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Effectiveness of high-intensity laser therapy in patients with plantar fasciitis: A systematic review with meta-analysis of randomized clinical trials

Hernán Andrés de la Barra Ortiz[A,C-F*], Faviola Jélvez[B-D,F], Diego Parraguez[B-C,E-F], Florencia Pérez[B-C,E-F], Catalina Vargas[B,D-F]

Exercise and Rehabilitation Sciences Institute, School of Physical Therapy, Faculty of Rehabilitation Sciences, Universidad Andres Bello, Santiago, Chile

***Corresponding author**: Hernán Andrés de la Barra Ortiz; Exercise and Rehabilitation Sciences Institute, School of Physical Therapy, Faculty of Rehabilitation Sciences, Universidad Andres Bello, Santiago, Chile; email: handresdelabarra@yahoo.es

Abstract

Plantar fasciitis (PF) is a plantar pain condition that often leads to discomfort that hinders both work and daily activities. High-intensity laser therapy (HILT) is a promising technology for managing pain in PF. Consequently, the purpose of this study was to assess the effects of HILT on patients with PF. A search was carried out in PubMed, Web of Science, Scopus, CINAHL, Science Direct, and PEDro databases (last update: July 23, 2023) with the aim of identifying clinical trials that compared HILT with other treatments in patients with PF. The primary outcomes of the study encompassed pain intensity and functionality assessed through various scales and measurements. Nine studies met the selection criteria, and a meta-analysis was conducted to consolidate the findings from visual analog scale (VAS) and Foot and Ankle Outcome Score (FAOS). The study quality was assessed using the Cochrane risk of bias (RoB) tool, and the Grading of Recommendations, Assessment, Development, and Evaluation approach was applied for evidence recommendations. The included studies showed a low RoB, with the blinding of assessors being the highest risk. Each randomized controlled trial reported analgesia (VAS) and an improvement in function (FAOS) for HILT. However, the meta-analysis demonstrated a statistically significant effect in mean differences for pain in first steps (MD = –1.27 cm, 95% CI: –1.87, –0.67), pain at rest HILT versus low-level laser therapy (LLLT) (MD = –2.76 cm, 95% CI: –3.51, –2.00), and quality of life (MD = 14.42%, 95% CI: 9. 43, 19.4), results consistent with the minimal clinically important difference.

The findings suggest that HILT significantly reduces pain in the first steps and has an impact on the quality of life of PF patients, with effects lasting for at least 3 months.

Keywords: high-intensity laser therapy, laser therapy, phototherapy, plantar fasciitis

Introduction

Foot musculoskeletal disorders have a high prevalence, affecting between 61% and 79% of the population [1,2]. Plantar fasciitis (PF) is a foot complaint considered one of the main causes of chronic pain in adults and is regarded, in many cases, as a degenerative condition rather than inflammatory [3]. Its prevalence is between 11 and 15% in the population, equally affecting young and active people or older and sedentary individuals, although it is more common between 40 and 60 years [4]. In addition, 38% of patients with PF

present with calcaneal spurs produced by avulsions due to greater tension in the fascia [1,5].

PF produces persistent heel pain at its proximal insertion point, with or without inflammation [4]. In most patients, the pain causes functional limitations and limits their ability to perform activities that involve lower extremity loading [6]. PF is classified as acute or chronic based on the duration of symptoms, proximal or distal based on its location, or whether it presents calcifications on radiographs [1].

PF risk factors include being female, wearing inappropriate footwear, being overweight, work or sports activities that involve repeated load, and the presence of flat or cavus feet, as well as medical conditions such as diabetes, ankylosing spondylitis, or tarsal tunnel syndrome [1,4]. PF has a generally favorable course, with a recovery of 60–80% of patients in 12–24 months from diagnosis [2].

Medical treatment is conservative and includes the use of anti-inflammatory drugs, shoe orthotics, and physical therapy. In chronic cases, corticosteroids or Botox injections into the calf muscles may be used to reduce tension in the fascia [7]. Physical therapy has been shown to be effective in PF through stretching exercises, therapeutic ultrasound (US), extracorporeal shock waves (ECSWT), and manual therapy, interventions that have been proposed to speed recovery and reduce pain [8–10].

Low-level laser therapy (LLLT) is a non-invasive resource used for pain relief [11]. Laser uses concentrated electromagnetic radiation in the red or infrared spectrum to promote or inhibit cell activity (photobiomodulation) [11,12]. LLLT does not produce thermal effects due to its low power, and its analgesic effects have been associated with an inflammation reduction, the release of β-endorphins, and lower nociceptive transmission [11]. These have supported laser therapy in different musculoskeletal disorders, including PF, proving to be effective in reducing pain and being recommended as part of the treatment [13,14].

Moreover, high-intensity laser therapy (HILT) is a relatively recent resource that has shown benefits in a variety of musculoskeletal disorders [15–17]. HILT has the same analgesic as LLLT, although one difference is that it uses longer wavelengths (commonly 1.064 nm), allowing greater depths [15,17]. Furthermore, with a high-power output, it can rapidly deliver energy, enabling the treatment of large areas in a shorter time. In turn, HILT can generate heating, making it a deep thermotherapy agent [17].

HILT is increasingly being considered for musculoskeletal pain, but its effects and evidence in PF are still unknown, in contrast to what has been reported for LLLT. In addition, randomized controlled trials (RCTs) in this field appear to be limited. Consequently, the purpose of this systematic review (SR) was to assess the analgesic effects of HILT in patients with PF.

Materials and methods

Design

This SR was conducted following the guidelines established by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) [18]. The SR was registered in the International Prospective Registry of Systematic Reviews (PROSPERO, registration number CRD42023388376) [19].

The research question followed the PICO (population, intervention, comparison, and outcome) approach. The population comprised patients diagnosed with PF, treated with HILT, and compared with those who received other physical therapy interventions, with or without placebo HILT. The main outcome was pain reduction using recognized instruments such as the visual analog scale (VAS), numerical scale (NPRS), or other validated scales. In addition, relevant secondary outcomes were considered, such as functionality assessment using widely accepted scales such as the Foot and Ankle Outcome Score (FAOS) or Foot Function Index (FFI).

Search

An electronic search for randomized clinical trials (RCTs) evaluating HILT in FP was performed. Recognized databases were utilized and included PubMed, Web of Science (WoS), Scopus, CINAHL, Science Direct, and the Physiotherapy Evidence-Based Database (PEDro) (last update: July 23, 2023).

Searching was performed using a set of keywords selected from the Medical Subject Headings (MeSH) dictionary. Keywords included *“lasers”, “laser therapy”, “phototherapy”, “high-intensity laser therapy”, “class IV laser”, “musculoskeletal pain”, “fasciitis”, “fasciitis, plantar”, “foot Diseases” and “heel Spur”*. These terms were combined using the boolean connectors “OR” and “AND” to obtain the search algorithm: (((((“Lasers”) OR (“Laser Therapy”)) OR (“Phototherapy”)) OR (“High Intensity Laser Therapy”)) OR (“Class IV laser”)) AND (((((“Musculoskeletal Pain”) OR (“Fasciitis”)) OR (“Fasciitis, Plantar”)) OR (“Foot Diseases”)) OR (“Heel Spur”)). In addition, the “clinical Trial” and “randomized controlled trial” filters were applied to ensure the inclusion of RCTs in the search.

The analysis of the titles and abstracts downloaded from each of the databases was carried out by three independent researchers (FJR-DPQ-FPM). To expedite this process, the Rayyan web tool was used [20], which

facilitated an accurate assessment based on predefined selection criteria.

This review considered as inclusion criteria: a) human RCTs with PF diagnosis; b) treatment with HILT as either the sole intervention or in combination with other therapies; c) comparison with other physical therapy treatments or HILT placebo; d) the main outcome was centered on pain intensity changes. Literature reviews and other SRs on HILT, other foot musculoskeletal or neurological conditions, and studies with incomplete or unavailable texts were excluded.

Risk of bias

The Cochrane Collaboration risk of bias (RoB) tool was used to determine bias in the studies that were included [21]. Studies that had two or more high risks of bias were of low quality. The kappa statistic was used to assess the agreement in the assessment of bias between the researchers [22].

