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HIGH-INTENSITY LASER THERAPY IN PAIN MANAGEMENT OF PATIENTS WITH KNEE OSTEOARTHRITIS

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ABSTRACT

Background: Knee osteoarthritis (KOA) is an important health condition, affecting one third of people aged 65 years or more. Pain is the main cause of disability. Laser therapy is part of many therapeutic protocols, with two forms: low-level laser therapy (LLLT) and high-intensity laser therapy (HILT). In the present study, an attempt has been made to review the recent references on the effect of HILT in pain management of patients with knee osteoarthritis. **Methods:** Though a total of 31 references were included in the study, 18 were compared and analyzed critically. **Results:** Research on number of published articles revealed that the analgesic effect was rapid, cumulative, and long lasting. Compared to sham, to LLLT, or to other combinations of therapeutic modalities, HILT provided significantly better results on pain reduction and functional improvement. **Conclusion:** It might be concluded that HILT was effective in pain reduction, improvement in function and disability, outperforming LLLT and some combinations of physical modalities.

KEYWORDS: Knee osteoarthritis, High-intensity laser therapy, Pain management, Physical stimulation.

INTRODUCTION

Knee osteoarthritis (KOA) is an important health issue worldwide. It affects approximately one third of people aged over 65 years (Turkiewicz et al., 2014). Below 50 years of age, men are more prone to develop KOA, and above 50 years of age, women are more prone to be affected, due to more complex hormonal and metabolic changes in them (Nasui et al., 2022). Even the people of younger ages are prone to develop joint disease, especially KOA, as a consequence of obesity and other metabolic disorders (Lee and Kwon, 2022).

Number of physiotherapeutic modalities is used for the management of KOA. Laser therapy (LT) is one of these. It is a non-invasive process which could be applied for the management of KOA (Arroyo-Fernández et al., 2023). Albeit low-level laser therapy (LLLT) is commonly used, high-intensity laser therapy (HILT) is a painless, recent and strong alternative with higher density radiation. The HILT can provide deeper penetration with a wavelength of 1064. The HILT can reach deeper and larger joints than LLLT. Through its deep thermal action, HILT is reported to increase local blood circulation, improves tissue regeneration, and reduces pain and edema.

Miofascial pain syndrome is a very common cause of disability in the population and an important issue to be addressed in therapy. HILT associated with physical exercise was found to be more effective that exercise alone in trapezius localization (Dundar et al., 2015; Ahmed et al., 2020). HILT was effective in improving pain in cervical myofascial pain syndrome but not the cervical range of motion (ROM), concluded a meta-analysis, mentioning that due to the heterogeneity of the trials, the latter allegation could be biased (de la Barra Ortiz et al., 2022). For chronic neck pain, an association of HILT and physical exercise significantly improved pain and mobility (Alayat et al., 2016). Subacromial impingement syndrome was successfully managed with a combination of HILT and exercise in terms of pain and function (Yılmaz et al., 2022). Patients with low back pain, a frequent health issue, reported an improvement in pain and functional status when receiving HILT and physical exercise (Gocevska et al., 2019).

Controversial results were reported for HILT in plantar fasciitis management, as different groups of researchers stressed either the effectiveness (Ordahan et al., 2018) or the lack of it (Tkocz et al., 2021; Naruseviciute and Kubilius, 2020) in pain reduction or in functioning (Yesil

et al., 2020), inviting further studies. Furthermore, a systematic review from 2020 concluded that HILT might be beneficial in a polymodal approach to musculoskeletal pain (Ezzati et al., 2020). In the present study an attempt has been made to review the recent references on the effect of HILT in pain management of patients with knee osteoarthritis.

MATERIALS AND METHODS

A total of 31 references were reviewed, of those, eighteen recent articles (published between 2016 and 2024) closely related to HILT in pain management of KOA were considered for this review article for comparison. These articles were consulted from databases such as PubMed, Google Scholar, and Web of Science, using a combination of MeSH terms: "high-intensity laser therapy", "high-level laser therapy", "high-power laser", "HILT", "HLLT", "knee osteoarthritis".

The inclusion criteria were as followed: (1) articles containing randomized controlled trials, case reports and case series on human adults with the (2) diagnosis of KOA, (3) HILT was referenced as a therapeutic intervention (4) compared to sham, LLLT, and other therapeutic interventions and there were, (5) well-defined clinical outcomes: improvement in pain, function, disability, ultrasound examination.

