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Shedding Light on Knee Osteoarthritis Management: How High-Intensity Laser Therapy can Impact Results

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OVERVIEW OF KNEE OSTEOARTHRITIS

Osteoarthritis (OA) is the most common musculoskeletal disease worldwide affecting about 528 million people.[1] The knee is the most frequently affected joint accounting for approximately 85% of OA cases. Knee OA is a chronic, progressive joint disorder characterized by the degeneration of articular cartilage, subchondral bone remodeling, and synovial inflammation. Knee OA develops when the protective cartilage that cushions the ends of the bones in the knee gradually wears down.[2] This leads to bone-on-bone contact causing pain, swelling, stiffness, and reduced mobility. Over time, pain and loss of movement become chronic resulting in a decreased quality of life for OA sufferers.[1,2] In addition, due to being limited in physical activity, these individuals can be at higher risk for developing other conditions such as obesity, diabetes, and cardiovascular issues.[1]

Risk Factors

- **Age:** Most common in individuals older than 55
- **Gender:** Women are more frequently affected than men
- **Obesity:** Increases mechanical stress on the knee joint
- **Joint injury or overuse:** Especially in athletes or labor-intensive occupations
- **Genetics:** Family history of OA[1,3]

Symptoms

- Pain during or after movement
- Joint stiffness, especially in the morning or after inactivity
- Swelling and tenderness
- Decreased range of motion
- Crepitus[1,3]

TREATMENT STRATEGY FOR KNEE OSTEOARTHRITIS

Knee OA is a complex condition with pain occurring from inflammatory and mechanical mechanisms and therefore can require using multiple treatment options to address patient complaints.[2] Not all patients will present with the same symptoms, so it is important to tailor treatments to the needs of the specific patient. Questions to consider are:

- What is the level of pain?
- When does the patient have pain?
- What is the location of the pain?
- Does the patient have stiffness and/or swelling?
- What is the patient's functional level?
- Is muscle weakness involved?

Keeping patients active should be the goal for managing knee OA because exercise and movement can lessen the severity of symptoms and reduce the risk of disease progression.[1] However, pain, weakness, and other complications of knee OA can prevent patients from achieving these movement goals. Addressing these impairments is critical to helping patients remain active.

Here's a look at some of the complications that knee OA patients experience and tools that can be used to help treat them:

Complications	Tools
Stiffness from capsular and/or soft tissue restrictions	High-intensity laser therapy (HILT), extracorporeal shockwave therapy (ESWT), manual therapy (MT)
Pain	Electrical stimulation, HILT, MT
Swelling	Thermal agents, compression, exercise
Weakness due to inhibition from pain	Neuromuscular electrical stimulation, exercise, HILT, ESWT
Poor endurance due to inactivity/ pain with activity	Exercise, electrical stimulation, weight loss management
Poor balance/ difficulty maneuvering	Functional training, strength/ endurance training, knee braces/ assistive devices

Given the progressive and chronic nature of knee OA, patients may also require additional pharmacological and surgical treatments such as:

- Topical non-steroidal anti-inflammatory drugs (NSAIDs)
- Oral NSAIDs
- Opioids
- Intra-articular injections with corticosteroids or hyaluronic acid
- Osteotomy
- Partial knee replacement
- Total knee replacement[2,3]
- Knee OA braces

FOR ADDITIONAL INFORMATION:

WATCH THE MANAGEMENT OF KNEE OA WEBINAR WITH FEATURED GUEST, DR. KARIN SILBERNAGEL, PT, PHD, ATC, FAPTA

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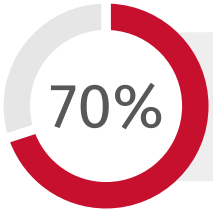
HIGH-INTENSITY LASER THERAPY: A MODALITY FOR ADDRESSING PAIN AND STIFFNESS

Managing a patient's pain is a key component of a successful physical therapy plan of care. Pharmacological agents can be used to minimize pain, but these come with the risk of side effects.

What if there was a non-invasive drug-free method to reduce pain?

Enovis® LightForce® therapy lasers are the right tool for this job. LightForce lasers are FDA-cleared to treat joint pain, joint stiffness, and arthritis pain.



A recent retrospective study on the efficacy of LightForce therapy lasers demonstrated that 93% of knee OA patients treated with laser had a clinically significant reduction in pain.[4]

The American Academy of Orthopaedic Surgeons recommendation is that "FDA-approved laser treatment may be used to improve pain and function in patients with knee osteoarthritis."[5]

HILT can result in beneficial therapeutic results such as the alleviation of pain, increased blood flow, muscle relaxation, and relief from joint stiffness.[6-8] Relieving pain and increasing muscle relaxation allows patients suffering from Knee OA to get more out of their therapy program which can lead to improved outcomes and an accelerated recovery.

