Review Article

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Efficacy of High Intensity Laser Therapy (HILT): A Review of Literature

Jagmohan*, Saurabh Sharma**

Abstract

Laser therapy irradiation have shown a positive response to the damaged and impaired oxygenation because of trauma, inflammation and swelling. Although there are numerous evidences for the low laser therapy in view of this but coming into existence is the High intensity laser therapy(HILT) which at present has got only a limited number of evidences in case of soft tissues injuries. It has been reported that the use of HILT provides a significant reduction in pain levels in acute and chronic conditions such as Osteoarthritis, Rheumtoid arthritis, Carpal tunnel syndrome,Fibromyalgia, Subacromial impingement syndrome(SAIS)etc [1-3]. The aim of the review article is to review the available researches done on the soft tissue injury management by High intensity laser therapy and to be able to bring about a common conclusion.

Keywords: High Intensity Laser Therapy(HILT); Low Level Laser Therapy(LLLT); Subacromial Impingement Syndrome(SAIS); Post Mastectomy Pain Syndrome(PMPS); Lateral Epicondylitis.

Introduction

The term LASER stands for " Light amplification by stimulated emission of radiations". Lasers for many decades have been used in a variety of medical applications such as LASIK, laser hair removal, surgeries etc. Low energy laser was pioneered in Europe and Russia [4]. Andre Mesterfirst observed the cellular changes in mice caused by a low level of laser energy in the year 1950(Mester 1967). Since then thousands of studies have been done to estimate the influence on cellular repair, reproduction or inhibition. (Hode and Turner 2002).

There are three basic principle of lasers, i.e. Collimation, Coherence and Monochromacity so it is the amplification of electron spin rates by passing photon energy through a particular medium to produce a single unidirectional laser beam having a different wavelength than the original beam [5]. Therapeutic lasers work on the mechanism of photo-biostimulation i.e. stimulation occurs at multiple levels of the cell, vascular structures, immune system and interstitial tissues.Photochemical effects occurs when laser light is absorbed by a chromophore. The most supported mechanism is that cytochrome C absorbs light from 500nm to 1100nm due to the specific properties of this large molecule (Karu 1995). Karu suggested that once the light is absorbed Cytochrome C is excited which entrails a cascade of reactions which causes short term activation of the respiratory chain (eg. Cytochromes, cytochrome oxidase and flavine dehydrogenase), leading to changes in redox status of both mitochondria and cytoplasm

Low level laser therapy (LLLT) has been under investigation and clinical application for more than 30 years, among which many studies favors the safety and efficacy of LLLT. Around the year 2000, lasers were widely used in the physical therapy and occupational therapy which are low level having a power output between 5mW TO 500mW. These devices have called "Low level laser" or "cold laser ". Cold laser term was coined because almost therapeutic lasers when used clinically will produce a small temperature changes in tissue if used for any significant time. The important thing to focus is that rise in the tissue temperature is not by the cause of cellular changes but it is caused by photochemical response to the absorbed laser light.

The expansion of laser therapy for pain

Author Affiliation: *MPT Student, **Assistant Professor, Jamiamilliaislamia, New Delhi-110025.

Reprint Request: Saurabh Sharma, Assistant Professor, Centre for Physiotherapy and Rehab Sciences, Jamia Millia Islamia, New Delhi-110025.
E-mail: saurabh14332003@yahoo.com

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management, inflammatory reduction and accelerated healing has driven the need for higher power output levels and longer wavelengths resulting in penetration of deeper tissues, since past 1 decade, there has been increasing trend to increase the power density and dose of lasers which brought high intensity laser therapy(HILT) into existence. Earlies therapeutic lasers offered a power output of only 5mW but current FDA cleared lasers can provide up to 10,000mW of power output. The best clinical results are achieved when an optimal number of photons reach the target tissue. The therapeutic dose of lasers is measured in Joules(J) delivered per cm^2. The World Association of Laser Therapy has established that the target tissues require a dose of 5-7 J/cm^2 to bring about a biological cellular response.

More recently, a form of high intensity laser therapy was introduced in physical therapy i.e. Pulsed Neodynium-doped yttrium aluminum (Nd:YAG) laser as compared to traditional lasers such as Helium Neon (He-Ne) and Gallium Aluminum Arsenide lasers(GaAlAs) which are almost outdated now. Nd:YAG works with a peak power of about 3kW and wavelength of 1064nm and considered to be a non-painful and non-invasive therapeutic electrotherapy modality. Higher intensity laser radiation causes minor and slow absorption of light by chromophores which is not obtained with concentrated light but with diffuse light in all directions (scattering phenomenon) resulting in increased mitochondrial reactions and ATP, RNA or DNA production (photochemistryeffects) and causing tissue stimulation (photobiologyeffects) HLLT has got an advantage over LLLT that it is able to penetrated deeper and so stimulates large and deep tissues [6]. Earlier studies have well documented the anti-inflammatoryand analgesic and anti-edematous effects of Nd:YAG lasers, justifying the evidence to incorporate in patient with pain issues. Here I review the available papers about the effectiveness of high intensity laser therapy in soft tissues. An online research from PubMed, science direct, laser medical science using the key words High intensity laser therapy(HILT) was performed.

Review of Articles

In a randomized control trial, Andrea et al [7] (2009) studied the short term effectiveness of HILT vs ultrasound therapy in 70 patients with subacromial impingement syndrome over 2 weeks, results showed greater pain reduction and improved articular movement and muscular strength of the affected shoulder after 10 treatment sessions with HILT as compared to US therapy group over a period of 2 consecutive weeks.

