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Effect of high intensity laser in the treatment of myofascial trigger points in symptomatic knee osteoarthritis: A randomized single-blinded controlled trial

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ABSTRACT

Background: Osteoarthritis (OA) is one of the most prevalent causes of musculoskeletal pain and disability among the middle age and elderly population. It significantly affects the overall quality of life of the affected individuals. **Objectives:** To find out the impact of high intensity laser therapy (HILT) on myofascial trigger points (MTrPs) in symptomatic knee OA. **Methods:** This is a single-blinded pre–post randomized experimental trial. A total of 40 patients, both male and female, falling within the age group of 35-55 years, BMI 25–29.9 Kg/Cm^2, diagnosed with bilateral knee osteoarthritis (grade 2), were recruited as participants of the study. All the participants were clinically evaluated for the signs and symptoms of myofascial pain, tenderness over the vastus medialis muscle and the medial head of the gastrocnemius muscle. The participants were randomly allocated into two groups with n=20 in each group. The participants of the experimental group received high-power laser therapy and underwent exercises on the MTrPS of the vastus medialis and the medial head of the gastrocnemius muscle. The participants of the control group received placebo laser "sham laser" and underwent exercises for the vastus medialis and the medial head of the gastrocnemius muscle. A blood cortisol level test, pressure algometer, digital electronic goniometer, and the KOOS-PS questionnaire were used to measure the pain level, pain threshold, knee ROM, and knee function. Outcome assessment was done at Day 0 and post intervention at the end of 4 weeks. **Results:** The MANOVA test revealed that both groups improved significantly in all parameters at week 4, with the HILT group improving

more than the sham group in blood cortisol levels, pressure algometer measures, knee passive ROM, and KOOS scores (P < .05). **Conclusion:** HILT is an efficient approach in the treatment of MTrPs in knee OA.

KEYWORDS: Myofascial pain syndrome; High Intensity Laser Therapy; Knee osteoarthritis

1. INTRODUCTION

Osteoarthritis (OA) is one of the most prevalent causes of musculoskeletal pain and disability among the middle age and elderly population. It significantly affects the overall quality of life of the affected individuals (Briggs et al., 2016). Among the pool of contributing factors, changes in the environment has significant contribution in the high incidence of OA in the last few generations (Gluck man &Hanson, 2008; Lieberman, 2015).

OA is still a complex whole-joint illness, with its appearance and development involving the modification of articular cartilage and the synovium, subchondral bone, ligaments, and muscles via sophisticated pathogenic processes (Roemer et al., 2018; Castrogiovanni et al., 2019). The true etiology of these mechanisms, which include acute and/or chronic insults from general wear and tear, obesity, age, and joint injuries, is unclear (Andriacchi, 2013). The knees, hands, and hips are the most prevalent sites for OA occurrence, with knee OA being the most frequent (Michael et al., 2010).

In a patient with OA, the commonly observed symptoms include, pain in the joints, stiffness, limitations and restrictions of motion, motor and sensory dysfunction, and impaired functioning. All these symptoms create negative impact on the overall quality of life of the affected individuals by prohibiting them from the active participation in their normal physical and daily life activities (Harish & Kashif, 2013). Most of the affected individuals seek medical consultation due pain in the knee joints. Pain and stiffness affect physical functioning of the OA patients which hamper their everyday activities if left untreated or ignored. It increases their risk of physical disability (Harish & Kashif, 2013).

Many investigations have highlighted the conflicts between the symptoms of the patients and the radiographic findings (Kornaat at al., 2006; Link et al., 2003; Pollard et al., 2008). This

could be due to the referred pain originated from the myofascial trigger points (MTrPs) in the surrounding muscles (myofascial pain), which cannot be observed via imaging

The term myofascial pain is described as "a complex of sensory, motor, and autonomic symptoms caused by MTrPs" (Simons et al., 1999). MTrPs, are hyperirritable regions in the skeletal muscles, which are linked to the hypersensitive palpable nodules in a taut band. Previous researches identified a high incidence of myofascial pain in patients with knee OA (Alburquerque-Garcia et al., 2015; Bajaj et al., 2001; Henry et al., 2012; Itoh et al., 2008).