RESULTS

Table 1 showed the analysis of the related articles reviewed reported between 2016 and 2024. There were eighteen articles selected and reviewed for this study. The detailed description of these articles was given below in tabular form for comparison.

Table 1: Analysis of the related articles reported between 2016 and 2024.

Author (s), Year of the Publication	Study Type, No of Patients	Intervention	Outcome	Moments of the Study	Findings
1. Wibisono et al., 2024	Prospective, randomized, pre-test and post-test-controlled, No. of patients = 27	HILT versus LLLT Two sessions/week, Four weeks	Berg balance scale	Baseline End of the treatment	Intra-group: both groups improved significantly HILT improved more.
Taheri et al., 2024	Prospective, randomized, controlled, No. of patients = 56	ET + NSAID + topic ointment. ET + NSAID + topic ointment + HILT (Three session/week, Two weeks)	Pain (VAS) Function (WOMAC)	Baseline End of treatment 3 months	All parameters were better in the HILT group at the end of the treatment and after twelve weeks
Roheym et al., 2023	Prospective, randomized, double-blinded, pre/post-test trial, No. of patients = 30 with bilateral KOA	ET ET + HILT (300 J/session, followed by 3000 J/session) three sessions/week, four weeks	US: suprapatellar fluid detection Function (WOMAC)	Baseline End of the treatment	Intra-group: significant improvements Better results in HILT
Astri et al., 2023	Prospective, double-blind randomized controlled clinical trial, No of patient = 61	LLLT + ET HILT + ET 3 sessions/week, 2 weeks	Pain Function (50-feet walk test)	Baseline Pain (after every session) End of the treatment	Pain improved in both groups, with better evolution at every moment for HILT Function improved better for HILT
Ahmad et al., 2023	Prospective, randomized, double-blinded, parallel-group clinical trial. No. of patients = 34	HILT + ET LLLT + ET Once a week, twelve weeks	Pain Disability (KOOS) Function (active flexion ROM; timed up and go test (TUG))	Baseline End of the treatment	Intra-group: all parameters improved HILT has significantly greater improvement
Katana et al., 2023	Prospective, descriptive, experimental, randomized trial.	Group I, standard protocol + HIMS. Group II, standard protocol + HILT	Pain (Likert scale) Functional (ROM)	Baseline Middle (four weeks) End of the	Intra-group analysis: both improved all parameters at all moments Inter-group analysis: Group II

	No. of patients = 60	One session/week, eight weeks	Disability (KOOS)	treatment (eight weeks)	showed significantly greater improvement in all moments
Ekici and Ordahan, 2023	Prospective, double-blinded, placebo-controlled, randomized. No. of patients = 60	Group 1 (HILT + hotpack + TENS + ET) 300 J/session followed by 3000 J/session Group 2 (sham laser + hotpack + TENS + ET) Nine sessions/three weeks	Pain (VAS) Functional (flexion ROM, isokinetic muscle strength, WOMAC) US: cartilage thickness	Baseline End of the treatment three months	Both groups improved in all items at the end of treatment and atthree months There was no difference between groups at any moment
Mostafa et al., 2022	Prospective, randomized controlled trial. No. of patients = 40	ESWT, one session/week, four weeks. HILT, three sessions/week, four weeks	Pain (VAS) Function (6 MWT; WOMAC)	Baseline End of the treatment	Intra-group: both improved Between groups: HILT better results
Samaan et al., 2022	Prospective, single blinded, randomized, controlled trial. No. of patients = 60	HILT + ET, LIPUS + ET, ET alone, 5 sessions/week, 2 weeks	Pain (VAS) Function (ROM; WOMAC) Proprioception accuracy	Baseline End of the treatment	HILT better results in all parameters
Siriratna et al., 2022	Prospective, randomized, single-blind, parallel group study. No. of patients = 42	Conservative treatment + HILT (562.5 J/session) Conservative treatment + sham 2–3 sessions/week, a total of 10 sessions	Pain (VAS) Function (WOMAC)	Baseline End of the treatment	Intra-group: both groups improved significantly in all items. Inter-group: HILT had lower pain scores (significant) No difference for WOMAC
Koevska et al., 2021	Prospective, one-sided blind randomized comparative study No. of patients = 72	HILT versus LLLT 10 sessions	Pain (VAS)	Baseline End of the treatment 30 days	Both goups improved significantly After treatment, pain on VAS had lower scores for HILT groups that LLLT
Akaltun et al., 2021	Prospective, double-blind randomized placebo-controlled. No. of patients = 40	HILT + ET (300 J/session analgesia, 3000 J/session biostimulation) Placebo + ET five sessions/week, two weeks	Pain (VAS) Functional (WOMAC; flexion ROM) US: cartilage thickness	Baseline End of the treatment six weeks	Both groups: two and six weeks: VAS, WOMAC—pain, WOMAC—function, WOMAC—stiffness, and WOMAC—total; cartilage thickness and FROM increased, Six weeks: HILT + ET significantly better values for all parameters versus PL + ET
Nazari et al., 2019	Prospective, assessor-blind, randomized controlled trial. No. of patients = 93	HILT + ET, TENS + US + ET, ET alone, twelve sessions, three sessions/week	Pain (VAS) Function (flexion ROM; timed up and go test (TUG); six-min walk test (six MWT), WOMAC)	Baseline End of the treatment twelve weeks	Intra-group: improvements at all moments, all parameters Between groups: HILT had better results on all parameters
Ciplak et al., 2018	Prospective, randomized, single blinded.	Hotpack + US + TENS + ET Hotpack + HILT +	Pain (VAS) Function (WOMAC)	Baseline End of the treatment	HILT was better significantly at all moments