Statistical analysis

The Review Manager software (RevMan) 5.4 was used for statistical analysis [23]. Heterogeneity between studies was assessed using the I^2 statistic in the categories negligible, moderate, substantial, or considerable [24]. The Mantel-Haenszel fixed-effects method was used to calculate the pooled mean difference for the interesting outcomes, with a 95% confidence interval.

Quality of evidence

The assessment of evidence quality was conducted through the utilization of the GRADE approach (Grading of Recommendations, Assessment, Development, and Evaluation) [25]. To provide a comprehensive summary of evidence concerning HILT in relation to PF, researchers employed the GRADEpro GDT tool for the purpose of guideline development (www.gradepro.org).

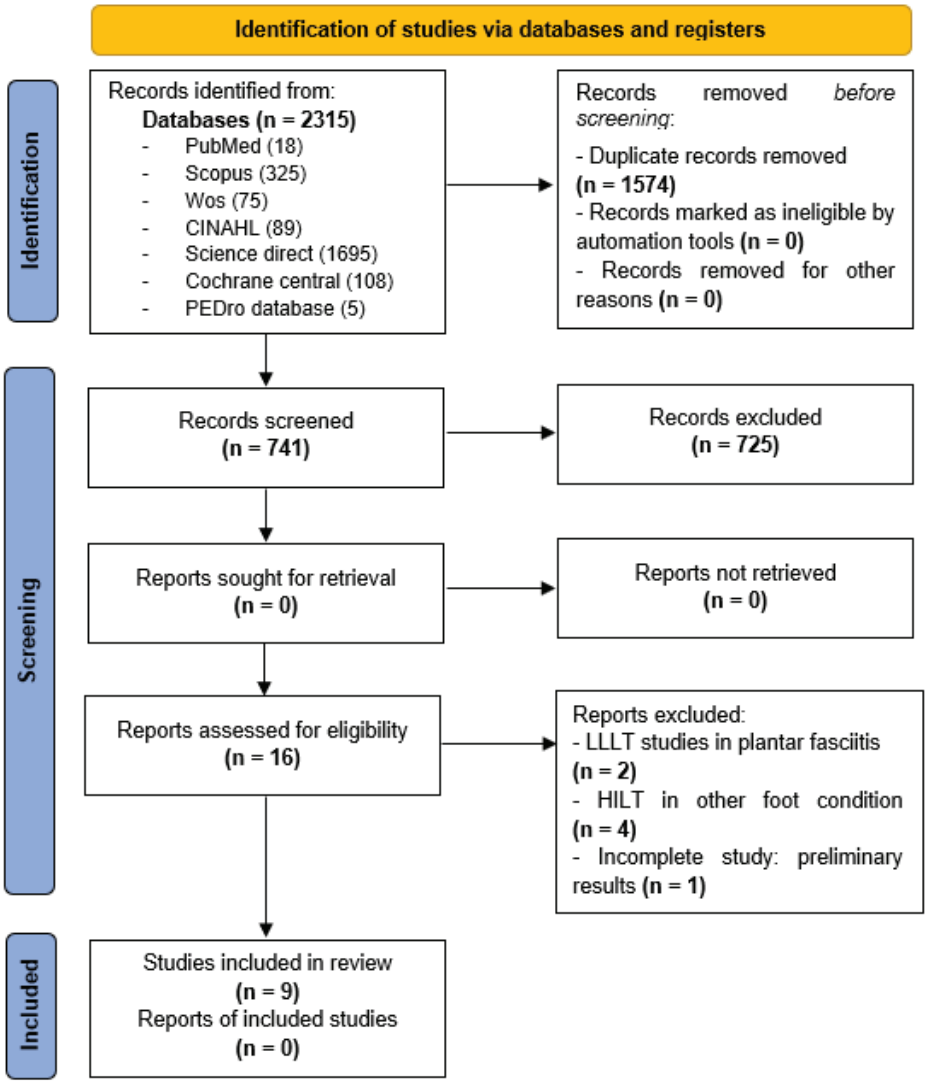

Fig. 1. PRISMA flow chart diagram

Results

Search results

The initial search in the electronic databases yielded a preliminary list of 2.315 articles (PubMed = 18; Scopus = 325; WoS = 75; CINAHL = 89; Science Direct = 1.695; Cochrane Central = 108; and PEDro = 5). After eliminating duplicate articles, 741 documents were obtained for analysis. Initially, 16 articles were chosen, but seven were excluded due to their relevance to other foot conditions (plantar ulcer and Achilles tendinopathy), research on LLLT in PF, and an incomplete study. This left nine articles for analysis [26–34]. Figure 1 depicts the flowchart with the search strategy.

Figure 2 presents the RoB assessment conducted by three investigators (HDB, FJR, CVI) for the studies encompassed within the analysis [26–33]. The analysis revealed commendable inter-rater agreement in evaluating bias (kappa 0.82) [22]. Elevated RoB levels were predominantly discerned in the context of randomization sequence (22.2%), concealed allocation (22.2%), and assessor blinding (55.6%). Conversely, the criteria of selective reporting and incomplete data demonstrated the least susceptibility to RoB.

Study characteristics

Table 1 provides a comprehensive overview of the key attributes of the selected RCTs. Pertinent information encompassing study groups, participant selection criteria, interventions administered, assessments, and main outcomes is elucidated. These RCTs were conducted across diverse geographical locations, such as Lithuania, Turkey, Malaysia, Poland and Pakistan, spanning the period from 2019 to 2023. Overall, a total of 447 participants diagnosed with PF were enrolled, demonstrating an average age of 50.7 years (SD ± 10.6). Among these participants were 274 women, 128 men, and one study that did not provide specifications regarding sex. A total of 237 patients underwent

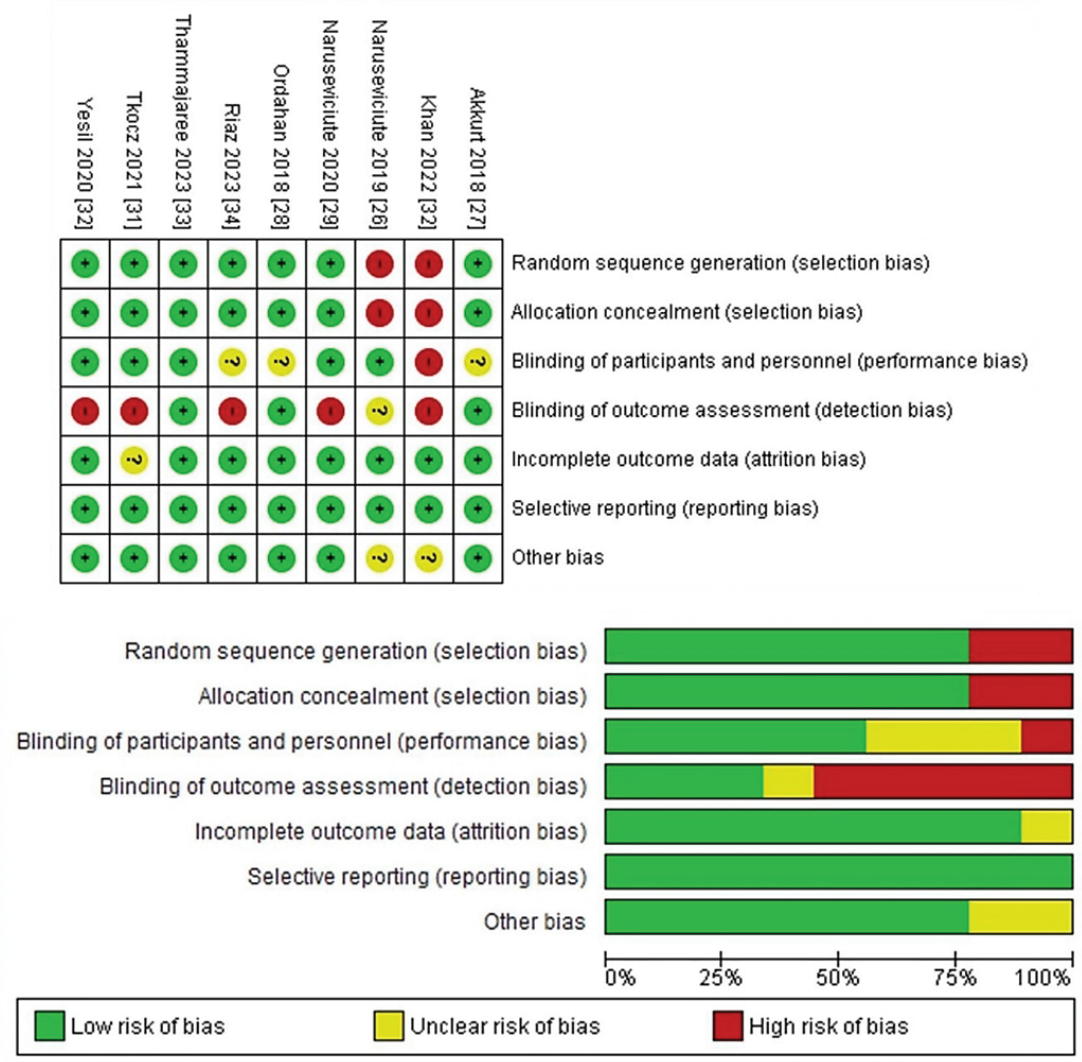

Fig. 2. Risk of bias summary: review author´s judgements about each risk of bias item for each included study