In a recent study conducted by Henry (2012), MTrPs were identified in the medial head of the gastrocnemius (92%) and the vastus medialis muscle (67%) among the patients with Osteoarthritis. Myofascial Pain Syndrome (MPS) treatment comprises activation of trigger points, relaxation of taut bands, and interruption of the pain-spasm-ischemia-pain cycle. The most commonly adopted treatment methods for MPS include; education, exercise, non-steroidal anti-inflammatory drugs (NSAIDs), superficial and deep heat therapy, laser treatment, electrotherapy, and local injections (Alvarez & Rockwell, 2002; Esenyel et al., 2000).

Laser therapy is a non-invasive, painless therapy used in treatment of variety of conditions. Recently, high intensity laser therapy (HILT) was introduced to the field of physical therapy. HILT has been widely used in the treatment of various musculoskeletal disorders (Kim et al., 2015). HILT has more beneficial effects that LLLT. HILT has more depth of penetration than in comparison to the LLLT (Zati & Valent, 2006). In many researches it has been evidenced that HILT has anti-inflammatory, anti-edematous, and analgesic properties, which supports its successful application in the pain management (Saggini et al., 2009). The present study was conducted with the aim to find out the effectiveness of HILT in the management of MTrPs in knee OA patients.

2. METHODS

This is a single-blinded pre–post randomized experimental trial. The present study was conducted in compliance with the Helsinki Declaration (1964) and the Consolidated Standards of Reporting Trials guidelines (Itoh et al., 2008) within the time frame of February 2021 to April 2021. The ethical approval was obtained from the local ethical committee board (CU-

NILES/19/20). The present study has been registered in the clinical trial registry at ClinicalTrials.gov, Registration number NCT05148416.

2.1. Participants

A total of 40 patients, both male and female, falling within the age group of 35-55 years, (BMI) 25–29.9 Kg/Cm^2, diagnosed with bilateral knee osteoarthritis (grade 2), were recruited as participants of the study. All the participants were clinically evaluated for the signs and symptoms of myofascial pain, tenderness over the vastus medialis muscle and the medial head of the gastrocnemius muscle. Five major and one of the minor criteria was used for contributed to the diagnosis of MTrPs. The participants fulfilling the diagnostic criteria for MTrPs were recruited for the present study. The major criteria included; local knee pain, referred pain from trigger points, the presence of a palpable and taut muscular band in implicated muscles, reduced ROM, and sensitivity throughout the length of the taut band. The minor criteria included; clinical pain reproduction or changed sensation via pressure on the tender spot, elicitation of a local twitch response via transverse snapping palpation at the tender spot of the taut band, and pain relief via elongation (stretching) of the muscle or release of the tender spot (trigger point). However, the individuals with the history of reactive synovitis, malignant tumors, chronic infection, Cushing's syndrome, who had undergone knee joint arthroplasty surgery and had undergone hyaluronic acid application in the previous 6 months were excluded from the study. The participants recruited for the present study were instructed to avoid taking analgesics or NSAIDs during the course of the study. The participants were recruited from a private outpatient clinic by random sampling method. All the participants were randomly allocated into two groups. The list of group assignment was enclosed in an opaque sealed envelope (Schulz, 1995). The experimental group participants received intervention with LASER, HILT and exercise sessions and control group participants received sham HILT and underwent exercises.

