Original Article

Therapeutic Effects of Low Level Laser Therapy (LLLT) in Knee Osteoarthritis, Compared to Therapeutic Ultrasound

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Abstract:

Introduction: Low-level laser therapy (LLLT) is thought to have analgesic and biomodulatory effects. Our objective was to assess the pain- relieving effect of LLLT and possible changes in joint stiffness and disability of patients with knee osteoarthritis (KOA) and compare it to the more commonly used modality; therapeutic ultrasound(US).

Methods: 37 patients with mild or moderate KOA were randomized to receive either LLLT, placebo LLLT or US. All patients received a common treatment including acetaminophen (up to 2gr/d) and medical advices for lifestyle modification and exercise. Treatments were delivered 5 times a week over a period of 2 weeks. Active laser group was treated with a diode laser (wavelength 880 nm, continuous wave, power 50 mW) at a dose of 6 J/point (24 J/knee). The placebo control group was treated with an ineffective probe (power 0 mW) of the same appearance. The third group received pulsed ultrasound with an intensity of 1.5-2 w/cm^2, and for 5 minutes per knee. Visual Analogue Scale (VAS) and Western Ontario MacMaster (WOMAC) questionnaires were used for data gathering before,1 and 3 months after completing the therapy.

Results: Pain reduced in all 3 groups but laser was superior in comparison. Stiffness improved 1 mo after therapy in the laser group but not in the others. Disability decreased in both laser and US groups (more significantly in the laser group) but not in the placebo group.

Conclusion: Our results show that LLLT reduces pain, joint stiffness and disability in KOA and is superior to placebo and US.

Keywords: low level laser; knee; osteoarthritis

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Introduction

Osteoarthritis or degenerative joint disease is delineated by destruction of joint cartilage combined with subchondral sclerosis, joint space

narrowing, marginal osteophytes, subchondral cysts and finally joint deformation. Osteoarthritis is the most common joint disorder and more commonly affects the weight bearing joints such as knee (1). Complaints of patients with knee osteoarthritis (KOA) include pain and joint stiffness which make patients restrict their activities. So KOA can cause significant disability and affect quality of life (2). Recently laser has been considered as a non-invasive method of treatment for KOA. Several mechanisms (such as increase in microcirculation, decrement of neutrophil activity, decrease in inflammatory biomarkers,…) have been suggested for its effect. The aim of this study is to gather evidence of the analgesic effect of low-level laser as well as its effect in decreasing joint stiffness and disability of patients with KOA.

Methods

Both male and female patients with mild to moderate knee osteoarthritis (KOA) were recruited to the study. Inclusion criteria comprised: 1-Mild destructive alterations detected by radiograph (Kellgren-Lawrence stage 1-3); 2- lack of history of other joint disorders such as RA, Calcium pyrophosphate deposition disease (CPPD), gout, knee fracture or surgery; 3- knee pain for at least 2 months.

Reasons for exclusion consisted of: 1-considerable deformity of the varus or valgus, ankylosis, or severe flexion contracture; 2 -Physiotherapy or intra articular injection during the past 6 months; 3- Severe destructive alterations detected by radiograph (Kellgren-Lawrence stage 4); and the common contraindications for laser therapy. Sixty-two patients were selected for the examinations, but only 37 patients (33 women and 4 men) completed the study, 13 of whom were in the active Low -level laser therapy (LLLT) group, 12 in the placebo LLLT group and 12 in the ultrasound group. The patients who left the experiment provided no reasons for doing so, nor did they return to the institute. The demographic data on the patients included in the study are summarized in Table 1.

A detailed case history and physical status were recorded. Various examinations were conducted prior to treatment in order to rule out other diseases and to attain patient homogeneity. Those who underwent treatment were given full disclosure

Table 1. Demographic data according to treatment procedure

	Group			
	Active LLLT	**Ultrasound**	**placebo LLLT**	**P-Value**
Age	61.7 ± 2.9	47.5 ± 7.1	61.2 ± 7.2	0.96
Gender				
Male	2 (16.7%)	1 (8.3%)	1(7.7%)	0.73
Female	10 (83.3%)	11 (91.7%)	12(92.3%)	

and signed an agreement form on participation in the study. Permission was granted for this study by the Institute's Research Ethics Committee. The patients received no other therapies or pain medication. During the study patients received acetaminophen (up to 2 gr/d), and medical advices for life style modification and exercise. Treatments were administered five times a week over a period of 2 weeks with a low power laser (power 50 mW, continuous wave, wavelength 880 nm) or with a placebo probe (power 0 mW) of the same appearance and display. Ultrasound treatment was given in pulsed method, 1 MHz, with a dose of 1.5-2 w/cm^2, for 5 minutes per knee. Randomization was ensured by having patients randomly choose sealed envelopes from a bowl containing an equal number of slips with either number 1, 2 or 3, which corresponded to one of the laser, probe or therapeutic ultrasound (US) groups. Neither the patients nor the operator knew which was the active or placebo LLLT probe. Treatment was administered in skin contact only over the joint which caused the most explicit complaints. The dose delivered was 6 J/point. In one session, a patient was given a total dose of 24 J/cm^2. The size of the point in the focus of the laser light was nearly 1 mm^2; that is to say, the power density was approximately 50 mW/1 mm^2. Treatment was administered over the femoral and tibial condyles in every case since enthesis is often responsible for the complaints mentioned by the patients. Laser irradiation was aimed at the synovia and cartilage in the joint line. The points that were irradiated were the medial and lateral epicondyles of the tibia and femur, the medial and lateral knee joint gap, and the medial edge of the tendon of the biceps femoris muscle and semitendinous muscle in the popliteal ditch (Figure 1).