Tab. 1. Characteristics of included studies

Nº	Author Year Country	Study	PEDro score	Participants (n) Mean age (x ± SD)	Inclusion criteria	Exclusion criteria	Interventions	HILT parameters	Sessions	Outcomes	Assessments
1	Naruseviciute 2019 [26] Lithuanian	Pilot study: the effect of high intensity laser therapy in treatment of patients with plantar fasciitis	4/10	N = 22 EG = 22 (18♀;4♂) 55.7 ± 10.9	– Age ≥18 – Plantar pain – Pain at least of 4 months	– Pregnancy/lactation – Fever – NSAIDs – Photosensitive drugs – Other painless regions – Concomitant pathologies – Rheumatoid diseases – Sensory alterations	EG: HILT CG: NA	– Wavelength: 1.064nm (Nd: YAG) – OP: 12W – Dose: continuos, 7W, 120J/cm^2 – Application: scan (spacer 10 mm) – Time: 7min – Area: 25cm^2	6s (3 weeks)	– PI (VAS) – PPT (ALG) – ROM (GNM) – Fascia thicknees (USG)	T0 = baseline T1 = 3 weeks (post-treatment)
2	Akkurt 2018 [27] Turkey	Efficacy of high-intensity laser therapy and silicone insole in plantar fasciitis	8/10	N = 52 EG = 25 (23♀;2♂) CG = 27 (23♀;4♂) 46.4 ± 7.1	– Age ≥18 – Unilateral plantar pain – Morning pain (VAS ≥ 4 cm)	– Surgeries – Foot deformity – Acute heel trauma – Corticosteroid injections – ECSWT treatments – Rheumatoid disease – Radicular or neuropathic pain – Local infections – Coagulation disorders – Pregnancy	EG: HILT + insole CG: insole	– Wavelength: 1.064 nm (Nd: YAG) – OP: 3.000W – Dose: pulsed, 510–710J/cm^2, 3.000J – Application: scan – Time: 15 a 20 min – Area: 25cm^2	10s (4 weeks)	– PI (VAS) – Heel sensivity (HTI) – PI (FAOS) – Symptoms (FAOS) – Disability-DLA (FAOS) – Sports and recreation (FAOS) – QoL (FAOS)	T0 = baseline T1 = 4 weeks (post-treatment)
3	Ordahan 2018 [28] Turkey	The effect of high-intensity versus low-level laser therapy in the management of plantar fasciitis: a randomized clinical trial	8/10	N = 70 EG = 35 (28♀;7♂) CG = 35 (27♀;8♂) 48.7 ± 11.1	– Heel pain at least 6 months – Pain on palpation – Failure in conventional treatment – Pain worsens in the first few steps – Pain increased with activities	– Corticosteroid injection – Rheumatic diseases – History of foot or lumbar spine surgery	EG: HILT + insole + SE CG: LLLT + insole + SE	– Wavelength: 1.064 nm (Nd: YAG) – OP: 12 W – Dose: continuous, 8 W, 6 J/cm^2, 150 J (session 1–3); continuous, 6 W, 120–150 J/cm^2 (session 4–10) – Application: scan – Time: 75 sec (sesión 1–3); 30 sec (session 4–10) – Area: NS	9s (3 weeks)	– PI (VAS) – Heel sensivity (HTI) – PI (FAOS) – Symtoms (FAOS) – Disability-DLA (FAOS) – Sports and recreation (FAOS) – QoL (FAOS)	T0 = baseline T1 = 3 weeks (post-treatment)

Nº	Author Year Country	Study	PEDro score	Participants (n) Mean age (x ± SD)	Inclusion criteria	Exclusion criteria	Interventions	HILT parameters	Sessions	Outcomes	Assessments
4	Naruseviciute 2020 [29] Lithuanian	The effect of high-intensity versus low-level laser therapy in the management of plantar fasciitis: randomized participant blind controlled trial	8/10	N = 102 EG = 51 (43♀;8♂) CG = 51 (13♀;38♂) 56.2±10.6	– Age ≥ 18 – Unilateral pain in the first steps – Plantar sensitivity	– Laser pretreatment – Other foot pathologies – Recent foot surgery or trauma – Wounds or infections – Altered sensitivity – Implants – Changes in skin pigmentation – Corticosteroid injection – Rheumatoid diseases – Plantar pain of neurological origin – Fever – Malignancy – Pregnancy	EG: HILT + SE + criotherapy + insole CG: LLLT + SE + criotherapy + insole	– Wavelength: 1.064nm (Nd: YAG) – OP: 12W – Dose: Phase 1 = continuous, 7 W, 120 J/cm^2, 840 J. Phase 2: continuous, 7 W, 120 J/cm^2, 2160 J – Application: slow scan (phase 1), fast scan (phase 2) – Time: 428 sec – Area: 25cm^2	8s (3 weeks)	– Pain intensity (VAS) – Pain at movement (VAS) – PPT (ALG) – Fascia thicknees (USG)	T0 = baseline T1 = 3 weeks (post-treatment) T2 = 3-4 weeks (follow-up)
5	Yesil 2020 [30] Turkey	The effect of high intensity laser therapy in the management of painful calcaneal spur: a double blind, placebo-controlled study	7/10	N = 42 EG = 21 (18♀;3♂) CG = 21 (18♀;3♂) 45.7 ± 10.8	– Pain at least of 1 month – Pain on palpation – Calcaneal spur (X-ray)	– Abnormal complete blood count – Corticosteroid injections – Concomitant pathology – Pregnancy – Malignancy – PF treatments in the last months – Treatment with HILT	EG: HILT + SE CG: Sham HILT + SE	– Wavelength: 1.064 nm (Nd: YAG) – OP: 3.000 W – Dose: Phase 1 = pulsed, 970–1170 mJ/cm^2, 624 J; Phase 2 = pulsed, 360–610 mJ/cm^2, 25.3 J; Phase 3 = pulsed, 970–1170 mJ/cm^2, 624 J – Application: Phase 1 (fast scan); Phase 2 (punctual); Phase 3 (slow scan) – Time: 10min – Area: 100cm^2	15s (3 weeks)	– PI (VAS) – PI (FAOS) – Symtoms (FAOS) – Disability-ALD (FAOS) – Sports and recreation (FAOS) – QoL (FAOS) – QoL (SF-36) – Plantar pressure (Pedograph)	T0 = baseline T1 = 4 weeks (post-treatment) T2 = 12 weeks (follow-up)
6	Tkocz 2021 [31] Poland	A randomised-controlled clinical study examining the effect of high-intensity laser therapy on the management of painful calcaneal spur with plantar fasciitis	7/10	N = 60 EG = 30 (19♀;11♂) CG = 30 (17♀;13♂) 60.2 ± 11.0	– Age ≥18 – PF older than 6 months – Persistent plantar pain – Calcaneal spur (X-ray)	– Malignancy – Pregnancy – Pacemaker – Skin diseases – Other foot conditions – Mental and sensory disorders	EG: HILT + US CG: Sham HILT + US	– Wavelength: 1.064 nm (Nd: YAG) – OP: 15 W – Dose: 7 W, pulsed, 149.9 J/cm^2, 4496 J – Application: punctual – Time: 12min – Area: 100cm^2	15s (3 weeks)	– PI (VAS) – PI (LPS)	T0 = baseline T1 = 3 weeks (post-treatment) T2 = 1 week (follow-up) T3 = 12 weeks (follow-up)