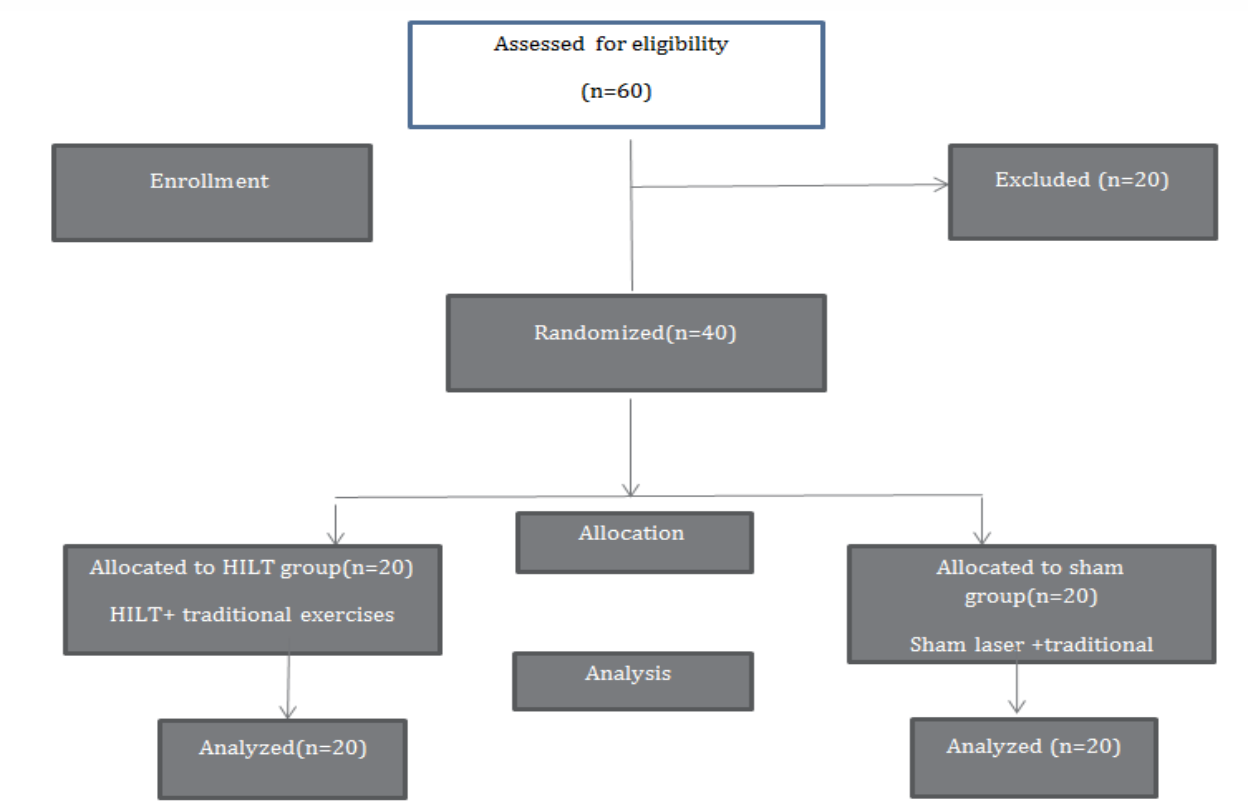

Figure 1. Flow chart

2.2. Sample size calculation

A preliminary power analysis (power (1−α error P) = 0.95, α = 0.05, effect size = 1.187) was performed to avoid a type II error. In the present study a total of 40 individuals were selected as the participants for the study. The participants were randomly allocated into two groups with n=20 in each group. The effect size was computed based on a pilot study conducted on 12 participants with n=6 participants in each group. The G*Power 3.1.9.2 software was used to perform the power analysis, which included the use of the t-test family and the statistical test difference between two independent means (two groups).

2.3. Interventions

The participants of both the groups completed stretching exercises for both the vastus medialis and gastrocnemius muscles, ROM exercises for knee flexion and extension, and isometric strengthening exercises for the previously mentioned muscles. These exercises were conducted under the supervision of a physiotherapist for 30 minutes a day, 3 days a week for a total of 4 weeks (Kudo et al., 2013).

