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. Bmj, 372. https://doi.org/10.1136/bmj.n71

Pellegrino, R., Paolucci, T., Brindisino, F., Mondardini, P., Di Iorio, A., Moretti, A., & Iolascon, G. (2022). Effectiveness of high-intensity laser therapy plus ultrasound-guided peritendinous hyaluronic acid compared to therapeutic exercise for patients with lateral elbow tendinopathy. Journal of Clinical Medicine, 11(19), 5492. https://doi.org/10.3390/jcm11195492

Riel, H., Lindstrøm, C. F., Rathleff, M. S., Jensen, M. B., & Olesen, J. L. (2019). Prevalence and incidence rate of lower-extremity tendinopathies in a Danish general practice: a registry-based study. BMC musculoskeletal disorders, 20, 1-6. https://link.springer.com/article/10.1186/s12891-019-2629-6

Riley, G. (2008). Tendinopathy—from basic science to treatment. Nature Clinical Practice Rheumatology, 4(2), 82-89. https://www.nature.com/articles/ncprheum0700

Salli, A., Akkurt, E., Izki, A. A., Zafer, Ş. E. N., & Yilmaz, H. (2016). Comparison of high-intensity laser and epicondylitis bandage in the treatment of lateral epicondylitis. Archives of rheumatology, 31(3), 234. https://doi.org/10.5606%2FArchRheumatol.2016.5793

Santamato, A., Solfrizzi, V., Panza, F., Tondi, G., Frisardi, V., Leggin, B. G., ... & Fiore, P. (2009). Short-term effects of high-intensity laser therapy versus ultrasound therapy in the treatment of people with subacromial impingement syndrome: a randomized clinical trial. Physical therapy, 89(7), 643-652. https://doi.org/10.2522/ptj.20080139

Song, H. J., Seo, H. J., Lee, Y., & Kim, S. K. (2018). Effectiveness of high-intensity laser therapy in the treatment of musculoskeletal disorders: A systematic review and meta-analysis of randomized controlled trials. Medicine, 97(51), e13126.

Verma, S., Esht, V., Chahal, A., Kapoor, G., Sharma, S., Alghadir, A. H., ... & Shaphe, M. A. (2022). Effectiveness of high-power laser therapy on pain and isokinetic peak torque in athletes with proximal hamstring tendinopathy: a randomized trial. BioMed Research International, 2022. https://doi.org/10.1155/2022/4133883

Yılmaz, M., Eroglu, S., Dundar, U., & Toktas, H. (2022). The effectiveness of high-intensity laser therapy on pain, range of motion, functional capacity, quality of life, and muscle strength in subacromial impingement syndrome: a 3-month follow-up, double-blinded, randomized, placebo-controlled trial. Lasers in Medical Science, 37(1), 241-250. https://link.springer.com/article/10.1007/s10103-020-03224-7