The placebo group was treated with an ineffective probe (power 0 mw) and with the same method. The third group received pulsed ultrasound with the intensity of 1.5-2w/cm^2 and for 5 minutes per

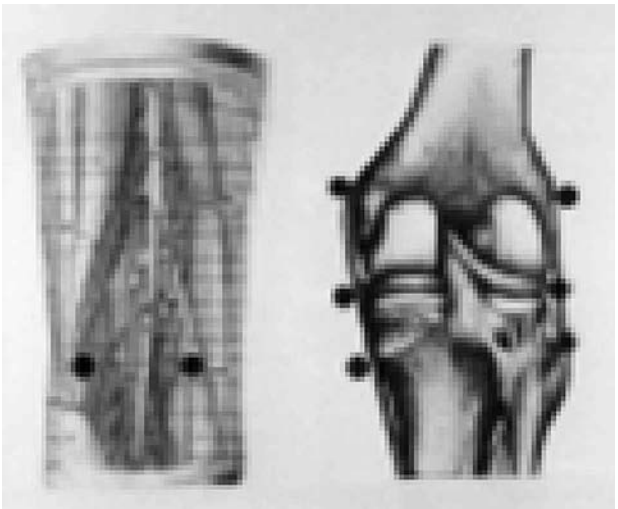

Figure 1. Irradiated points.

knee.VAS and WOMAC questionnaires were used for data gathering before and 1, 3 months after completing the therapy.

Results

The graph shows changes in the parameters examined, plotted against time, for treatment with active and placebo LLLT probes and ultrasound. Certain examination times were compared to the initial data; a comparison was also made between the two groups for the time of examination. For statistical analysis, t- tests were used for within-group differences and ANOVA for between-group comparison over time. In the active laser group VAS was 6.3 before treatment (BT), 4.5 1m AT and 4.8 3m AT. In the group treated with the placebo LLLT probe, VAS 5.2 BT, 4.5 1m after treatment(AT), and 4.4 3m AT. In the US group VAS was 5.4 BT, 4.4 1m AT and 4.1 3m AT. The VAS changes 1m AT was significantly more considerable in the active laser compared to other groups ($p \geq 0.05$).

WOMAC pain subscale was 9.6 BT, 6.3 1m AT and 7.1 3m AT in the active laser group. In the placebo group WOMAC pain subscale was 6.9 BT, 6.2 1m AT and 6.1 3m AT. In the US group WOMAC pain subscale was 8.5 BT, 6.6 1m AT and 6.5 3m AT. WOMAC pain subscale improvement in the active laser group was more significant 1 mo AT compared to other groups and 3m AT compared to the placebo group ($p \geq 0.05$).WOMAC disability subscale was 23.5 BT, 20 1m AT and 21.3 3m AT in the active laser group. In the placebo group WOMAC disability subscale was 21.6 BT, 21 1m AT and 20.1 3m AT. In the US group WOMAC disability subscale was 22.6 BT, 20.3 1m AT and 20.8 3m AT. WOMAC stiffness subscale change in the active laser group was more significant 1and 3m AT compared to other groups and 3m AT compared to the placebo group ($p \geq 0.05$). In the active laser group WOMAC stiffness subscale was 2.2 BT and1.5 1 & 3m AT. In the placebo group WOMAC stiffness subscale was 2.2 BT, 2 1m AT and 2.3 3m AT. In the US group WOMAC stiffness subscale was 1.4 BT, 1.3 1m AT and 1 3m AT. WOMAC stiffness subscale improvement was more considerable in the active laser group 1m AT compared to other groups ($p \geq 0.05$).

Discussion

Our measurement results provide evidence that treatment with the active LLLT probe resulted in significant improvement for all evaluated parameters. In the placebo LLLT group, we found significant changes in pain, but not in joint stiffness and disability. In the ultrasound group, pain and disability were improved but stiffness did not change. In the active LLLT group, we found significant improvement with regard to pain, stiffness and disability in comparison with the placebo and US groups. The positive effects obtained from active LLLT still persisted 3m after treatment except for joint stiffness. Over the years many studies have been published on the effects of LLLT. These articles also showed the favorable anti -inflammatory and analgesic effects of LLLT (3). Gur showed that LLTT improves pain in fibromyalgia (4). Bignol demonstrated that pain reduction happens as the effect of LLLT in patients with shoulder pain (5). Pain improvement in myofacsial pain syndrome with laser irradiation was also shown by Bahrami (6). Tosteson noticed increase in Range Of Motion (ROM) and decrease in pain in patients with Low Back Pain (LBP) with laser therapy (7). Hgedus concluded that improvement of pain, ROM and microcirculation happens after LLLT in patients with knee OA (8). Tascioglu demonstrated that LLLT affects pain, stiffness and disability in patients with knee OA and improves these parameters (9).With evaluation of the results obtained, we noticed reduction in pain, stiffness and disability in patients with knee OA.

Conclusion

Our experience showed that low-level laser is an effective treatment for short-term improvement in patients suffering from painful KOA.

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