	No. of patients = 48	ET ten sessions/two weeks		six weeks	
White et al., 2017	Prospective, case series, before and after treatment. No. of patients = 39	1–3 daily sessions HILT	Pain (VAS) Function (ROM) Clinical issues (swelling, numbness)	Baseline End of treatment one to three weeks	Improvement of all items at all moments
Alayat et al., 2017	Prospective, single-blinded randomized controlled trial. No. of patients = 67	Group 1: HILT, GCS, ET. Group 2: GCS + ET. Group 3: placebo + ET. two sessions/week, six weeks	Pain (VAS) Function (WOMAC) US (synovial thickness, femoral condylar cartilage)	Baseline End of the treatment three months	Intra-group: all have significant improvement at six weeks, persistent at three months, except US cartilage thickness Between groups: HILT improved better; no difference between groups 2 and 3
Angelova and Ilieva, 2016	Prospective, pilot trial, randomized, clinical, single-blinded, placebo controlled. No. of patients = 72	HILT (300 J/session analgesic, 3000 J/session biostimulatory) versus sham, 7 daily sessions	Pain Pedobarometric gait analysis (static and dynamic)	Baseline End of the treatment one and three months	HILT group improved significantly after treatment and results were maintained at follow-up
Kim et al., 2016	Prospective, randomized. No. of patients = 20	Group CPT (conservative physical therapy), Group HILT (CPT + HILT) three times/week, four weeks, 1500 J/cm^2	Pain (VAS) Function (WOMAC)	Baseline End of the treatment	Intra-group: both groups improved statistically Inter group: HILT had better scores

LLLT= low-level laser therapy; HILT= high-intensity laser therapy; HA = hyaluronic acid; ROM= range of motion; FROM= flexion ROM; VAS= visual analogue scale; HP= hot pack; ET= exercise therapy; HIMS= high induction electromagnetic stimulation; LIPUS= low-intensity pulsed ultrasound; KOOS= Knee Injury and Osteoarthritis Outcome Score; WOMAC= Western Ontario and McMaster Universities Osteoarthritis Index.

DISCUSSION

Knee osteoarthritis is one of the leading causes globally for disability and pain. The objective of the study was to investigate whether High-Intensity Laser therapy has superior pain-relieving effects in individuals with knee osteoarthritis. A total of eighteen closely related reference of the research problem were reviewed. The findings were discussed critically below:

