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Laser Acupuncture in Knee Osteoarthritis: A Double-Blind, Randomized Controlled Study

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ABSTRACT

Objective: **The purpose of this study was to investigate the effects and minimum effective dose of laser acupuncture in knee osteoarthritis (KOA), and to determine if it is superior to placebo treatment (sham) in the evaluation of clinical-functional outcome and quality of life.** ***Methods:*** **In this randomized, placebo-controlled study, patients with grade 2 and 3 primary KOA were selected. Group I (*n* = 27) received 904-nm low-level laser irradiation with 10 mW/cm^2 power density, 4 mW output power, 0.4 cm^2 spot size, 0.48 J dose per session, and 120-sec treatment time on the medial side of the knee to the acupuncture point Sp9. Group II (*n* = 25) received placebo-laser therapy at the same place on the same point. Patients in both of the groups had treatment 5 days per week (total duration of therapy was 10 days) and 20 min per day. The study was comprised of a 2-week (10-session) intervention. Participants were evaluated before treatment (baseline), after treatment (2nd week), and at the 12th week. In this double-blind study, a blind examiner carried out all outcome assesments. The main outcome measures were as follows: pain on movement (pVAS), 50-foot walking time (50 foot w), knee circumference (KC), medial tenderness score (MTS), Western Ontario and McMaster Universities osteoarthritis index (WOMAC), and Nottingham Health Profile (NHP).** ***Results:*** **Statistically significant improvement was observed in PVAS, 50 foot w, and KC in group 1. In Group II, statistically significant improvement was observed in PVAS, 50 foot w, and WOMAC. When groups were compared with each other, the improvement observed in KC was superior in Group I at the 2nd week (*p* = 0.005).** ***Conclusion:*** **Laser acupuncture was found to be effective only in reducing periarticular swelling when compared with placebo laser.**

INTRODUCTION

OSTEOARTHRITIS (OA) is a major cause of disability and is among the most frequent forms of musculoskeletal disorders.[1] It is characterized pathologically by both focal loss of articular cartilage, and marginal and central new bone formation.[2] OA is strongly associated with aging, and with the increasing proportion of elderly in Western populations, large joint OA, particularly of the knee, will become an even more important healthcare problem.[2–4] Knee osteoarthritis (KOA) is associated with symptoms of pain and functional disability. Physical disability arising from pain and loss of functional capacity reduces quality of life and increases the risk of further morbidity and mortality.[2,5]

The objectives of the management of KOA are pain relief, maintainence and improvement of mobility and minimizing disability. There are several guidelines on the management of OA. They are mostly based on the evidence of the various interventions like patient education, pharmacological and non-pharmacological therapy and surgery.[6–9]

A new non-invasive therapy, low-level laser therapy (LLLT),[10] was added 10 years ago to existing physical therapy agents used in physiotherapy in the treatment of OA. LLLT is a light source that generates extremely pure light of a single wavelength. The effect is not thermal but rather related to photochemical reactions in the cells. The effectiveness of laser therapy is still unclear and needs to be examined more rigorously.[10,11]

It is known that pain anatomically follows pain receptors initially consisting in the depolarized peripheral nerve endings. Electrical, chemical, thermal, or luminous stimuli are sufficient to evoke an action potential with sodium ions passing to the inside and potassium ions passing to the outside, stimulating A delta fibers opening the filter to tactile sensations capa-

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ble of inhibiting pain fibers. This is called the gate control theory,[12] and laser acupuncture as a luminous stimulant may have analgesic effect in this way.[11] However, a meta-analysis on the effect of LLLT on musculoskeletal pain showed that LLLT has no effect on musculoskeletal pain syndromes.[13] The results of laser therapy on the pain sensation of OA patients are conflicting. Some authors found no improvement in pain sensation in OA patients with laser therapy.[10,14,15] In contrast, other authors found significant improvement in pain relief with laser therapy.[16–18]

In this study, we investigated the effects of low level laser irradiation on the Sp9 acupuncture point[19]; an acupoint for knee with excitable muscle/skin/nerve complexes with a high nerve ending density and intended to find out the minimum effective dose with respect to clinical-functional outcome and quality of life in KOA.