2.3.1. Laser group

In the Experimental group, 20 participants were allocated by random allocation method. The participants of the experimental group received high-power laser therapy and underwent exercises on the MTrPS of the vastus medialis and the medial head of the gastrocnemius muscle. Before starting with the intervention, the surface area of the marked trigger point was sanitized with alcohol. LASER therapy was given using Zimmer high-power laser (with 810 and 980 nm and a maximal output power of 7 w, made in Germany) equipment. LASER therapy was given with the help of a probe, kept perpendicular to the targeted surface i.e. knee joint. The total energy supplied to the participant during a session was 1060 j in 3 therapy phases.

In the first phase, the knee joint line, the vastus medialis muscle, and the medial head of the gastrocnemius muscle underwent rapid manual scanning. The scanning was conducted in both transverse and longitudinal directions over the two muscles. During this phase, a total energy dosage of 500 j was administered. In the 2nd phase, the LASER application was done using a hand piece with the spacer kept vertically at 90 degrees to the previously detected painful active trigger points of the two muscles. In this phase, a total energy of 60 j was administered. The 3rd phase included slow manual scanning of the two muscles with a total energy of 500 j. HILT was administered once a day, three days a week, for four weeks (Figure 3).

Figure 2. High-power laser used in the study

Figure 3. Application of HILT on vastus medialis

2.3.2. Sham group

In the Experimental group, 20 participants were allocated by random allocation method. The participants of the control group received placebo laser "sham laser" and underwent exercises for the vastus medialis and the medial head of the gastrocnemius muscle. The sham group received the same HILT therapy procedure as the active group, but the laser equipment was turned off during application. The same physiotherapist conducted all laser applications to the participants of the control group.

2.4. Outcomes measures

Pre-post intervention assessment was done at baseline i.e. Day 0 and at the end of 4 weeks post intervention using various outcome measures. The intensity of pain was assessed using blood cortisol levels, and the pressure pain threshold (PPT) was determined using a Commander Algometer (JTECH medical, Midvale, Utah, USA). The Arabic neck disability index (KOOS-Ps) was used to assess knee function, and the digital electronic goniometer was used for passive knee ROM assessment.

2.4.1. Pain intensity

Blood cortisol levels were used in many researches as a blood biomarker for pain (Lin et al., 2014). Serum cortisol level was measured by collecting blood sample of the participants

between 9 a.m. and 1 p.m. 5 mL of blood was collected twice from the cubital pain of the participants.

2.4.2. Pressure pain threshold

The Commander Algometer (JTECH Medical, Midvale, Utah, USA) was used to measure the pain pressure threshold (PPT). It is a hand-held tool that uses manual pressure to test pain sensitivity in deeper structures. It is a valid tool that has been widely used to measure the pain pressure threshold (PPT). The algometer's tip was positioned on the trigger area, and pressure was raised at a rate of one kilogram per second. When the patient expressed discomfort and verified it verbally, the pressure measurements were recorded as kg/cm2. This technique was followed three times at 60-second intervals and the average score was recorded (Fabio, 1998; Vanderween et al., 1996).

2.4.3. Knee function

The changes in functional disability were measured using the KOOS score. KOOS is a valid and reliable questionnaire that is used to assess the functioning and the quality of life of the individuals suffering from osteoarthritis or any type of knee joint injury (Bekkers et al., 2009; Salavati et al., 2008; Goncalves et al., 2009). KOOS is a self-reported, joint-specific questionnaire with 42 items divided into five subscales: pain (9 items), symptoms (7 items), activities of daily living (17 items), sport and recreational activities (5 items), and knee-related QoL (4 items). Every item is assigned a score ranging from 0 (no issues) to 4 (major issues). The scores have been adjusted to a 0–100 scale for every subscale, with higher values reflecting better status (Roos & Lohmander, 2003).