HILT is a form of light therapy based on the photochemical process called photobiomodulation (PBM). In PBMT, a light source is placed near or in contact with the skin; the light energy penetrates the skin, reaching the mitochondria of damaged or diseased tissue, leading to photobiomodulation.

The application of a therapeutic dose of light to impaired or dysfunctional tissue leads to a cellular response mediated by mitochondrial mechanisms involved in pain relief and tissue repair processes.[7] **Power is a key factor when delivering a therapeutic dose to deep target tissues. Not only do LightForce® lasers have higher output powers, but they also have larger beam areas, making them more capable of delivering a therapeutic dose to larger treatment areas, as is needed with Knee OA.**

The primary target (chromophore) for the PBM process is the cytochrome c complex which is found in the inner membrane of the cell mitochondria. Cytochrome c is a vital component of the electron transport chain that drives cellular metabolism. As light is absorbed, cytochrome c is stimulated, leading to increased production of adenosine triphosphate (ATP), the molecule that facilitates energy transfer within the cell.[7-9]

In addition to ATP, laser stimulation also produces free nitric oxide and reactive oxygen species. Nitric oxide is a powerful vasodilator and an important cellular signaling molecule involved in many physiological processes. Reactive oxygen species have been shown to affect many important physiological signaling pathways including the inflammatory response. In concert, these molecules have been shown to increase growth factor production and promote extracellular matrix deposition.[8]

The physiological effects that result are:

- Analgesia
- Increased tissue oxygenation and nutrition
- Increased synthesis of ATP
- Impacting the biochemical pathways involved in tissue repair
- Increased microcirculation [8,9]

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RESEARCH REVIEW: HIGH-INTENSITY LASER THERAPY AND KNEE OSTEOARTHRITIS

High-intensity laser therapy has become increasingly popular in the physical therapy field as research continues to support the benefit it provides when added to treatment protocols. For example, a recent systematic review and meta-analysis by French et al. looked at the efficacy of several different electrophysical modalities when used as an adjunct to exercise therapy to treat knee osteoarthritis. The study concluded that adjunctive laser therapy is the only modality that showed a statistically significant benefit in pain and function in the short term when compared to placebo treatment.[10]

Numerous other studies have been published on the efficacy of HILT in treating pain from Knee OA. Here are summaries of a few articles with results substantiating that HILT can:

Effectively alleviate pain and improve function when combined with exercise

Reduce pain long term

Give patients better outcomes than treatment with lower power lasers

EFFICACY OF HIGH-INTENSITY LASER THERAPY IN COMPARISON WITH CONVENTIONAL PHYSIOTHERAPY AND EXERCISE THERAPY ON PAIN AND FUNCTION OF PATIENTS WITH KNEE OSTEOARTHRITIS: A RANDOMIZED CONTROLLED TRIAL WITH 12-WEEK FOLLOW UP[11]

Ahmad Nazari, Azar Moezy, Parisa Nejati, Ali Mazaherinezhad

Purpose: This study was conducted to determine the efficacy of high-intensity laser therapy (HILT), conventional physical therapy (CPT), and exercise therapy (ET) on the pain and function of patients with knee osteoarthritis (KOA).

METHODS

Treatments: 93 patients with mild-to-moderate KOA were randomized to either:

- **ET only:** standardized at home protocol of 9 exercises to be completed twice daily for 12 weeks.
- **CPT + ET:** at home exercises as described above and transcutaneous electrical nerve stimulation alternating with ultrasound conducted 3 times per week for 4 weeks.
- **HILT + ET:** at home exercises as described above with laser therapy 3 times per week for 4 weeks. Laser therapy device peak power was 5 W, and patients received a total dose of 2,400 J per session.

Assessments: Outcome measures included the visual analogue scale (VAS), Timed Up-and-Go test (TUG), knee flexion, 6-min walk test (6MWT), and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) subscales. Outcome measures were assessed at baseline, post-intervention (4 weeks), and at 12 weeks.

RESULTS

- At 12 weeks, all 3 groups showed statistically significant improvement in VAS, TUG, knee flexion, 6MWT, and WOMAC compared to baseline.
- The HILT + ET group was **significantly better** than the other groups after treatment and at 12 weeks follow-up in VAS, knee flexion, and WOMAC. One of the biggest effects seen was in the VAS. The HILT + ET group had a 43% reduction in pain score at the 4 week timepoint (compared to 36% in the CPT + ET group and 21% in the ET group) and the pain relief continued out to the 12 week follow-up.

Conclusion: HILT + ET is more effective than conventional physical therapy plus exercise and exercise alone at improving the pain and function of KOA patients, and the positive effects of HILT last long-term.