METHODS

Patients

A total of 55 patients ages 42–65 (53 women, two men) were included in our study with KOA and randomized into LLLT (n = 28) and plasebo-laser (n = 27) therapy groups. KOA diagnosis was made according to the American College of Rheumatology criteria. Those patients with Kellgren and Lawrence grade 2 and 3 KOA were included, and the most painful knee was taken for evaluation.[20,21] The patients had an average pain intensity of 40 or more on a 100-mm Visual Analoque Scale (VAS) for the last month before baseline assesment. Patients who had knee surgery, serious valgus or varus deformity or who had hormonal, metabolic, or systemic rheumatologic problems leading to secondary KOA were excluded. Patients who had physiotherapy in the last 6 months were excluded also. Local-oral analgesic or nonsteroid antiinflammatory drug use in the previous 4 weeks or patient having a systemic disease (cardiac-cerebrovascular-pulmonary system or malignancy) that contraindicated to physiotherapy and exercise were also excluded. Recruitment attempts were made by calling patients from the Atatürk Rehabilitation and Rheumatology Center outpatient department. Of 105 prospective patients who responded, 41 of them did not meet the inclusion criteria, and nine of them refused to join the study. All of the participants were given written informed consent, and hospital ethical committee approval was obtained. The university research committee sponsored the research project.

Assignment

Participants were randomly assigned to laser acupuncture and placebo (sham therapy) groups. Simple randomization was done by using a computer generated table of random numbers and treatment allocation to groups was concealed. An independent researcher gave instructions to the patients for the questionnaires and performed the outcome measurements.

Intervention

The study was comprised of a 2-week (10-session) intervention. Participants were evaluated before treatment (baseline), after treatment, and at the 12th week.

Group I (n = 28) received LLLT. Group II (n = 27) received placebo laser therapy. Patients in both of the groups had treatment for 20 min per day and 5 days per week (total duration of therapy was 10 days). Treatments were performed in the same location and under the same conditions for both of the groups using the same physical agent (infrared 27 GaAs diyode laser instrument, Roland Serie Elettronica Pagani). The laser used in the intervention group had an output power of 4 mW, 10 mW/cm^2 power density, 0.4 cm^2 spot size, 120-sec treatment time and 0.48 J dose per session. The irradiation was pulsed (duration of 1 pulse was 200 nanosecond), and only one point was treated with contact application technique. The treatment was applied to the medial side of the knee to the acupuncture point (Sp9) on the sural nerve, which is associated with knee pain.[19] Sham laser therapy, 0 J/cm^2, was used in the plasebo group. The laser had a switch for placebo and true laser selection, and patients were allowed to see the red light of the instrument to be convincing. Laser units were checked by the manufacturer just before the patients started. Uludag University Physics Department also checked the units. A home-based, standardized exercise program was given to all of the patients in both of the groups by a physiotherapist. The exercise consisted of 10 sets of isometric contraction to quadriceps muscle and active range of motion exercises (20 repetitions) for knee. At the end of the 12th week, patient response was assessed by phone, and the patient was called for the third examination. They were instructed not to use any analgesic or non-steroid antiinflammatory drugs (NSAID) during the follow-up period.

Masking

In this double-blind study, allocation to groups was concealed, and a blind examiner carried out all outcome assesments. Participant blinding was optimized by using the same physical agent at the same place and at the same time. The most painful knee was evaluated. The statistician was unaware of treatment allocations until completion of analysis.

Primary outcomes

Pain on movement (pVAS). Pain on movement was measured by VAS from 0 to 100, in 1-mm ıntervals.[22]

50 foot walking time (50 foot w). Participants were instructed to walk a standard distance as fast as they could in the outpatient department. The walking duration was recorded in seconds using a hand chronometer.[9]

Knee circumference (KC). Knee circumference was measured by a standard tape measure (cm) at the middle part of patella. The reference point was the medial malleolus, and the same distance from the medial malleolus to patella was marked to fix the measurement point in the KC evaluation.[23]

Medial Tenderness Score (MTS). The most painful point on the knee was evaluated by using a pressure algometer.[24,25] Tenderness score was obtained by applying 4 kg/cm of pressure on the inferior of the medial-tibiofemoral area (Force Dial FDK60).