Nº	Author Year Country	Study	PEDro score	Participants (n) Mean age (x ± SD)	Inclusion criteria	Exclusion criteria	Interventions	HILT parameters	Sessions	Outcomes	Assessments
7	Khan 2022 [32] Malaysia	Effectiveness of high intensity Hilthera 4.0 laser treatment on patients with plantar fasciitis+	4/10	N = 22 EG = 22 (11♀;11♂) 45.4 ± 12.8	– Diagnosis of unilateral or bilateral PF – 20-70 years – Acute PF	– Lower limb injuries – Foot deformity – Diabetes	EG: HILT CG: NA	– Wavelength: 1.064 nm (Nd: YAG) – OPr: 3.000 W – Dose: 3.000 W, pulsed (1-100Hz) and 500 J – Application: NS – Time: 15min – Area: NS	8s (4 weeks)	– PI (VAS) – Disability (FFI)	T0 = baseline T1 = 4 weeks (post-treatment)
8	Thammajaree 2023 [33] Thailand	Effects of radial extracorporeal shockwave therapy versus high intensity laser therapy in individuals with plantar fasciitis: A randomized clinical trial	9/9	N = 32 EG = 16 (8♀;8♂) CG=16 (8♀;8♂) 47.1 ± 10.2	– Age ≥18 – Unilateral foot pain – Pain at medial calcaneal tuberosity (VAS ≥ 2) – Pain at the first step in the morning (VAS ≥ 2)	– Other musculoskeletal disorders – Prior surgery – Metallic implants – Acute PF or severe pain (VAS = 10) – Unable to bear weight (Ottawa's rule) – NSAIDs – Malignancy – Autoimmune or vascular disease – Diabetes – Pregnancy – Local Tattoos – Nerve or neurologic impairments – BMI ≥ 29	EG: HILT CG: ECSWT	– Wavelength: 1.064 nm (Nd: YAG) – OP: 6 W – Dose: Phase 1 = pulsed, 5 J/cm2,, 60J; Phase 2 = pulsed, 5 J/cm2, 30J; Phase 3 = pulsed, 5J/cm2, 60J – Application: Phase 1 (fast scan); Phase 2 (punctual); Phase 3 (slow scan) – Time: 15min – Area: 12cm2	6s (3 weeks)	– PI (VAS) – Pressure pain (VAS) – Skin blood flow and temperature (LDF) – Fascia thicknees (USG) – Disability (FFI)	T0 = baseline T1 = end of the first session T2 = 1 week T3 = 2 weeks T4 = 3 weeks (post-treatment)
9	Riaz 2023 [34] Pakistan	Comparison of Extracorporeal Shockwave and High-Intensity Laser in Treating Chronic Plantar Fasciitis– A single-blinded Randomized controlled trial	7/10	N = 45 EG = 15 (NS) CG1 = 15 (NS) CG2 = (NS) 38.37 ± 11.9	– Chronic PF diagnosis – Age ≥ 18 – Pain at the first step (VAS ≥ 2)	– PF surgery – Pregnancy – Pacemaker – Bleeding disorder – Malignancy – Calcaneus stress fracture	EG: HILT + HE CG: ECSWT + HE CG2: HE	– Wavelength: 980nm (Nd: YAG) – OP: 30W – Dose: 10.000J – Application: slow scan – Time: NS – Area: NS	9s (3 weeks)	– PI (VAS) – Disability (FFI)	T0 = baseline T1 = 3 weeks (post-treatment) T2 = 12 weeks (follow-up)

ALG – algometry, CG – control group, DLA – daily living activities, ECSWT – extracorporeal shockwave therapy, EG – experimental group, FAOS – foot and ankle outcome score, FFI – foot function index, GNM – goniometry, HILT – high-intensity laser therapy, HTI – heel tenderness index, J – joules, LLLT – low-level laser therapy, LDF – Laser Doppler flowmetry, LPS – Laitinen pain scale, MRS – roles and Maudsley, Nd: YAG – neodymium-doped yttrium aluminum garnet, NS – not specified, NSAIDs – non-steroidal anti-inflammatory drugs, OP – Output power, PI – pain intensity, PF – plantar fasciitis, PPT – press pressure threshold, QoL – quality of life, SE – stretching exercise, SF36 – the Short Form 36 Health Survey Questionnaire, HE – home exercise, US – therapeutic ultrasound, USG – ultrasonographic, VAS – visual analogue scale, W – watts.

HILT, while 210 controls (CGs) received conventional physical therapy. In the experimental group (EGs), 60 patients received only HILT [26,32,33], while 177 participants received HILT in combination with insoles [27–29], stretching exercises [28–30,34], therapeutic ultrasound (US) [31] or cryotherapy [29]. In CGs, LLLT [28,29], insole [27–29], US [31] and ECSWT [33,34] were used. In addition, two studies applied the HILT placebo [30,31].

HILT treatments were administered to the plantar surface, predominantly utilizing the scan technique with a 30-mm-diameter spacer [26–30]. In two studies, the punctual technique was employed [31,33], whereas in one study, the application method was not specified [32]. Neodymium-doped yttrium-aluminum-garnet (Nd:YAG) lasers with a wavelength of 1.064 nm were employed, featuring maximum powers of 3.000W and 7W in a pulsed emission mode, with an average power of 7W, and energy delivery spanning from 500 to 4496J. Additional HILT parameters, encompassing pulse frequencies (Hz), energy density (J/cm^2) and treatment time, are outlined in Tab 1. Notably, treatment sessions ranged from six to fifteen, conducted over intervals of 3 to 4 weeks.

Outcomes

All investigations assessed pain intensity during rest, the first steps, and/or movement. The primary instruments utilized for this purpose were the VAS or FAOS [27–30]. Additional measured variables encompassed pain pressure threshold [26,29], range of motion [26], and disability assessment using either FAOS [27,28,30] or the foot function index (FFI) [32,33]. In addition, some studies considered changes in PF thickness using ultrasonography [26,29,33], quality of life (QoL) measured by the SF-36 questionnaire [30], and plantar contacts using podography [30]. All studies conducted assessments before and after treatment, and three of them conducted follow-up sessions between four and twelve weeks after treatment.

Table 2 summarizes the interesting outcomes of the RCTs that were included. Pain reduction was observed for each study in all groups ($p < 0.05$), both in the HILT-treated group and in the CGs, during the assessments [26,26–31,33]. However, at the end of the treatment and follow-up, greater analgesia was observed for the HILT groups. Disability shows statistically significant changes in both groups before and after treatment ($p < 0.05$), but the results were contradictory when it came to determining whether HILT was more effective than other physical therapy interventions [27,28,30,33]. Improvements were found in PF thickness [26,29,33] and in QoL in the EGs ($p<0.05$) [30], highlighting greater effectiveness for HILT.

Tab. 2. Results and statistical comparisons for the interesting outcomes for the HILT and control groups

Study	Outcome	HILT					CG					
		T0: baseline (mean ± SD)	T1: post-treatment (mean ± SD)	T2: follow-up (mean ± SD)	p-value T0-T1	p-value T0-T2	T0: baseline (mean ± SD)	T1: post-treatment (mean ± SD)	T2: follow-up (mean ± SD)	p-value T0-T1	p-value T0-T2	p-value Intergroup post-treatment
Naruseviciute 2019 [26]	Pain at rest (VAS-cm)	2.49 ± 2.8	1.38 ± 2.1		0.191							
	Pain first steps (VAS-cm)	7.60 ± 2.9	4.44 ± 3.2		0.004*							
	Pain after walking (VAS-cm)	4.99 ± 2.4	2.94 ± 1.8		0.001*							
	Pain when sitting for a long time (VAS-cm)	6.07 ± 3.1	2.86 ± 2.2		0.002*							
	Pain on long walks (VAS-cm)	7.83 ± 2.4	5.14 ± 3.2		0.011*							
	PPT (ALG-kg/cm2)	4.76 ± 3.6	2.20 ± 2.1	/	0.006*	/	Without CG					NA
	Plantarflexion ROM (GNM-grades)	41.6 ± 15.5	46.4 ± 9.8	/	0.04*							
	Dorsiflexion ROM (GNM-grades)	16.6 ± 11.1	20.2 ± 11.8		0.03*							
	1st metatarsophalangeal extension ROM (GNM-grades)	38.3 ± 8.5	41.3 ± 8.2		0.012*							
	1st metatarsophalangeal flexion ROM (GNM-grades)	31.7 ± 15.8	38.3 ± 13.5		0.001*							
	Fascia Thickness (USG-mm)	1.84 ± 1.0	1.32 ± 0.9		0.004*							

