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Long-term efficacy of low level laser therapy in women with fibromyalgia: A placebo-controlled study

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Abstract. *Aim:* To investigate the efficacy of low level laser therapy (LLLT) in fibromyalgia patients.
Materials and Methods: Thirty-four fibromyalgia patients were randomly assigned to LLLT ($n = 16$) and placebo laser groups ($n = 16$). Outcome measures included number of tender points (NTP), Fibromyalgia Impact Questionnaire (FIQ), morning stiffness, global improvement as reported on a verbal scale (VSGI), and total myalgia score. Clinical evaluations were performed before, immediately after, and six months after the treatment.
Results: In the LLLT group, significant improvement was observed in clinical parameters at the end of the treatment ($p < 0.01$). On the other hand, significant improvements were observed only in the number of tender points and morning stiffness in the placebo group ($p < 0.05$). In comparing the groups, significant improvements were detected in scores of FIQ, VSGI, and total myalgia in the active laser group ($p < 0.05$). The clinical evaluations performed after six months demonstrated improvements in the clinical parameters only in the LLLT group ($p < 0.05$). When the groups were compared with each other, significant improvements were found in the LLLT group ($p < 0.05$).
Conclusion: Our results suggest that LLLT has both short- and long-term effectiveness in the treatment of fibromyalgia.

Keywords: Fibromyalgia, low level laser therapy, and placebo

1. Introduction

Fibromyalgia syndrome (FMS) is a chronic painful condition of unknown etiology that affects the quality of life for about 3.4% of the female population [35,36]. The typical patient is a middle-aged woman, although fibromyalgia can also occur in men and children. Moreover, it is the second most common condition seen by rheumatologists [23].

According to the 1990 classification criteria of the American College of Rheumatology (ACR), fibromyalgia syndrome is defined as widespread pain in combination with tenderness at 11 or more of certain specific tender point sites [36]. The most frequent additional symptoms are unrestorative sleep patterns, fatigue, headaches, irritable bowel and bladder syndrome, morning stiffness, paresthesias, anxiety, and depression [11].

The basic pathophysiologic mechanisms in FMS are unknown, and until such mechanisms are clarified, treatments will be based on hypotheses. Therefore, it is not surprising that little is known about treatment [12]. In addition, FMS patients have high rates of complementary and alternative medicine use, and they experience dissatisfaction with or ineffectiveness of traditional medical therapy [21].

Treatment modalities for FMS include tricyclic antidepressants [21], seratonin antagonists [7], nonsteroidal anti-inflammatory drugs [10], trigger point injections [13], massage [20], exercise, physical therapy, electrotherapy, and biofeedback training [27]. All of these diverse treatment procedures have shown only limited success [26].

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According to experimental and clinical studies that have been performed since 1967, LLLT has been claimed to have biostimulant and pain reduction effects [30]. Low level laser therapy is increasingly used as a modality of physical therapy in the management of a variety of musculoskeletal diseases. However, the results of studies investigating the effectivenss of low level laser treatment show considerable variation [4,14, 17,25,31,33]. Moreover, very few controlled clinical studies of low-power lasers applied in the treatment of FMS have been reported, and the long-term efficacy of LLLT has not been investigated in any of these trials [15,16].

Therefore, the aim of the present study was to evaluate the short- and long-term effects of low power laser therapy on clinical symptoms in female fibromyalgia patients.

2. Materials and methods

The study was carried out at the Physical Therapy and Rehabilitation Department of Osmangazi University Hospital. The sample for the study consisted of thirty-four female patients who had fibromyalgia according to the criteria of American College of Rheumatology 1990 [36]. These criteria include 1) the presence of widespread pain for at least 3 months located on both sides of the body and above and below the waist, and 2) the presence of at least 11 of 18 tender points on digital palpation (cervical spine, anterior chest, thoracic spine, low back pain) [36]. Exclusion criteria for the study were:

1. Inflammatory cause of the pain;
2. Inability to interrupt therapy with analgesic, anti-inflammatory medications, antidepressants, sleeping medications, or any other central nervous system-active drugs;
3. Presence of neurological, inflammatory, endocrine, or clinically significant chronic disease, such as inflammatory bowel disease, rheumatoid arthritis, systemic lupus eritamotosis, or diabetes mellitus;
4. Another severe disease such as a tumor or liver or renal disease;
5. Pregnancy;
6. History of major psychiatric disorders.