WOMAC. Western Ontario and McMaster Universities osteoarthritis index (WOMAC) is a multi-dimensional measure of pain, stiffness and physical functional disability. As recom-

mended by the OMERACT (Outcome Measures in Rheumatology Clinical Trials), WOMAC parameters were scored using the five-point Likert scale (1 = no pain, 2 = mild, 3 = moderate, 4 = severe, and 5 = very severe pain). The sum of the scores (WOMAC) was obtained by adding the scores of five parameters of pain (WOMAC total pain score = W-TPS), two parameters of stiffness (WOMAC total stiffness score = W-TSS), and 17 parameters of physical function (WOMAC total physical function score = W-TPFS).[26–28]

Secondary outcomes

Quality of life. The Nottingham Health Profile (NHP)[29,30] assessed perceived physical, social, and emotional health with 38 items answered "yes" or "no." One point was given to the related question for each "yes" answer and 0 point for each "no" answer. NHP total score was obtained from the sum of the scores of the subgroups.

Statistical analysis

All statistical analyses were done under the supervision of the staff biostatistician using the SPSS 10.0 program. Posttreatment changes occuring in each group were compared with pretreatment values using Wilcoxon test. Percent changes in two groups was calculated and compared by Mann-Whitney *U* test.

RESULTS

The demographic and baseline clinical characteristics of all patients were similar between the two treatment groups (Table 1). Mean age of the patients was 55.1 years, and 97.6% of the patients were women. Distribution of the patients in each group was homogeneous according to the variables: body weight, height, body mass index, duration of the symptoms, pain, KC, WOMAC, and NHP scores. Radiographic analysis of joints, space narrowing, and marginal osteophyts showed no significant differences. Three patients dropped out without any reason; 52 patients remained (27 in LLLT and 25 in placebo group) eligible for evaluation.

Statistically significant improvement was observed in pVAS ($p = 0.036$ at the 2nd week), 50 foot w ($p = 0.024$ at the 12th week) and in KC ($p = 0.005$ at the 2nd week) in Group 1 (Table 2). In Group II, statistically significant improvement was observed in PVAS ($P = 0.01$ at the 2nd week, $p = 0.03$ at the 12th week), 50 foot w ($p = 0.03$ at the 2nd week, $p = 0.034$ at the 12th week), WOMAC ($p = 0.003$ at the 2nd week), W-TPS ($p = 0.012$ at the 2nd week), W-TSS ($p = 0.02$ at the 2nd week) and W-TPFS ($p = 0.002$ at the 2nd week; Table 2).

The results obtained from both of the groups were compared using the change scores and percent changes for each variable. Analysis of data only showed statistically significant improvement in Group I only for KC at the 2nd week ($p = 0.005$) when compared with Group II (Table 3). No systemic or local side effects (e.g., erythema, burning, blood pressure, and heart rate elavation) were observed during the study.

DISCUSSION

Though osteoarthritis is seen with the ratio of 1.7:1 in females and males at the ages of 55–65, the complaining individuals in our study are entirely women. This may be explained by pain threshold and sociocultural factors.[31,32] In the studies about chronic or experimental pain, females have higher pain prevelancy and lower pain threshold.[33,34] In addition, gained experiences, positive family factor or sociodemographic or cultural factors also can help to explain why the majority of the complaining people are women.[35]

It is shown that laser irradiation applied on the Sp9 acupuncture point on the medial side of the knee was effective in the improvement of the variables PVAS, KC, and 50 foot walking duration according to baseline values, but this improvement was not statistically superior to placebo, except with respect to KC (Tables 2 and 3). Placebo laser was effective in the im-

Table 1. Distribution of the Patients in Each Group According to Baseline Variables

	Group I	*Group II*
Female	27	26
Male	1	1
Age (years)	51.83 ± 6.83 (43–65)	53.478 ± 7.13 (42–72)
Weight (kg)	78.22 ± 21.22 (62–91)	79.11 ± 7.08 (66–94)
Height (cm)	157.63 ± 8.21 (145–148.64)	155.88 ± 8.15 (136–164)
BMI (kg/m^2)	31.76 ± 8.81 (22.47–39.69)	32.72 ± 3.71 (24.97–38.15)
Duration of the symptoms (months)	61.59 ± 51.96 (37–183)	66.59 ± 57.81 (14–179)
Duration after the diagnosis (months)	22.45 ± 23.13 (7–96)	30.90 ± 33.16 (9–145)
pVAS	6.47 ± 1.61	6.06 ± 2.17
KC	39.53 ± 3.56	38.42 ± 4.12
WOMAC	66.53 ± 17.61	51.31 ± 18.94
NHP	8.79 ± 3.77	8.06 ± 4.48

BMI; body mass index; pVAS, pain on motion with Visual Analogue Scale; KC, knee circumference; WOMAC, WOMAC total score; NHP, Nothingham Health Profile total score.