Study	Outcome	HILT					CG					
		T0: baseline (mean ± SD)	T1: post-treatment (mean ± SD)	T2: follow-up (mean ± SD)	p-value T0-T1	p-value T0-T2	T0: baseline (mean ± SD)	T1: post-treatment (mean ± SD)	T2: follow-up (mean ± SD)	p-value T0-T1	p-value T0-T2	p-value Intergroup post-treatment
Akkurt 2018 [27]	Pain first steps (VAS-cm)	5.76 ± 2.4	1.56 ± 1.0	/	< 0.001*	/	5.59 ± 1.8	3.29 ± 1.7	/	<0.001*	/	<0.001*
	Pain after walking (VAS-cm)	7.52 ± 1.9	3.44 ± 1.3				7.48 ± 1.2	4.62 ± 1.7				0.01*
	Pain when sitting for a long time (VAS-cm)	8.64 ± 0.9	4.36 ± 1.6				8.59 ± 0.5	5.48 ± 1.8				0.008*
	Heel sensivity (HTI-score)	2.08 ± 0.8	0.88 ± 0.5				2.22 ± 1.0	1.37 ± 1.0				0.014*
	Pain intensity (FAOS-%)	46.22 ± 5.3	67.0 ± 10.9				44.54 ± 9.4	55.9 ± 11.0				0.001*
	Symptoms (FAOS-%)	49.14 ± 1 2.3	62.4 ± 18.1				50.5 ± 8.4	58.7 ± 16.2		0.007*		0.243
	Disability-DLA (FAOS-%)	42.6 ± 5.6	65.1 ± 13.0				45.8 ± 12.2	59.8 ± 14.0		<0.001*		0.080
	Sport and recreation (FAOS-%)	40.1 ± 24.4	61.2 ± 18.7				39.8 ± 17.0	52.8 ± 20.3		0.006*		0.081
	Quality of life (FAOS-%)	33.3 ± 8.4	66.8 ± 8.6		0.001*		29.9 ± 11.0	41.0 ± 16.4		<0.001*		0.004*
Ordahan 2018 [28]	Pain at rest (VAS-cm)	8.9 ± 1.5	2.8 ± 1.8	/	0.017*	/	8.4 ± 1.8	5.6 ± 2.1	/	0.036*	/	0.048*
	Heel sensivity (HTI-score)	2.1 ± 0.9	0.4 ± 0.5		0.021*		2.1 ± 1.2	1.0 ± 0.5		0.038*		0.043*
	Pain intensity (FAOS-%)	46.8 ± 16.2	54.7 ± 10.2		0.019*		45.9 ± 18.5	50.0 ± 10.8		0.038*		0.023*
	Symptoms (FAOS-%)	56.5 ± 23.7	68.3 ± 20.5		0.014*		56.9 ± 23.9	60.8 ± 21.3		0.037		0.023*
	Disability-DLA (FAOS-%)	45.6 ± 18.1	58.8 ± 20.5		0.01*		46.5 ± 18.3	51.6 ± 20.2		0.028		0.033*
	Sport and recreation (FAOS-%)	42.3 ± 21.1	56.9 ± 25.9		0.011*		42.8 ± 20.5	49.2 ± 25.1		0.022		0.022*
	Quality of life (FAOS-%)	45.5 ± 9.4	57.6 ± 14.6		0.018*		45.8 ± 11.0	52.8 ± 22		0.020		0.034*
Naruseviciute 2020 [29]	Pain at rest (VAS-cm)	6.78 ± 2.1	2.9 ± 3.3	1.7 ± 3.4			5.99 ± 2.3	5.57 ± 3.5	0.18 ± 2.6	>0.05		
	Pain first steps (VAS-cm)	6.69± 2.9	4.4 ± 2.7	4.4 ± 2.8			6.93 ± 2.6	4.70 ± 3.7	0.68 ± 2.9			
	Pain after walking (VAS-cm)	5.63 ± 2.8	3.6 ± 3.1	0.51 ± 1.6	<0.05*		4.52 ± 2.1	3.08 ± 2.1	0.45 ± 2.0	<0.05*		
	Pain when sitting for a long time (VAS-cm)	6.35 ± 2.5	3.7 ± 3.0	0.29 ± 1.7		>0.05	6.18 ± 2.1	3.78 ± 2.9	0.15 ± 2.6		>0.05	<0.05*
	Pain at evening (VAS-cm)	7.63 ± 2.1	4.15 ± 2.6	0.05 ± 2.9			7.02 ± 2.6	3.11 ± 3.5	0.23 ± 3.0			
	PPT (ALG-kg/cm2)	4.05 ± 3.4	1.77 ± 2.9	0.77 ± 2.4	>0.05		3.03 ± 2.6	1.80 ± 6.4	0.27 ± 0.5			
	Fascia thicknees (USG-mm)	1.46 ± 0.8	0.30 ± 0.6	0.59 ± 0.54	<0.05*		1.51± 0.8	0.19 ± 0.6	0.18 ± 0.5	>0.05		

Study	Outcome	HILT					CG					
		T0: baseline (mean ± SD)	T1: post-treatment (mean ± SD)	T2: follow-up (mean ± SD)	p-value T0-T1	p-value T0-T2	T0: baseline (mean ± SD)	T1: post-treatment (mean ± SD)	T2: follow-up (mean ± SD)	p-value T0-T1	p-value T0-T2	p-value Intergroup post-treatment
Yesil 2020 [30]	Pain at rest (VAS-cm)	6.50 ± 1.2	4.10 ± 1.2	2.0 ± 1.7	NS		7.20 ± 1.6	4.50 ± 1.2	2.90 ± 2.1	NS		0.326
	Pain at rest (MRS-score)	3.19 ± 0.6	2.30 ± 0.6	1.30 ± 0.7			3.30 ± 0.6	2.50 ± 0.7	1.90 ± 0.8			0.070
	Pain intensity (FAOS-%)	50.1 ± 19.2	58.3 ± 17.9	60.7 ± 17.8			53.3 ± 11.5	61.6 ± 14.3	66.8 ± 16.8			0.893
	Symptoms (FAOS-%)	63.8 ± 15.7	68.6 ± 15.2	72.0 ± 13.1			54.5 ± 14.4	64.6 ± 12.0	75.8 ± 13.3			0.022*
	Disability-DLA (FAOS-%)	50.2 ± 14.9	60.8 ± 15.0	62.6 ± 15.8			52.1± 18.3	61.0 ± 13.8	67.0 ± 18.7			0.537
	Sport and recreation (FAOS-%)	32.4 ± 18.1	40.5 ± 15.7	46.5 ± 16.8			46.4 ± 21.6	56.1 ± 22.2	61.7 ± 24.9			0.879
	Quality of life (FAOS-%)	35.1 ± 14.1	45.5 ± 17.8	47.6 ± 18.8			38.7 ± 18.0	45.8 ± 21.5	54.2 ± 20.8			0.038*
	Quality of life (general health SF36-score)	41.9 ± 15.6	58.3 ± 10.5	62.2 ± 11.8			43.6± 15.6	57.5 ± 14.0	60.5 ± 15.5			0.412
Tkocz 2021 [31]	Pain at rest (VAS-cm)	6.30 ± 1.4	2.80 ± 1.5	2.60 ± 2.0	<0.001*		5.70 ± 2.0	2.70 ± 2.0	2.30 ± 2.2	<0.001*	<0.001*	<0.001*
	Pain at rest (LPS-score)	7.20 ± 2.1	3.30 ± 1.8	3.0 ± 2.0			6.70 ± 2.0	3.50 ± 2.0	2.70 ± 2.1	0.002*	<0.001*	
Khan 2022 [32]	Pain at rest (VAS-cm)	6.59 ± 1.4	3.00 ± 1.0	/	<0.001*	/	Without CG					NA
	Disability (FFI-score)	46.2 ± 16.8	26.6 ± 7.7									
Thammajaree 2023 [33]	Pain at rest (VAS-cm)	4.58 ± 2.5	1.55 ± 1.6	/	< 0.001*	/	4.75 ± 2.3	2.60 ± 2.7	/	<0.001*	/	0.002*
	Pain first steps (VAS-cm)	5.11 ± 2.52	1.90 ± 2.0				5.57 ± 2.4	2.79 ± 2.7				0.001*
	Pain at pressure (VAS-cm)	5.13 ± 2.39	1.65 ± 1.9				5.19 ± 3.2	2.33 ± 2.5				0.007*
	Disability (FFI-score)	67.9 ± 27.7	22.3 ± 21.2				88.9 ± 27.4	45.8± 45.1		0.001*		0.001*
Riaz 2023 [34]	Pain at rest (VAS-cm)	7.60 ± 1.2	2.80 ± 1.7	2.67 ± 1.9	< 0.001*		6.93 ± 1.4	1.33 ± 1.39	1.33 ± 1.0	<0.001*		<0.001*
	Disability (FFI-score)	98.1 ± 17.7	57.5 ± 18.8	58.9 ± 21.4			95.0 ± 12.8	43.6 ± 11.7	40.8 ± 6.5			