2.4.4. Passive knee ROM

A digital electronic goniometer Halo device was used to measure passive knee ROM through a standard procedure of measurement. The electro goniometer device is considered as a standard, simple, portable, valid, and reliable tool for measurement of the range of motion of the joints (Goodwin et al., 1992; Norkin & White, 1985). The ROM measurement was done at baseline and at the end of 4 weeks post intervention at every joint site using the procedures recommended by Joseph et al. (2011). The goniometer placement was done at predetermined anatomical sites. The passive movement was performed. Once the end range was attained, the

goniometer was again positioned over the same anatomical landmarks. A total of 3 measurements were recorded for every movement. All measures were completed by the same tester, blinded to the group of the participants.

To measure the knee joint flexion, the participant was asked to lie down prone with the test-side ankle off the plinth, the leg extended, and the knee passively flexed. Goniometer placement: Axis location – lateral epicondyle of the femur; stationary arm – along the femur to the greater trochanter; movement arm – along the fibula to the lateral malleolus.

To measure the knee joint extension, the participant was asked to lie down supine with the test-side ankle off the plinth, the knee flexed, and passively extended. Goniometer placement: Axis location – lateral epicondyle of the femur; stationary arm – along the femur to the greater trochanter; movement arm – along the fibula to the lateral malleolus.

2.5. Statistical analysis

Statistical analysis of the collected data was done using SPSS for Windows, version 26 (SPSS, Inc., Chicago, IL). The data verification was done for normality assumptions followed by the removal of extreme scores before final analysis. Descriptive analysis was done employing the histograms, the bell shaped curve and Shapiro-Wilk test was performed for establishing data normality. Descriptive analysis revealed that, data was normally distributed among both the groups with respect to the variables of the study which included, age, BMI, cortisol level, algometer measures of the right vastus point 1, the left vastus point 1, the right vastus point 2, the left vastus point 2, the right gastrocnemius point 1, the left gastrocnemius point 1, the right gastrocnemius point 2, the left gastrocnemius point 2, right knee flexion, left knee flexion, right knee extension, left knee extension, and KOOS. 2×4 mixed-design MANOVA was done for between group comparison and within group comparison for each variable. Two independent factors were tested in this study. The first was the (test group) where there were two levels to the subject factor (laser group and the conventional treatment group). The second was the periods of measurement, which was a two-level factor within the subject (before treatment and after treatment). The alpha level was set as 0.05.

3. RESULTS

A total of 40 patients were involved in the statistical analysis, with n=20 in each group. No significant difference was found between demographic characteristics (age and BMI) of the participants between both the groups, with $p > 0.05$ at day 0, as shown in the Table 1.

Within group comparison was done using Bonferroni pairwise test. The findings of the test revealed statistically significant difference with $p< 0.05$ on comparison between pre and post intervention scores of all the tested variables within experimental group. The tested variables were: cortisol level, algometer measures of right vastus point 1, left vastus point 1, right vastus point 2, left vastus point 2, right gastrocnemius point 1, left gastrocnemius point 1, right gastrocnemius point 2, left gastrocnemius point 2, right knee flexion, left knee flexion, right knee extension, left knee extension, and KOOS. However, in the sham group statistically significant difference was found with $p< 0.05$ on comparison between pre and post intervention scores of all the tested variables except for the cortisol level

While the Bonferroni pairwise comparison between both the groups revealed statistically non-significant results with $p> 0.05$ on comparison between pre scores of all the tested variables between group A and group B. However, While the Bonferroni pairwise comparison between both the groups revealed statistically significant results with $p< 0.05$ on comparison between post intervention scores of all the tested variables between group A and group B as shown in the Table 2.