Table 2. Results and Statistical Comparisons of the Pre-treatment, Post-Treatment (2nd Week) and 12th Week Evaluations in Groups I and II

		BT (1)			*AT (2)*			*12th week (3)*				
		MV	*SD*	*95% CI*	*MV*	*SD*	*95% CI*	*MV*	*SD*	*95% CI*	*p*	*(1–3) p*
PVAS	G I	6.47	1.61	(9.6) to (3.3)	59.29	2.45	(64.1) to (1.7)	5.58	2.36	(10.2) to (1.8)	0.036*	0.056
	G II	6.06	2.17	(10.3) to (1.8)	4.94	2.64	(10.1) to (0.9)	4.81	3.49	(11.7) to (–0.8)	0.010*	0.031*
50 Foot w	G I	18.97	3.20	(25.2) to (12.7)	18.69	2.84	(24.3) to (13.4)	17.92	2.30	(22.4) to (14.5)	0.314	0.024*
	G II	20.4	4.61	(29.4) to (11.4)	19.33	4.36	(27.9) to (11.9)	18.91	3.42	(25.6) to (13.7)	0.030*	0.034*
KC	G I	39.53	3.56	(46.5) to (32.6)	38.82	3.58	(45.8) to (32.5)	39.54	3.52	(46.4) to (32.6)	0.005**	0.904
	G II	38.42	4.12	(46.5) to (30.3)	38.43	3.96	(46.2) to (30.7)	38.50	4.00	(46.3) to (30.6)	1.000	0.555
MTS	G I	4.39	1.75	(7.8) to (35.0)	3.95	1.65	(7.2) to (35.2)	3.88	1.55	(6.9) to (35.4)	0.086	0.071
	G II	5.04	2.32	(9.6) to (33.9)	4.84	2.03	(8.8) to (34.4)	4.71	2.17	(9.0) to (34.2)	0.720	0.363
WOMAC	G I	66.53	17.61	(101.0) to (32.0)	62.53	22.81	(107.2) to (17.8)	62.41	22.25	(106.0) to (18.8)	0.305	0.163
	G II	51.31	18.94	(88.4) to (14.2)	44.63	17.73	(79.4) to (9.9)	50.63	23.62	(96.9) to (4.3)	0.003**	0.460
W-TPS	G I	13.65	4.77	(23.0) to (4.3)	12.65	5.89	(24.2) to (1.1)	13.47	5.84	(24.9) to (2.0)	0.368	0.754
	G II	11.63	4.87	(21.2) to (–2.1)	10.13	4.81	(19.6) to (0.7)	11.50	5.99	(23.2) to (–0.2)	0.012*	0.918
W-TSS	G I	5.35	1.73	(8.7) to (2.0)	5.00	1.87	(8.7) to (1.3)	4.71	1.99	(8.6) to (0.8)	0.387	0.150
	G II	4.38	2.09	(8.5) to (0.3)	3.88	2.03	(7.9) to (–0.1)	3.88	2.16	(8.1) to (–0.4)	0.023*	0.107
W-TPFS	G I	47.53	12.85	(72.7) to (22.3)	44.88	16.53	(77.3) to (12.5)	44.24	15.83	(75.3) to (13.2)	0.305	0.108
	G II	35.31	13.75	(62.3) to (8.4)	30.63	12.44	(55.0) to (6.2)	35.25	16.64	(67.9) to (2.6)	0.002**	0.569
NHP	G I	8.79	3.77	(16.2) to (1.4)	7.26	5.58	(18.2) to (–3.7)	7.58	5.41	(18.2) to(–3.0)	0.097	0.180
	G II	8.06	4.48	(16.8) to (–0.7)	6.31	5.76	(17.6) to (–5.0)	6.44	6.27	(18.7) to (–5.8)	0.065	0.074

*$p < 0.05$.

**$p < 0.01$.

***$p < 0.001$.

BT, before therapy; AT, after therapy, MV, mean value; SD, standard deviation; PVAS, pain on motion with Visual Analogue Scale; 50 foot w, 50 foot walking distance; KC, knee circumference; MTS, medial tenderness score of the knee; WOMAC, WOMAC total score; W-TPS. WOMAC Total Pain Score; W-TSS. WOMAC-Total Stiffness Score; W-TPFS, WOMAC Total Physical Function Score; PGE, Patient Global Evaluation; TD, Tenderness Score; NHP, Nothingham Health Profile total score.