ALG – algometry, CG – control group, DLA – daily living activities, FAOS – foot and ankle outcome score, FFI – foot function index, HILT – high-intensity laser therapy, HTI – heel tenderness index, LPS – Laitinen pain scale, GNM – goniometry, MRS – Roles and Maudsley score, N – newtons, NA – not apply, NS – not specified, PPT – press pressure threshold, ROM – range of movement, SD – standard deviation, SF36 – the Short Form 36 Health Survey Questionnaire, USG – ultrasonographic, VAS – visual analogue scale, *p < 0.05.

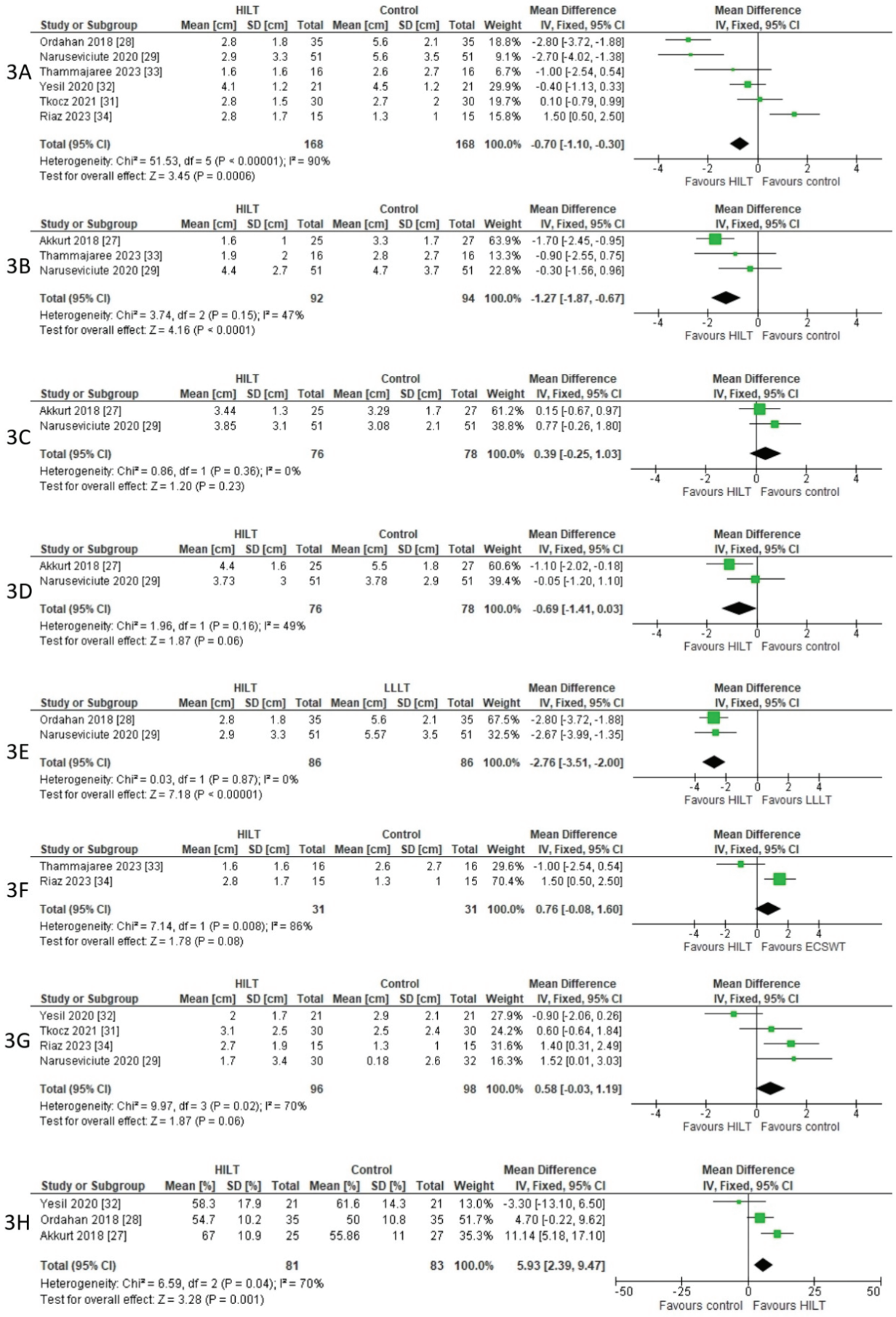

Fig. 3. Forest plots for pain intensity assessed with VAS (3A-3G) and FAOS (3H) at the end of treatment