Table 1. Patient demographic data for both groups

Qualitative Variables	**Laser Group**	**Traditional Group**	**P-value**
	Mean ± SD	**Mean ± SD**	
Age (years)	46.6 ± 6.995	46.3 ± 5.774	0.918
BMI	28.54 ± 0.919	27.84 ± 1.471	0.218

Table 2. Comparison between (Mean±SD or Median) values of measured outcome variables pre- and post-treatment within and between groups

		Laser Group (n= 20) Mean±SD	**Traditional Group (n= 20) Mean±SD**	**P-value (between groups)**
Serum cortisol level	Before treatment	10.959±1.466	9.82±1.832	0.0621
	After treatment	7.469±0.929	9.4±2.008	0.0129*
	P-value	0.0001*	0.1568	
Algometer of Rt. vast. point (1)	Before treatment	2.23±0.406	2.71±0.679	0.071
	After treatment	4.53±0.359	3.22±0.761	0.0001*
	P-value	0.0001*	0.0008*	
Algometer of t. vast. point (1)	Before treatment	2.38±0.459	3.02±0.857	0.052
	After treatment	4.52±0.397	3.91±0.706	0.0285*
	P-value	0.0001*	0.0001*	
Algometer of Rt. vast. point (2)	Before treatment	2.3±0.452	2.72±0.516	0.0687
	After treatment	4.72±0.262	4.42±0.29	0.0258*
	P-value	0.0001*	0.0001*	
Algometer of Lt. vast. point (2)	Before treatment	2.55±0.675	2.54±0.613	0.9727
	After treatment	4.43±0.55	3.38±0.727	0.0019*
	P-value	0.0001*	0.0005*	
Algometer of Rt. gastro. point (1)	Before treatment	2.83±0.435	2.54±0.69	0.2755
	After treatment	4.19±0.363	3.61±0.681	0.0287*
	P-value	0.0001*	0.0001*	
Algometer of Lt. gastro. point (1)	Before treatment	2.44±0.611	2.59±0.669	0.6071
	After treatment	4.38±0.454	3.61±0.753	0.0127*
	P-value	0.0001*	0.001*	
Algometer of Rt. gastro. point (2)	Before treatment	2.22±0.496	2.16±0.728	0.8318
	After treatment	4.13±0.554	3.16±0.834	0.0067*
	P-value	0.0001*	0.0001*	

Algometer of Lt. gastro. point (2)	Before treatment	2.58±0.452	2.19±0.837	0.2112
	After treatment	4.32±0.447	3.37±0.797	0.0041*
	P-value	0.0001*	0.0001*	
Rt. knee flexion	Before treatment	92.32±10.469	93.98±8.526	0.702
	After treatment	112.76±12.647	100.43±9.278	0.023*
	P-value	0.0001*	0.0001*	
Lt. knee flexion	Before treatment	97.94±7.092	93.91±8.66	0.2698
	After treatment	114.49±10.555	102.22±9.454	0.0135*
	P-value	0.0001*	0.0001*	
Rt. knee extension	Before treatment	172.35±2.194	174.08±4.618	0.2987
	After treatment	179.05±2.075	175.71±4.275	0.0393*
	P-value	0.0001*	0.008*	
Lt. knee extension	Before treatment	175.72±3.007	174.67±4.286	0.5339
	After treatment	180.86±2.179	177.26±4.097	0.0246*
	P-value	0.0001*	0.0001*	
KOOS	Before treatment	26.3±15.72	30.5±16.748	0.5703
	After treatment	65.1±14.302	48.5±16.702	0.0281*
	P-value	0.0001*	0.0001*	

**Notes: Vast. = Vastus medialis; Gast. = Gastrocnemius; KOOS = Knee injury and Osteoarthritis Outcome Score; * = significant at P < 0.05.*

4. DISCUSSION

The pathophysiology of myofascial pain syndrome is associated with inappropriate acetylcholine activation at the neuro-muscular junction, which causes the sarcomere to contract in continuation, leading to the development of a taut band. This further leads to the development of a situation known as “energy crisis” occurring as a consequence of the release of the materials from the injured muscle and the extracellular fluid surrounding the MTrPs; pain occurs as a result (Simons, 2004; Climent et al., 2013).