EFFECTS OF LOW-LEVEL AND HIGH-INTENSITY LASER THERAPY AS ADJUNCTIVE TO REHABILITATION EXERCISE ON PAIN, STIFFNESS AND FUNCTION IN KNEE OSTEOARTHRITIS: A SYSTEMATIC REVIEW AND META-ANALYSIS[12]

Mohd Azzuan Ahmad, Mohamad Shariff A. Hamid, Ashril Yusof

Purpose: This systematic review and meta-analysis was conducted to examine the effects of Low-Level Laser Therapy (LLLT) and High-Intensity Laser Therapy (HILT) combined with rehabilitation exercise on pain, stiffness, and function in knee osteoarthritis (KOA) patients.

METHODS

Study Selection: Included randomized controlled trials comparing LLLT + Exercise (LLLT + E) or HILT + Exercise (HILT + E) against exercise alone or with placebo laser.

Assessments: Outcome measures included in the analysis were the visual analogue scale (VAS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) subscales.

RESULTS

- **Studies Reviewed:** 10 studies (6 on LLLT + E, 3 on HILT + E, 1 on both).

Findings:

- **LLLT + E:** Analysis of the studies using LLLT + E demonstrated that the VAS and WOMAC scores significantly improved in both the laser therapy group and control group post-treatment. However, the VAS and WOMAC function scores were significantly better in the LLLT + E group compared to control.
- **HILT + E:** The studies using HILT + E also demonstrated that the VAS and WOMAC scores significantly improved in both the laser therapy group and control group post-treatment. The VAS and WOMAC function, pain, and stiffness scores were all significantly better in the HILT + E group compared to control.

Due to a limited number of studies, a direct comparison of HILT to LLLT could not be completed. However, the data suggests that HILT + E has a larger effect in reducing knee pain and stiffness and improving function compared to LLLT + E.

Conclusion:

- Both LLLT and HILT are beneficial adjuncts to rehabilitation exercise for KOA.
- Given the larger effect that HILT + E has on pain, function, and stiffness compared to LLLT + E, the authors suggest that high-intensity lasers are the better choice to combine with exercise to manage KOA.

COMPARISON BETWEEN LOW-LEVEL AND HIGH-INTENSITY LASER THERAPY AS AN ADJUNCTIVE TREATMENT FOR KNEE OSTEOARTHRITIS: A RANDOMIZED, DOUBLE-BLIND CLINICAL TRIAL[13]

Ahmad MA, Moganan M, A Hamid MS, Sulaiman N, Moorthy U, Hasnan N, Yusof A.

Purpose: This study was conducted to determine whether high-intensity laser therapy (HILT) or low-level laser therapy (LLLT) provides better pain and functional outcomes for patients with knee osteoarthritis (KOA) when used as an adjunct to exercise therapy (EX).

METHODS

Participants: 34 adults with mild-to-moderate KOA.

Treatment: All participants completed an exercise program tailored to the individual's needs and was conducted weekly for 12 weeks. Participants were randomly assigned to either:

- **HILT + EX:** Patients in this group were treated with laser therapy once per week for 15 minutes for 12 weeks. The laser had an output power of 5 W, and patients received a total dose of 3,190 J per session.
- **LLLT + EX:** Patients in this group were treated with laser therapy once per week for 15 minutes for 12 weeks. The laser had a peak output power of 400 mW, and patients received a total dose of 400 J per session.

Assessments: Study outcome measures included the Knee Injury and Osteoarthritis Outcome Score (KOOS), Numerical Pain Rating Scale (NPRS), active knee flexion, and Timed Up-and-Go test (TUG). Outcomes were assessed prior to start of laser therapy and after 12 weeks of treatment.

RESULTS

- **Improvements:** Though both groups showed statistically significant improvements in KOOS, NPRS, active knee flexion, and TUG scores compared to baseline, the HILT + EX group performed significantly better in all outcomes. The HILT + EX group also demonstrated clinically significant improvement in KOOS and NPRS.
- **HILT vs. LLLT:** HILT is better than LLLT in relieving KOA patients' pain and improving their physical function and knee-related quality of life. For example, the average LLLT + EX group pain score decreased by 32%, but the average HILT + EX group pain score decreased by 50%. In addition, the average KOOS score for the HILT + EX group improved by 32% while the LLLT + EX group improved by only 11%.

Conclusion:

- **Effectiveness:** Combining laser therapy with knee rehabilitation exercises improves KOA patients' knee pain, function, and mobility. Because the best results were seen when patients were treated with a high-intensity laser, the authors suggest that HILT is the more effective treatment option than LLLT for managing KOA.

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