In an another study, Alayat et al [8] (2014) compared the effects of HILT alone or combined with exercise in the treatment of chronic low back pain in 72 male patients over 4 weeks and 12 weeks of follow up. Outcome measures such as Lumbar range of motion, VAS, Roland Disability Questionnaire (RDQ) and Modified Owestry Disability Questionnaire(MODQ). Results were HILT combined with exercise appeared more effective than either HILT alone or placebo laser with exercise.

Alayat et al [9] (2014) conducted a randomized control trial to compare the effects of low level laser therapy(LLLT) Vs high intensity laser therapy (HILT) on 53 knee osteoarthritis patients. Results revealed that HILT and LLLT combined with exercise program were efficient indecreasing the VAS and WOMAC scores after 6 weeks of treatment. However, HILT with exercises was much more efficient than LLLT withexercises and both modalities were better than exercises alone in the treatment ofpatients with knee OA.

In an another randomized doubleblind placebo control trial by Alayat et al [10] (2016) investigation of the effects of HILT in 60 chronic neck pain patients taking into account outcome measures such as cervical ROM,VAS and Neck Disability Index(NDI). After 6 weeks of treatment, cervical ROM, VAS and NDI scores improved significantly in all the groups but HILT with exercise showed much better results during in group comparison.

Another randomized study by Haladaj et al [11] (2015) assessed the progress of rehabilitation in 150 patients with cervical radicular pain syndrome after using two different methods of treatment: HILT(Group 1) and Spinal traction withSaunders device(Group 2). Results showed greater analgesic efficacy, improved global mobility and reduced functional impairment in patients treated with Saunders method as compared to HILT group.

Dundar et al [12] (2015) did a prospective, randomized, controlled study to investigate the effects of HILT in patients with lateral epicondylitis and further comparing it with results of brace and placebo HILT. Results at 4 weeks and 12 weeks of treatment showed significant improvement for HILT and brace groups in pain scores, grip strength, disability scores and several subparts for short form 36 health survey.

Akkurt et al [13] (2016) investigated short and long term effects of HILT in 30 lateral epicondylitis

patients on VAS, DASH and Hand Grip Strength test (HGST). Results showed activity and resting VAS, DASH and HGST scores significant improved following treatment at 6 months.

In another double blind, placebo control, randomized study by Ebid et al [14] (2015) to assess the long term effect of pulsed HILT in treatment of the post mastectomy pain syndrome(PMPS) in 61 patients for 4 weeks. Outcome measures were VAS, Shoulder ROM and Quality of life(QOL). Results showed significantly increased shoulder ROM in laser group after 4 weeks of treatment and after 12 weeks of follow up as compared to the placebo group and QOL showed a significant improvement in laser group which still improved after 12 weeks of follow up.

Discussion

However only few studies have been done on high intensity laser therapy(HILT) efficiency on soft tissues, regarding the results of most studies, it seems that HILT can be an appropriate alternate for the current treatment as compared to other electrotherapy modalities such as low level laser and ultrasound therapy which were among the mainstay of the treatment.

Andrea et al [7] showed that HILT is better than ultrasound therapy in short term effectiveness in 70 SAIS patients over 2 weeks of treatment. However, there is a need for long term effectiveness and contradictoryfact about the soft tissue healing in 2 weeks.

Alayat et al [8] showed that isolated HILT is not effective in treating chronic low back pain but that study has a lack of exercise therapy protocol in conjunction with HILT which signifies the limitation of HILT.

Another study by Alayat et al [9] compared the LLLT with HILT on 53 OA patients which showed that both the modalities are effective in relieving pain if used with exercises but effects of HILT with exercises were much more pronounced than LLLT with exercises.

Alayat et al [10] studied effectiveness of HILT on chronic neck pain of 60 patients over 6 weeks which again showed the HILT with exercises are beneficial.

Haladaj et al [11] showed thatSaunders device is more effective than HILT in chronic radicular pain syndrome which showed that HILT has not limitations without any other active intervention.

In lateral epicondylitis, HILT proved to be beneficial as compared to placebo and brace groups by Dundar et al [12] which shows the efficacy of HILT in tendinosis, however the chronicity of lateral epicondylitis was not mentioned in the study.

Another study by Akkurt et al [13] on short term and long term effects of HILT in lateral epicondylitis showed increased functionality but pre-treatment and post-treatment ultrasonographyevaluation could have added to the knowledge for the of tendon composition and changes as a result of laser irradiation.

HILT was found to be beneficial in post-mastectomy pain syndrome in a study Ebid et al [14].

There are different mechanism for the pain attenuation by the lasers which include increase in ATP production, prostaglandin(PG) synthesis, conversion of PG type G and PG type H_2 into PG type I_2 , increased pain threshold in nerve fibers, decreased histamine and serotonin secretion, increased local microcirculation, promoting angiogenesis, decrease bradykinin production , lymph node circulation and edema decline, increased serotonin secretion in urine, increase in beta-endorphins CSF levels, increased glucocorticoids urinary secretions, changes in activity of epinephrine and norepinephrine, modulates inflammatory pain by reducing the levels of biochemical markers (PGE2 ,mRNA Cox2 , IL-1β , TNF-α), oxidative stress and neutrophil cell influx [15-17].

Conclusion

HILT is an effective treatment for the soft tissue injuries when combined with a suitable exercise therapy protocol. HILT alone has got very limited number of evidences to support the effectiveness. Moreover, HILT focuses on the symptoms of the injury rather than targeting the actual cause for it, so further evidences are required to support the isolated effectiveness of HILT.

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