Table 3. Comparison of the Two Groups by Percent Changes (Both for 2nd and 12th Weeks)[a]

		BT-AT (MV ± SD)	*p*	*BT -12th week (MV ± SD)*	*p*
PVAS	Group I	–0.18 ± 0.31	0.857	–0.14 ± 0.37	0.502
	Group II	–0.25 ± 0.35		–0.3 ± 0.47	
50 Foot w	Group I	–0.007 ± 0.10	0.333	–0.05 ± 0.08	0.756
	Group II	–0.05 ± 0.07		–0.06 ± 0.10	
MTS	Group I	–0.07 ± 0.25	0.481	–0.08 ± 0.22	0.883
	Group II	0.07 ± 0.45		0.03 ± 0.44	
KC	Group I	–0.02 ± 0.03	0.005*	0.001 ± 0.02	0.403
	Group II	0.001 ± 0.007		0.003 ± 0.01	
WOMAC	Group I	–0.05 ± 0.25	0.465	–0.07 ± 0.19	0.606
	Group II	–0.13 ± 0.12		–0.04 ± 0.21	
W-TPS	Group I	–0.06 ± 0.30	0.709	–0.02 ± 0.21	0.986
	Group II	–0.12 ± 0.17		–0.02 ± 0.28	
W-TSS	Group I	–0.04 ± 0.28	0.709	–0.10 ± 0.30	0.683
	Group II	0.11 ± 0.15		–0.10 ± 0.26	
W-TPFS	Group I	–0.05 ± 0.24	0.510	–0.08 ± 0.19	0.510
	Group II	–0.13 ± 0.11		–0.02 ± 0.23	
NHP	Group I	–0.14 ± 0.54	0.656	–0.19 ± 0.49	0.607
	Group II	–0.29 ± 0.45		–0.35 ± 0.54	

[a]For all abbreviations, see Table 2.

provement of pVAS, 50 foot w, and WOMAC, but this improvement was not statistically superior to laser therapy (Tables 2 and 3). Different personal motivation and characteristics may have led to significant improvement for these variables in the placebo group. Another possibility is that individuals who did exercises better may have better pain and functional scores after therapy in addition to placebo effect. KC was affected by laser therapy, and laser therapy was superior to placebo ($p = 0.005$).

Therefore, laser irradiation was effective only in reducing the periarticular swelling evaluated by the measurement of the KC when compared with plasebo laser ($p = 0.005$; Table 3). As baseline characteristics; Group I had shorter duration of symptoms and shorter duration after diagnosis. Though this difference was not statistically significant, the probability must be noted that Group I simply may have responded more favorably to concurrent exercise benefits on periarticular swelling than group II.

Similarly, Stergioulas[36] demonstrated that 40 mW at 16 Hz LLLT was effective in reducing edema in second degree ankle sprains ($n = 15$). However, in comparison with the current study, considerably more treatment points (10 points), higher power density and dose was used in this study. Giuliani et al.[37] also reported that, very LLLT (<3 mW) was effective in reducing edema and hyperalgesia in acute and chronic inflammation if administered at the points usually selected for acupuncture. Enkephalin mRNA level was strongly upregulated in the external levels of the dorsal horn of the spinal cord in the animals with neuropatic and chronic pain.

LLLT increases metabolism at the cellular level causing accelerated ATP production, protein synthesis, DNA and RNA formation and many positive markers. At the tissue level, circulation increases, new blood and lymphatic vessels are formed, collagen synthesis is enhanced. Elevated endorphins and acetylcholine, nerve blockade, decreased synthesis of bradykinin-histamine and increased microcirculation to correct ischemia and acidosis are accepted as the pain relief mechanisms.[38]

The results for pain are conflicting. Three trials using patients with OA at different joints found no improvement in pain.[10,14,15] Two other trials found a significant improvement in pain relief with laser,[17,18,39] in morning stiffness,[39] and in knee ROM,[39] with laser. Only one RCT[40] constantly found a significant reduction of knee pain after 4, 8, or 12 weeks of LLLT (5-min stimulation time, 200-nanosecond maximum pulse duration, 2.5-kHz pulse frequency, 20-W maximum output per pulse, 10-mW average power, 1 cm^2 surface, 3 J total energy, and 30 J accumulation dose) application. Furthermore, lower dosage (2 J/cm^2) of LLLT was found to be more effective than higher dosage (3 J/cm^2) in reducing pain and improving knee range of motion. The results show no statistical improvements for any of the following: localized swelling, muscle strength, functional status, or global assessments with laser treatment.