This study was designed as a clinical, prospective, randomized, placebo-controlled study. Thirty-two female patients met the entry criteria. After admission to the study, each patient was randomly assigned to the LLLT group ($n = 16$) or the placebo laser therapy group ($n = 16$). The patients were assessed by an independent physician who was blind to the study protocol. The ethics committee of the Osmangazi University Medical School approved this study, and all patients gave their informed consent.

2.1. Therapy

For low level laser source, a Gal-Al-As diode laser device (Endolaser 476, Enraf Nonius, Netherlands) was used with a power output of 50 mW and a wavelength of 830 nm. The diameter of the laser beam at the treatment point was 1 mm. The laser was set to deliver a continuous form of energy. In the LLLT group, a one-minute period of irradiation at each tender point was considered to be one irradiation dose. The dose per tender joint was 2 joules.

The patients in the control group were treated with a placebo laser. For the placebo laser application, the same laser device seemed to be working, but with no laser beams transferring to the treated area, and all painful points were irradiated.

All patients received treatments once a day, five days a week, for a total duration of 10 days. All patients were treated by the same physician.

2.2. Evaluation

Clinical assessments were performed at baseline, at the end of the treatment, and six months after the treatment by a blinded evaluator.

The assessments included the following:

Number of tender points (*NTP*)*:* The 18 tender points were examined by means of digital palpation according to the ACR [36]. For a tender point to be considered positive, the patient had to report pain on palpation.

Morning stiffness: An ordinal Likert scale scoring system for grading the severity of the outcomes was used: no (0), mild (1), moderate (2), severe (3), extreme (4) [6].

Fibromyalgia Impact Questionnaire (*FIQ*)*:* The FIQ is a 10-item, self-administered instrument measuring physical functioning, work status, depression, anxiety, sleep, pain, stiffness, fatigue, and well-being in persons with FMS [5]. The Turkish version of the questionnaire was administered [29]. Scores ranged from 0 to 100 with a higher score indicating more severe effects on the person's life.

Table 1
Baseline demographic and sociodemographic characteristics of the study population

	LLLT Group ($n = 16$)	Placebo Group ($n = 16$)
Age (years)	38.94 ± 4.85	37.63 ± 5.90
Duration of pain (years)	5.50 ± 3.03	6.12 ± 3.44
Education		
(%) completed elementary school	8 (50%)	7 (44%)
(%) completed high school	5 (42%)	5 (42%)
(%) completed university	3 (18%)	4 (25%)
Employment status		
(%) employed	4 (25%)	3 (19%)
(%) not working/retired	4 (25%)	4 (25%)
(%) homemaker	8 (50%)	9 (56%)
Marital status		
(%) Married	9 (56%)	8 (50%)
(%) Single/divorced/widow	7 (44%)	8 (50%)

Table 2
Baseline values and the follow-up data on efficacy for the patients treated with LLLT

	Pre-treatment	Post-treatment	Month 6
Tender point count	13.68 ± 2.12	11.81 ± 1.80*	12.50 ± 1.71[a]
Morning stiffness	3.00 ± 0.63	2.38 ± 0.62*	2.56 ± 0.89[a]
VSIQ	3.44 ± 1.03	2.56 ± 0.63*	3.00 ± 0.73[a]
FIQ	65.50 ± 9.01	58.50 ± 10.3*	62.02 ± 8.99[a]
Total myalgia score	25.00 ± 8.66	19.50 ± 6.95*	22.44 ± 6.79[a]

*$p < 0.01$, baseline versus post-treatment.
[a]$p < 0.05$, baseline versus month 6.

Table 3
Baseline values and the follow-up data on efficacy for the patients treated with placebo laser

	Pre-treatment	Post-treatment	Month 6
Tender point count	13.94 ± 2.11	12.88 ± 2.09*	13.95 ± 1.88
Morning stiffness	3.06 ± 0.77	2.50 ± 0.89*	3.25 ± 0.58
VSIQ	3.38 ± 0.96	3.19 ± 0.75	3.69 ± 0.70
FIQ	65.38 ± 9.44	63.63 ± 9.59	66.94 ± 8.44
Total myalgia score	27.56 ± 9.67	26.00 ± 8.952	28.75 ± 9.86

$p < 0.05$baseline versus post-treatment.