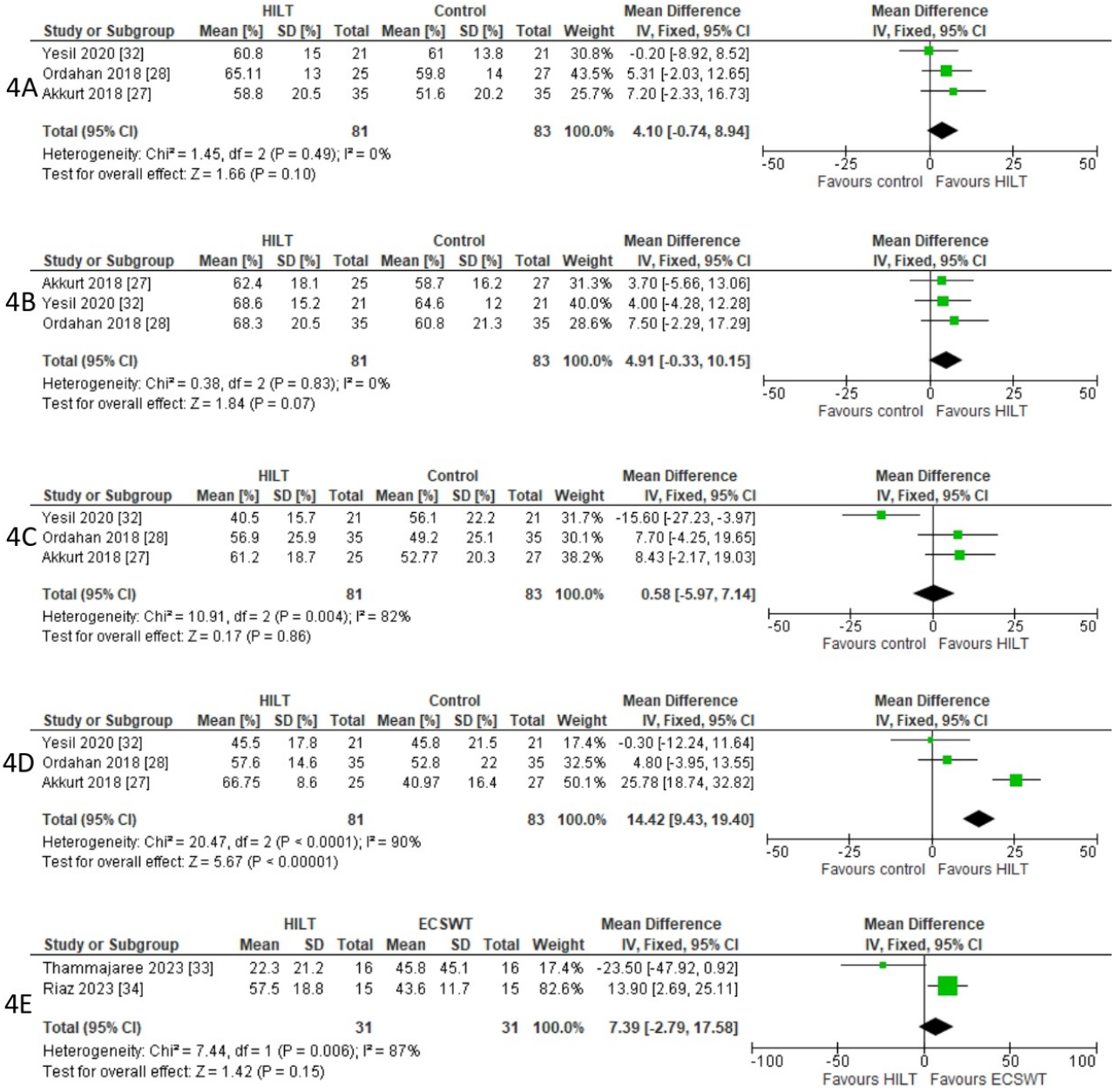

Fig. 4. Forest plots for FAOS and FFI: (4A) HILT versus control for daily life activities (FAOS subscale); (4B) HILT versus control for symptoms (FAOS subscale); (4C) HILT versus control in performance of sports and recreation activities (FAOS subscale); (4D) HILT versus control for quality of life (FAOS subscale); (4E) disability with FFI comparing HILT versus ECSWT at the end of treatment

Metanalysis

Seven studies were considered for meta-analysis in relation to pain intensity (Fig. 3) and functionality (Fig. 4). The Mantel-Haenszel fixed effects method was used to determine the pooled effect by mean difference (MD) [23,24]. The results show a statistically significant difference in favor of HILT in pain intensity at rest (VAS: MD = – 0.70cm; 95% CI = –1.10,-0.30; $p < 0.01$) (FAOS: MD = 5.93%; 95% CI = –1.55,-0.68; $p < 0.01$), as well as a reduction in pain in the first steps (VAS: MD = –1.27cm ; 95% CI = –1.87,-0.67; $p < 0.01$). However, no statistical differences were found in pain intensity when walking, pain intensity when sitting, when comparing rest pain versus ECSWT, pain at rest at 3-month follow-up. Furthermore, when comparing rest pain between HILT and LLLT added to a physical therapy plan, a statistically significant change was observed for HILT (VAS MD = –2.76cm; 95% CI = –3.51, -2.0; $p < 0.01$). The I^2 coefficient revealed a negligible or moderate degree of heterogeneity, except for pain at the first steps. Researchers assessed the quality of the evidence as important for pain intensity in first steps

Tab. 3. Summary of findings and quality of evidence for interesting outcomes

Certainty assessment							Patients (n)		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	High-intensity laser therapy	Conventional physical therapy	Relative (95% CI)	Absolute (95% CI)		
Pain intensity at rest (assessed with: VAS; Scale: 0–10 cm)												
6 [28,29, 31–34]	RCTs	Not serious[a]	Very serious[b]	Not serious[c]	Not serious[d]	None	168	168	–	MD **0.7cm lower** (1.10 lower to 0.30 lower)	⊕⃞⃞⃞ Low	Not important
Pain intensity at the first steps (assessed with: VAS; Scale: 0–10 cm)												
3 [27,29,33]	RCTs	Not serious[a]	Serious[e]	Not serious[c]	Not serious[d]	None	92	94	–	MD **1.27cm lower** (1.87 lower to 0.67 lower)	⊕⊕⊕⃞ Moderate	Important
Pain intensity at rest between HILT and LLLT added to a physical therapy program (assessed with: VAS; Scale: 0–10 cm)												
2 [28,29]	RCTs	Not serious[a]	Not serious[f]	Not serious[c]	Not serious[d]	None	86	86	–	MD **2.76cm lower** (3.51 lower to 2 lower)	⊕⊕⊕⊕ High	Critical
Less pain at rest (assessed with: FAOS; Scale: 0–100%)												
3 [27,28,32]	RCTs	Not serious[a]	Very serious[b]	Not serious[c]	Not serious[d]	None	81	83	–	MD **5.93% higher** (2.39 higher to 9.47 higher)	⊕⊕⃞⃞ Low	Important
Quality of life (assessed with: FAOS; Scale: 0–100%)												
3 [27,28,32]	RCTs	Not serious[a]	Very serious[b]	Not serious[c]	Not serious[d]	None	81	83	–	MD **14.42% higher** (9.43 higher to 19.4 higher)	⊕⊕⃞⃞ Low	Important

CI – confidence interval, MD – mean difference. Explanations: a. The high risk of bias was primarily related to outcome assessment blinding (50%), and radomization process (25%). Moreover, all RCTs rated incomplete data, selective reporting, and other bias hazards as low risk, b. The heterogeneity was assessed as substantial, as indicated by the I2 test revealing a considerable degree of heterogeneity (50–90%), c. Due to the direct comparison of interventions and outcomes specifically related to the study's issue, it was determined that the indirect evidence held little significance, d. The imprecision was evaluated based on the width of the confidence interval (CI) for the pooled mean difference and the crossing of the no-effect line in the meta-analysis, e. The heterogeneity was assessed as moderate as indicated by the I2 test revealing a considerable degree of heterogeneity (30–60%), f. The heterogeneity was assessed as not important as indicated by the I2 test revealing a considerable degree of heterogeneity (0–40)

(VAS) and least pain at rest (FAOS), but with low certainty due to high inconsistency. However, comparing HILT and LLLT evidence quality was rated as critical and of high certainty (Tab. 3).

No statistical differences were found between the groups for FAOS in activities of daily living, symptoms and development of sports activities. Nevertheless, a significant difference in favor of HILT was observed for QoL (MD = 14.42%; 95% CI = 9.43,19.40; $p < 0.01$). There was also no difference in disability for FFI when HILT was compared to ECSWT. The heterogeneity obtained for disability was important, except for activities of daily living. The quality of the evidence for the improvement in QoL was considered important, but with low certainty due to inconsistency (Tab. 3).

Discussion

PF is a common musculoskeletal foot complaint, impacting both sedentary individuals and athletes across age groups. Notably, diminished functionality and pain are core features. Despite its self-resolving nature, the recovery period can extend to twelve months, underscoring the significance of expediting recuperation [1,2]. Physical therapy is the main conservative approach, within which LLLT has been investigated as a viable and efficacious non-invasive treatment for PF [13,14]. HILT has recently emerged as an analgesic resource for various musculoskeletal disorders [15–17]; however, the evidence supporting it in PF requires evaluation. Therefore, the purpose of this SR was to investigate the analgesic effects of HILT compared to other physical therapy modalities in patients with PF.

HILT in pain reduction

HILT reduces pain at rest (VAS) when combined with interventions such as exercises, insoles, or cryotherapy, with an average decrease in pain of –0.7 cm (95% CI: –1.1, –0.3), results that, despite being statistically significant on paper, are not clinically important for VAS, where an average decrease of –0.9 to –1.3cm (95% CI: 0.6 to 1.8) is expected. [28–30,33–36]. Moreover, when compared to LLLT, HILT seems more effective, with an average analgesia of –2.76cm for VAS (95% CI: –3.51-2.0), although it should be noted that the number of RCTs that compared both lasers was limited (28,29), which could lead to publication bias and highlights the need for further research. In addition, the analgesic effects of HILT are notable in the first steps, with a pooled effect of –1.27cm for VAS (95% CI: –1.87,-0.67).