The major findings of the study included significant improvement in the level of pain indicated by lowering blood cortisol level and increased PPT in both the vastus medialis and the gastrocnemius muscles, increased knee ROM and knee functional activities in the laser group compared to the sham laser group.

In the experimental group, HILT was employed, which included high laser radiation that produces minimal and slow light absorption via chromophores. This absorption occurs due to the concentration of the light rays at the targeted area as well as due to the diffusion effect (scattering phenomena). It enhances the mitochondrial oxidative response and adenosine triphosphate (ATP), ribonucleic acid, or deoxyribonucleic acid creation with the unique and specific characteristics of HILT. In HILT a particular waveform is used in which there are regular peaks of elevated amplitudes for a very short time followed by a pause interval. The pause interval helps in the reduction of the of thermal buildup phenomena in tissues; it is also capable of quickly inducing photothermal and photochemical impacts in underlying deep tissues (Zati and Valent, 2006).

The relationship between pain (acute or chronic), the hypothalamic-pituitary-adrenal axis, and cortisol levels has been extensively studied (Tennant, 2013). Therefore, such biochemical indicators of stress and muscle injury (cortisol and creatine kinase, or CK) could be linked to the myofascial pain in the individuals diagnosed with knee OA. CK and cortisol were utilized as indirect indicators of muscle injury as they are the effective methods for measurement of the stress level in a muscle (Foschini et al., 2007; De souza vale et al., 2009). Under stressful and painful conditions, cortisol creates a catabolic condition in the metabolism and is released into the bloodstream as a pulsatile stress hormone. People with chronic pain who are subjected to constant stress have higher cortisol levels than healthy individuals (Eichler et al., 2019).

To the best of researcher's knowledge, this is the first study that measured the effect of HILT on the cortisol levels. In the same context, Mu-Lein et al. (2014) who assessed the efficiency of LLLT and cupping on lower back pain used plasma cortisol levels as an assessment method for assessment of pain in the sample participants. Authors of the study concluded that the measurement of the serum cortisol levels was a useful method for assessment of pain in combination with the scores of VAS. This is in agreement with the findings of Santamato et al. (2009) who, conducted their study on 70 patients, diagnosed with subacromial impingement syndrome. They concluded that HILT had significant effect on intensity of pain among the

participants of the study. Furthermore, Alayat et al. (2014) reported that HILT coupled with exercise appeared to be more helpful in relieving pain in patients experiencing chronic lower back pain than either HILT alone or placebo laser in combination with the exercise sessions.

Moreover, a similar study was conducted by Dundar et al. (2015) on 76 female patients with MPS of the trapezius muscle. Authors of the study stated that HILT is an effective method for treating myofascial pain syndrome of the trapezius muscle. Hatem et al. (2020) also investigated the effectiveness of HILT as an adjunct to physiotherapy techniques on cervical MTrPs. The results of the present study were also in accordance to a study conducted by Fiore et al. (2011). The findings of his research suggest that HILT can have a greater benefit in reducing lower back pain and its associated disability. Additionally, high-intensity LASER with combined wavelengths of 830 nm and 1064 nm, which generate a superior transparency with lower scattering and high-energy transfer, were found to be superior to transcutaneous electrical nerve stimulation in alleviating pain, paresthesia, and neurophysiological variables in carpal tunnel syndrome (Casale et al., 2012). The current results were also supported by a study conducted by Štiglić-Rogoznica et al. (2011). Authors of this study stated that HILT patients showed a statistically significant decrease in pain. As a result, HILT has an excellent and rapid analgesic impact.