Verbal scale of global evaluation by the patient concerning her well-being (*VSGI*)*:* A score from 1 to 5 was used (1 = great improvement, 2 = moderate improvement, 3 = slight improvement, 4 = no improvement, and 5 = worsening) [18].

Total myalgia score: The 18 tender points and the myalgia score were assessed in all patients. In response to a digital force of 4 kg, subjects were asked to indicate whether they felt no discomfort (scored 0 points), tenderness (scored 1 points), pain with no grimace, flinching, or withdrawal (scored 2 points), or pain with grimace, flinching, or withdrawal (scored 3 points). The total myalgia score can range from 0 to 54 [9].

Laboratory assessment was performed only at baseline and included routine haematological and blood biochemistry tests.

2.3. Statistical analysis

Baseline characteristics of the treatment groups were compared using an unpaired t test for independent samples and a chi-square test for homogeneity of proportions. Friedman's one-way analysis of variance was used to test for changes in index values between the three periods in each group. A Mann-Whitney U test was used to compare the two groups with respect to parameters.

All analyses were performed using the SPSS 10.0 for Windows software program. Results were expressed as mean ± SD. Differences with P values $\leqslant 0.05$ were

Table 4
The overall assessment by the patients in pretreatment, post-treatment, and month 6 time periods

	Pre-treatment	Post-treatment	Month 6
Tender point count			
LLLT group	13.69 ± 2.12	11.81 ± 1.80	12.50 ± 1.71
Placebo group	13.94 ± 2.11	12.88 ± 2.09	13.94 ± 1.88
			$p < 0.05$
Morning stiffness			
LLLT group	3.00 ± 0.63	2.38 ± 0.62	2.56 ± 0.89
Placebo group	3.06 ± 0.77	2.50 ± 0.89	3.25 ± 0.58
			$p < 0.05$
VSIQ			
LLLT group	3.44 ± 1.03	2.56 ± 0.63	3.00 ± 0.73
Placebo group	3.38 ± 0.96	3.19 ± 0.75	3.69 ± 0.70
		$p < 0.05$	$p < 0.05$
FIQ			
LLLT group	65.50 ± 9.01	58.50 ± 10.33	62.06 ± 8.99
Placebo group	65.38 ± 9.44	63.63 ± 9.59	66.94 ± 8.44
		$p < 0.05$	$p < 0.05$
Total myalgia score			
LLLT group	25.00 ± 8.66	19.50 ± 6.95	22.44 ± 6.79
Placebo group	27.56 ± 9.67	26.00 ± 8.92	28.75 ± 9.86
		$p < 0.05$	$p < 0.05$

considered statistically significant, and all results have been expressed as 95% confidence intervals.

3. Results

Thirty-two female patients with FMS with ages between 26–47 years were included in the trial, and all of them completed the study. The demographic and socio-demographic characteristics of the patients are presented in Table 1. There were no significant differences in the baseline characteristics of the 32 patients randomised in the study.

The patients in both groups had similar pretreatment conditions. In the LLLT group, significant improvement was observed in all clinical parameters at the end of the treatment ($P < 0.01$). The clinical evaluations performed after six months demonstrated improvements in all clinical parameters in this group ($P < 0.05$) (Table 2). On the other hand, significant improvements were observed only in the number of tender points and in morning stiffness in the placebo laser group at the end of the treatment. At month 6, no significant difference was observed in the placebo group as compared to baseline ($P < 0.05$) (Table 3).

Pretest and posttest scores for the outcome measurements performed in this study are given in Table 4. When we compared the groups with each other, significant improvements were found in the FIQ, VSGI, and total myalgia scores in favor of the LLLT group at the end of the treatment ($p < 0.05$). In comparing the groups at month 6, significant improvements in all parameters were detected in the LLLT group ($p < 0.05$).

No systemic or local side effects were reported during or after the treatment period.

4. Discussion

This study was designed to assess the effects of LLLT on the clinical manifestations of patients with FMS. The results that we have obtained reveal that LLLT is effective in treating the clinical symptoms of FMS in both short- and long-term assessments.