Despite the statistically significant results and the considerable effect size, the comparisons between HILT and LLLT are the most reliable due to the lack of heterogeneity in the data ($I^2 = 0\%$). This is in contrast to pain at rest, as well as in the first steps or after walking, where a moderate-to-high level of heterogeneity is observed [24]. The result in the first steps is consistent with the established minimally important clinical difference (MCID) for VAS of at least –1.3cm [35]. Nevertheless, concerning pain during rest, the decrease of –0.7cm falls short of this value. This suggests a more pronounced analgesic effect of HILT in relation to functional tasks like walking, which retains significance due to its involvement in routine activities of daily life [27,29,33]. The decline in pain aligns congruently with outcomes reported in other SRs investigating LLLT for PF. They have exhibited an average pain reduction of approximately –1.3cm (95% CI: –0.4,–2.3) or –0.95cm (95% CI: –1.2,–0.7) when evaluating LLLT either alone or in conjunction with US, ECSWT, or exercises [13,14]. Hence, there exists substantiation to contemplate the adoption of both lasers for analgesic purposes. These conclusions have prompted researchers to assign a good level of evidence concerning the influence of HILT on pain at first steps, while deeming it of utmost critical importance when compared with LLLT for pain during rest.

Furthermore, there is significant evidence pointing to the heightened analgesic efficacy of HILT compared to LLLT, insoles, or placebo, as evidenced by the results in FAOS. However, even though this finding is statistically significant, the cumulative effect size of 5.9% (95% CI: 2.39,9.47) does not meet the recommended MCID threshold of 9.5% for the pain subscale [37].

The superior analgesia of HILT over LLLT can be attributable to quicker energy delivery, particularly in continuous mode, and the ability to cover larger treatment areas through scanning applications, as outlined in the RCTs [28,29]. This phenomenon mirrors the Reprocity Busen Roscoe's principle, wherein enhanced power results in quicker attainment of physiological effects (38). In addition, continuous emission allows for a greater thermal effect, giving HILT advantages over LLLT and the other treatments.

Although the analgesic effects of the laser are clear and are based on disminuting the inflammatory process, β-endorphins release, cytochrome C-oxidase activation, and decreasing nociceptors discharge, these effects could be potentiated by the generation of heat [11,12,17]. The elevation in temperature reinforces the analgesic impact by promoting vasodilation, thereby aiding in the removal of inflammatory mediators. This process reduces the activity of nociceptors and sensitizes transient receptor potential cation channel subfamily V member 1 (TRPV-1) receptors, particularly when the heat remains consistent, and the skin

reaches a temperature of 37°C [39]. Moreover, muscle relaxation induced by heat could potentially contribute to an additional analgesic effect by promoting the disruption of the muscle spasm-pain cycle [40]. Furthermore, the rise in temperature also impacts tissue viscoelastic properties, a factor that is advantageous when considering the integration of laser therapy with stretching exercises, a practice strongly advocated for managing PF to alleviate pain and enhance functionality [8,41]. This aligns with the SRs of LLLT and PF, where RCTs incorporating stretching exercises demonstrated a notable decrease of –1.98cm in the VAS score post-treatment, resulting in both statistical and clinical significance [14]. This underscores the imperative of complementing laser therapy, irrespective of its type, with stretching exercises.

During the 3-month follow-up period, there were no discernible differences in resting pain between the study groups, suggesting that HILT may be more effective in the short term than the long term. Corresponding observations are noted for LLLT, where the analgesic effect is more pronounced during the treatment period [13,14]. This prompts the consideration of incorporating HILT into an intervention plan while concurrently exploring supplementary approaches to enhance post-treatment outcomes. For instance, implementing stretching exercises targeting the PF and gastrocnemius muscles could be valuable in optimizing results beyond the treatment period [8,41].

The superiority of HILT over ECSWT remains uncertain, a consideration of significance given the established evidence supporting ECSWT in cases of PF [33,34]. Analogous outcomes have emerged from comparisons between LLLT and ECSWT, revealing no statistically significant distinctions [13,14]. Consequently, this situates HILT as an equivalent or supplementary clinical option for PF treatment, potentially on par with ECSWT. The choice between these modalities could hinge on factors such as resource availability, cost considerations, and patient or physical therapist preferences.

HILT in functionality

The RCTs utilized FAOS as the principal instrument for evaluating functionality. FAOS is endorsed for its established validity in appraising plantar pain, with robust reliability across all its subscales (ICC: 0.81-0.92) [42,43]. FAOS assessments reveal that HILT does not demonstrate superiority over other interventions such as LLLT, insoles, or the combination of placebo HILT and exercises in terms of daily activities, symptoms, and sports activities [27,28,30]. Nonetheless, it is worth noting that HILT does exert an influence on QoL, manifesting an average enhancement of 14.4% in comparison to these treatment modalities. This outcome is of significance, as it exceeds the threshold recognized as the MCID for this subscale, established at 5% [37,43].

These findings are significant due to the well-established relation between pain and QoL, particularly in the domains of physical and emotional functioning [44]. Consequently, a treatment with a substantial analgesic effect is highly likely to exert an influence on QoL. However, this also depends on the duration, intensity, scope, affectivity, and pain meaning, which implies that this improvement will not always be a "sine qua non" condition [44,45]. Furthermore, it is crucial to understand that pain does not always indicate poor QoL, although it is a significant factor [44]. Despite being a social construction, QoL has also gained importance in health research as an interesting outcome, which makes measuring it relevant, especially when complaints are chronic [44,46].

Likewise, the QoL results should be analyzed in greater detail due to the I^2 index between the studies [24]. This consideration prompted researchers to categorize the evidence related to HILT's impact on QoL as important, though not of the highest level.

Similar findings in disability for FFI were obtained in two RCTs comparing HILT with ECSWT, with no significant change in favor of either treatment. However, this conclusion is not definitive due to the limited number of studies [33,34].

Recommendations

This SR reveals a marked variability of HILT dosages used among RCTs, a situation analogous to that of LLLT SRs [13,14]. However, the authors have established a dosage recommendation for the application of HILT at a wavelength of 1.064nm, with the following predefined parameters: an output power of 12W, continuous mode, an energy density of at least 120J/cm² and a minimum total energy of 3.000J for a treatment area of 25cm^2. The scanning application was the predominant one, presumably to cover the entire sole of the foot. Moreover, sessions should range between 8 and 10, carried out at intervals for a period of no less than 3 weeks. Furthermore, the best results seem to be seen by adding PF and calf stretching to HILT and the use of insoles [27,28,30,34].

A single study reports HILT plus cryotherapy [29]. However, the researchers propose cryotherapy for the exacerbation of symptoms after activities like walking or towards the end of the day, thereby avoiding any potential interference with the thermal effects induced by HILT [47].

Limitations

To our knowledge, this is the first SR to evaluate the effectiveness of HILT in FP. The transparent approach based on the PRISMA guidelines and the registration of the protocol in PROSPERO to evaluate and present the evidence are highlighted. Limitations identified by researchers include: (i) despite an extensive search across six databases, the potential inclusion of articles in languages beyond those covered cannot be definitively ruled out due to the geographic origin of the RCTs in Turkey, Malaysia, Pakistan, and Lithuania; (ii) the considerable heterogeneity among RCTs impedes our ability to provide a conclusive analysis for pain at rest and functionality, thereby limiting the definitive interpretation of these aspects; (iii) RoB in certain RCTs, particularly concerning the blinding of assessors and concealed allocation, raises the possibility of an overestimation of the effects attributed to HILT or conventional physiotherapy treatments.

Next steps for HILT in treating PF

The authors have outlined two potential future research directions. Firstly, they propose conducting comparative clinical trials to assess the effectiveness of HILT and ECSWT in the treatment of PF. Secondly, they recommend further investigations into HILT for PF, including an examination of the outcomes with additional treatment sessions of HILT and a direct comparison with Low-Level Laser Therapy (LLLT). It should be noted that the mean number of treatment sessions across the included randomized controlled trials (RCTs) ranged from 8 to 10. It is plausible that increasing the number of treatment sessions could enhance the long-term efficacy of HILT, given the chronic nature of PF.

Conclusions

This SR demonstrates that HILT is more effective in relieving pain in the first steps and improving the QoL of patients with PF than LLLT, ECSWT, or US, at least in the short term (up to 3 months). Moreover, the effects on pain at rest and functionality are similar to those achieved with ECSWT, which positions both treatments as viable alternatives. However, more RCTs are required to compare the long-term effects of both treatments. It is recommended adding stretching exercises to HILT to ensure more effective results.

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Conflicts of interest

The authors declare no conflict of interest.

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