The underlying mechanism for pain relief by HILT on MTrPs may be explained because laser treatment utilizes photons of light energy for inducing bio-simulative impacts on the cells of the body, inflicting no further harm or trauma. When a section of the skin's surface is irradiated, photons penetrate tissue cells and are absorbed via photo acceptor molecules inside the membrane of the cell and cytosolic organelles, like mitochondria. Light energy is absorbed through chromospheres within the mitochondrion, particularly by cytochrome c oxidase, in which it is converted into biochemical energy, resulting in physiologic reactions that promote ATP synthesis, cell proliferation, healing of wounds, tissue repair, as well as regeneration (Parr et al., 2010). Moreover, it is believed that the exposure of the tissues to the laser therapy following injury inhibits the release of pro-inflammatory cytokines, that hold key importance in an acute inflammatory response (Bjordal et al, 2003).

Laser treatment has been shown to reduce pain by affecting peripheral nociceptors directly or indirectly. It further causes reduction in the nerve conduction velocity, alteration in the neural membrane depolarization potential, reduction in the muscular spasm and edema

(Bjordal et al., 2003). The most important clinical effects are analgesia and bio stimulation. The analgesic impact is produced by high-power pulsed applications within the body through the creation of photomechanical waves that reach the subcutaneous pain receptors, and activate the A beta fibers, thereby shut the gate for pain transition (as per Melzack's gate control theory; Melzack, 1993). The capacity to bio-stimulate cell proliferation and repair is known as the bio-stimulation impact (Tache-Codreanu et al., 2015).

Application of HILT over MTrPs create some photo thermal energy, which is transmitted into deeper tissues, helping to resolve the local energy need or energy crisis close to the MTrP (Climent et al., 2013). Moreover, HILT increases blood flow creating better vascular permeability, and provides good cellular metabolism (Santamato et al., 2009; Kujawa et al., 2004). It therefore helps to repair damaged muscles and removes the painful stimulus. This physiological explanation justifies the significance results and beneficial effects of HILT on MTrPs with respect to the reduction in cortisol level. Thus, it is strongly believed that LASER therapy itself can alter tissue and cellular function, depending on its unique characteristics of coherence and wave length (Basford, 1995).

Multiple processes exist in the Central nervous system, Peripheral nervous system, and at the level of injured tissues which contribute to the pain reduction produced by HILT. At the level of the CNS, there was a significant increase in the secretion of endogenous opioids and b-endorphins, which are stimulated as a result of exposure to laser therapy and consequently inhibit pain sensations. As the level of PNS, laser treatment had shown to reduce substance P secretion (responsible for sensitizing pain-transmitting neurons and leading to hyper-algesia). Additionally, laser therapy may prolong the latency and lower the conduction speed of sensory nerves by blocking A-delta and C-fiber transmission potentially reducing pain-signal transmission. Laser therapy can lower histamine release and bradykinin in injured tissues and raise the pain threshold at the tissue level. The different underlying mechanisms implicated in the regulation of pain in MPS are explained in various studies (Song et al., 2018).

The significant improvement in the knee ROM and knee function could be attributed to the effect of HILT on pain relief, which is represented by the decrease of serum cortisol levels and increase in pain pressure threshold measures. The current findings agreed with the study conducted by Ordhan et al. (2018). Authors of the study concluded that improvement in the functional activity scores of the foot and ankle was found in the participants of the HILT group

than the LLLT group with positive impact on the quality of life of the participants. Moreover, these results are in agreement with the study conducted by Gocevska et al. (2019). The authors of the study stated that more improvement was observed in the functional activity scores of the participants having low back pain, who were treated with HILT.

The existing study had few limitations, which included lack of follow-up of the participants. This made difficult for the researchers to predict for how long the effect of HILT would persist in the affected individuals. As a result, the authors recommend that future research should be conducted to find out the effect of HILT on the different age groups, and the follow up should be taken, including varied follow-up periods in the research design.

5. CONCLUSION

Based on the findings of the study, the research team concluded that HILT is effective in decreasing level of pain, lowering blood cortisol levels, increasing functional performance, and improving QoL for patients with MTrPs with symptomatic knee OA.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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