HILT versus Sham/Placebo

Seven articles with a total of 320 patients compared different regimens of HILT with sham (placebo). One study (with 72 patients) compared HILT alone with sham on pain, function, and gait (Taheri et al., 2024). They reported that HILT was associated with significant improvement in all variables studied after treatment, and the results were maintained at 3 and 4 months. The regimens were either 10 alternate-day sessions or 7 daily sessions, with 3000 J/session and a biostimulator effect. Six studies with a total of 242 patients, compared HILT associated with different conservative therapies (physical exercise; hot packs + interferential therapy + physical exercise; NSAID + topic ointments + physical exercise). Pain (assessed on VAS), function (WOMAC index), and ultrasonographic measurements (femoral condylar cartilage thickness and suprapatellar fluid) were performed at baseline, after treatment, and after a timeframe of 4 weeks to 3 months. All studies reported significant improvement in all parameters in the intra-group analysis for all moments. As for intergroup analysis, most studies (four out of six) reported significantly better results in the HILT group for pain and function. Ultrasound measurement of intra-articular fluid found an important reduction after HILT therapy (Kim et al., 2016; Akaltun et al., 2021; Siriratna et al., 2022; Ekici and Ordahan, 2023; Taheri et al., 2024; Roheym et al., 2023). One study with 60 patients, failed to establish any significant difference for HILT versus sham in pain and function (Ekici and Ordahan, 2023), whereas another study with 42 patients reported a significant improvement in pain only, not in function (Siriratna et al., 2022).

HILT versus LLLT

LLLT has been a part of pain therapy for a long time. Four studies with 194 patients compared the two forms of laser therapy (LLLT and HILT), either in monotherapy (Koevska et al., 2021; Wibisono et at., 2024) or associated with physical exercise (Ahmad et al.,

2023; Astri et al., 2023). The patients reported significant improvements in pain (VAS scores), function (WOMAC index, 50-feet walk test, TUG), and disability (KOOS) in intra-group analysis at the end of therapy and one month later, with better results in the HILT group. Compared to sham, both LLLT and HILT were followed by clinical improvement. HILT produced significant improvement in pain scores versus LLLT in all reported studies. Function was documented in several ways, with an emphasis on disability evaluation (Berg balance scale, TUG, 50-feet walk test), and the results were significantly better for HILT patients. Protocols of HILT therapy varied from once a week for 12 weeks, two sessions/week for 4–6 weeks, three sessions/week for 2 weeks, to ten daily sessions. Doses were in the analgesic range (300 J) followed by a biostimulatory effect (3000 J) (Koevska et al., 2021;, Ahmad et al., 2023; Astri et al., 2023; Wibisono et at., 2024).

HILT versus Other Therapeutic Modalities

Six studies included 301 patients receiving therapeutic protocols using different forms of physical agents for analgesic purposes and therapeutical exercise to evaluate the effectiveness of HILT. It is worth noting that all the following schemes included physical exercise as a cornerstone, underlying its importance in the management of KOA. The association with different modalities was thought to add value to therapy. Three sessions/week for 4 weeks of either HILT or conventional therapy (TENS + ultrasound) were followed by significant improvement in pain and function (flexion ROM, TUG, 6 MWT, and WOMAC) in the HILT group. The difference was significant at 12 weeks after treatment completion, suggesting a persistent effect of HILT (Nazari et al., 2019). Ten HILT sessions over 2 weeks proved to be more effective on pain and function (ROM and WOMAC) than low-intensity pulsed ultrasound (LIPUS) (Samaan et al., 2022). HILT and hot pack for 10 sessions over 2 weeks proved to be more efficient than ultrasound, TENS, and hot pack on pain and function (WOMAC), with a lingering effect after 6 weeks (Ciplak et al., 2018). HILT (three sessions/week, 4 weeks) was significantly more effective than ESWT (four weekly sessions) on pain and function (WOMAC, 6 MWT) after treatment completion (Mostafa et al., 2022). Comparing eight weekly sessions of HILT to high-intensity magnetic stimulation (HIMS) with a standard protocol (shockwave therapy, TENS, massage, physical exercise) showed better scores for pain and function in the HILT patients after therapy (Katana et al., 2023). Two of the six above-mentioned trials followed patients after the end of the therapy for 6 and 12 weeks and noted the persistence of significantly better results for HILT therapeutic schemes (Nazari et al., 2019; Ciplak et al., 2018).

CONCLUSIONS

With the analysis of the studies reviewed, it might be concluded that HILT was effective in pain reduction, outperforming LLLT and some combinations of physical modalities or drug administration. When function and disability were assessed, HILT might produce significant improvement. The success of the achievements was documented for an interval between one week and 4 months in the reported studies.

Declaration by authors

The authors hereby declared that it was their original peace of research and had not been sent to any other journal for publication.

Ethical approval

Approved.

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Conflict of interest

The authors declared no conflict of interest.

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