Though they were not statistically superior to each other, both of the groups in the current study showed improvement in pain by movement. Analgesic effects of laser acupuncture may be explained by the altered sensorial input to the central nervous system by stimulating the trigger points and decrease of the perception of localized pain in the treated area.[38] Analgesic effect may be due to increased activity of the "sodium-potassium pump" or increased pain threshold by counterstimulation. Other researchers have claimed that an endogeneous opioid secretion as in acupuncture and TENS can play a role or micro-

circulatory system may be stimulated leading to the clearance of the algesic substances.[9,40,41] Wavelength, power, and pulsing modify the energetic response formed by laser irradiation. Light is an energy and may have an effect like needles, electrical stimulation, and herbs. The body's response is activated by unusual stimulus.[42]

The use of concurrent exercise program could have also led to pain relief.[39] There is also conflicting results related to pain relief between trials who applied LLLT not only on the affected joint but also on the superficial nerve.[10,18] Although there is insufficient evidence to support the idea, the greater pain reduction when nerves as well as joints were irradiated[18] suggests that this treatment strategy should be explored to enhance CNS input.

The effect of LLLT on pain sensation in the superficiel nerve endings is presented as a pain reduction mechanism due to direct stimulation of peripheral nerves, an increase of serotonin metabolism or a decrease in the amplitude of electrically evoked potentials. Moreover; it has been reported to have an increasing effect on resolution of inflammation (swelling) and chondrocyte proliferation and matrix synthesis.[43] Bjordal et al.[44] reported that LLLT at a dose of 5.4 J per point can reduce PGE_2 concentrations, inflammation, and pain in achilles tendinitis. Lopes and Martin et al.[45] suggested that LLLT at 2.5 mW, 7.5 J/cm^2 reduced inflammation (leucocyte cell migration) more than 3 and 15 J/cm^2. Ferreira et al.[46] reported that 2.5 J/cm^2 He-Ne stimulation increased the pain threshold and reduced edema by means of reduced hyperalgesic mediators instead of opioid receptors. In addition, Albertini et al.[47] reported that LLLT exerts its anti-inflammatory effect by stimulating the release of adrenal corticosteroid hormones.

In a metaanalysis for OA,[48] a total of 197 patients were randomized. Pain was assessed by three trials. The pooled estimate (random effects) showed no effect on pain, but there was statistically significant heterogeneity ($p > 0.05$). Other outcomes of joint tenderness, joint mobility, and strength were not significant. In conclusion, the results were found to conflict with other studies, which might depend on the method of application and other features of the laser irradiation.

In the study of Bingol et al.,[49] the same laser (Roland series) was used with 904-nm wavelength, 4-mV output power, 2000 Hz, and a treatment time of 60 sec resulting in approximately 2.98 J/cm^2 energy dose (calculated with the formula; $D = P \times t/A$) to treat patients with shoulder pain. The results showed better improvement in palpation sensitivity and passive extension, but no significant improvement was observed in pain, active range of motion, or algometric sensitivity in laser treatment group when compared with the control group. From a clinical standpoint, it is concluded that higher energy doses employed with more developed laser instruments could have led to more beneficial treatment results. However, it is thought that the lower energy dose employed in this study does not necessarily deserve to be interpreted as a methodological inconsistency, even if it may have led to less than desirable clinical results.[50]

The limitations of the present study and that of the study by Bingol et al.[49] are that the applied doses may be less than the doses recommended by World Association with Laser Therapy (WALT)[51] for musculoskeletal diseases. Therefore, the probability exists that the valid dose for the true effect is not tested. Another point of view is that the optimum energy dose may be different for various wavelengths and frequencies, which needs further investigation to put forth the true effect ranges for different musculoskeletal disorders and symptoms.

In conclusion, laser acupuncture of 0.48 J per session on the Sp9 point was effective only in reducing the periarticular swelling evaluated by the measurement of the KC when compared with plasebo. This result may be explained by the resolution of inflammation due to reduction in prostoglandin synthesis or the improvement of local circulation. However, there is still insufficient evidence to have firm conclusion regarding the use of laser acupuncture for treatment of OA. Further large and long-term scaled studies are needed with special attention to standardized dosages, application techniques, and outcome measures as well as complete details of the instrumentation used.

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