

The role of laser therapy devices in the treatment of musculoskeletal disorders

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Abstract

This study provides a scientific analysis of the role of laser therapy devices in the treatment and rehabilitation of musculoskeletal disorders (MSDs). The aim of the study was to evaluate the clinical effectiveness of Low-Level Laser Therapy (LLLT) and High-Intensity Laser Therapy (HILT), as well as to describe their mechanisms in reducing pain, suppressing inflammatory processes, and promoting tissue regeneration. In modern physiotherapy and rehabilitation practice, laser therapy has demonstrated significant potential for improving clinical outcomes and accelerating functional recovery.

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Relevance

According to the World Health Organization (WHO), musculoskeletal disorders are among the leading causes of disability worldwide, affecting more than 1.71 billion people globally (WHO, 2021). In Uzbekistan, musculoskeletal diseases account for approximately 18–22% of overall morbidity and continue to increase annually.

Chronic conditions such as osteochondrosis, osteoarthritis, and arthritis reduce work capacity and significantly impair quality of life. Conventional pharmacological treatments may be associated with adverse effects and limited long-term efficacy, thereby increasing the demand for effective physiotherapeutic interventions.

Laser therapy is a non-invasive, painless, and modern physiotherapeutic modality that is increasingly utilized in rehabilitation medicine.

Materials and methods

The study was based on an analysis of 47 clinical trials, 6 meta-analyses, and 3 systematic reviews published between 2015 and 2024 and indexed in the PubMed, Scopus, and Web of Science databases.

Two principal forms of laser therapy were evaluated. Low-Level Laser Therapy (LLLT) employs a power range of 1–500 mW and wavelengths between 630 and

1064 nm and is primarily used for superficial tissues and pain management. High-Intensity Laser Therapy (HILT) utilizes power outputs ranging from 1 to 12 W and a 1064 nm Nd:YAG laser, enabling deeper penetration into muscles and joint structures.

Clinical outcomes were assessed using the Visual Analog Scale (VAS), the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), the Oswestry Disability Index (ODI), and ultrasound imaging. The BTL-6000 HILT, Chattanooga Vectra Genisys, and THOR Photobiomodulation systems were comparatively analyzed.

Results and discussion

LLLT reduced pain intensity by 58.3% on the VAS scale compared with 21.4% in the control group (Alayat et al., 2022). HILT demonstrated prolonged analgesic effects lasting up to 72 hours after treatment.

A meta-analysis conducted by Bjordal et al. (2007) reported that LLLT reduced pain by 29.8 mm on a 100-mm VAS scale and improved functional activity by 30.1%. Furthermore, a 2023 Cochrane review confirmed statistically significant benefits of laser therapy compared with placebo treatment.

Laser irradiation has been shown to decrease prostaglandin E₂ and interleukin-1 β levels by approximately 40–45% while inhibiting TNF- α production, thereby reducing inflammation without the adverse effects commonly associated with nonsteroidal anti-inflammatory drugs (NSAIDs).

Photobiomodulation increases mitochondrial ATP production by 30–50%, stimulates fibroblast proliferation, and enhances collagen synthesis. As a result, tendon and ligament healing may be accelerated by approximately 35–40% (Hamblin, 2018).

Doppler studies have demonstrated that laser therapy increases local blood flow by 25–38% and improves capillary permeability and lymphatic drainage.

Combined physiotherapeutic approaches incorporating laser therapy, magnetotherapy, and massage have been shown to produce 15–20% better clinical outcomes than laser therapy alone.

Conclusion

Laser therapy, including both LLLT and HILT, is a scientifically supported, safe, and effective modality for the treatment and rehabilitation of musculoskeletal disorders. Clinical evidence indicates that laser therapy significantly reduces pain, suppresses inflammation, accelerates tissue regeneration, and enhances functional

recovery. Owing to its non-invasive nature, minimal side effects, and compatibility with pharmacological treatment, laser therapy has become an important component of modern rehabilitation medicine. Further large-scale clinical studies and the development of standardized treatment protocols are recommended to optimize its clinical application.

Keywords

Laser therapy; Low-Level Laser Therapy (LLLT); High-Intensity Laser Therapy (HILT); musculoskeletal disorders; osteochondrosis; osteoarthritis; arthritis; rehabilitation; physiotherapy.