The efficacy of LLLT in FMS has been investigated only in a few studies. In an earlier study by Gur et al., LLLT was compared to placebo in a single-blind and placebo controlled study. In that study, a Ga-As laser with a 904 nm wavelength was used, and patients were treated for 3 min at each point daily for two weeks. The results showed a significant decrease in pain score, muscle spasm, morning stiffness, and number of tender points in favor of laser group after therapy [16]. In another placebo controlled study, Gur et al. compared the effectiveness of LLLT, amitriptyline, and placebo laser. Patients were treated with the same laser therapy protocol. A significant difference was observed in clinical parameters such as pain intensity, fatigue, morning stiffness, FIQ, and depression score in favor of the laser group over the other groups after therapy [15].

The duration of therapy in this study was similar to that of Gur's study, in which 10 sessions of laser therapy were applied. In contrast to the studies mentioned above, a Gal-Al-As diode laser was used in our study, and each tender point was treated for 1 minute. In spite of these differences in design, our results are similar to those reported by Gur et al.

Previous studies of the analgesic effects of low level laser applications in musculoskeletal disorders have yielded conflicting results. There are reports of useful pain relief [17,31], amongst growing evidence of a significant placebo action [14,33,4]. This controversy may be related to various factors. Different lasers may have different levels of effectiveness in different diagnoses, and parameters such as wavelength, duration of treatment, energy density, number of treatments, and mode of delivery may be important [2]. In the evaluation of a therapy, it is often difficult to determine the optimal dosage and treatment schedule. For laser therapy, the minimal effective dosage is in most cases unknown, and an additional question is which wavelength will be optimal [3]. There is little evidence in the literature giving clues to the optimal dosage of laser energy with regard to intensity, frequency, wavelength, and peak pulse on the one hand and to the various pathological conditions on the other [32]. Because of these reasons, the findings of these clinical studies must be interpreted against this background.

The exact mechanism of pain reduction by laser therapy is not completely understood. Different experimental studies suggest that low level laser therapy has anti-inflammatory and analgesic effects [19,34, 8]. It has been reported that LLLT therapy had anti-inflammatory and anti-oedematous actions due to its reduction effect in prostaglandin synthesis. Its inhibition effect on prostacyclin has especially been reported to provide pain and inflammation regression [24]. In another study, the authors had suggested that an inhibition of neuronal activity might be responsible for the therapeutic effect, and the laser irradiation selectively inhibited nociceptive signals at peripheral nerves [22]. Several observations have shown that serotonin metabolism abnormalities may be involved in the pathogenesis of FMS. Both serum and cerebrospinal fluid concentrations of serotonin and its precursors have been found to be significantly lower in patients with FMS than in controls [28,37]. Additionally, Walker has stated that laser therapy decreased pain by increasing serotonin and endogen opioid oscillation and that laser therapy can therefore be effective on serotonin metabolism [34]. The results of these studies have also been affected by various factors, such as the condition of the subjects, the characteristics of the laser (wavelength, dosage, and pulse), the irradiated areas, and the application time and period, and it is possible that unknown mechanisms may be involved in the pain reduction following low power laser treatment [19].

In this study, we additionally investigated the long-term effects of laser treatment in fibromyalgia syndrome. The results of our study revealed that laser treatment is effective in improving the long-term symptoms of fibromyalgia syndrome. Since there were no studies investigating the long-term effects of laser treatment on the fibromiyalgia syndrome in the literature, it is difficult for us to comment on this subject. We do not know the exact mechanisms of the long-term beneficial effects provided by laser therapy. It is possible to speculate that different analgesic effects, which have been described in experimental and clinical studies, may lead to this recovery.

In conclusion, the results of this study indicate that low level laser treatment is effective in both acute and long-term symptoms of fibromyalgia syndrome. Therefore it seems reasonable to use such lasers in treatment of fibromyalgia syndrome. In addition, the gallium-aluminium-arsenide lasers have been shown to be safe in several controlled studies [17,1]. On the other hand, there are questions to be answered about the optimal treatment protocol. Because of this reason, we believe that future well-designed studies are needed to confirm the efficacy of low level laser therapy.

References

[1] J.R. Basford, The clinical status of low energy laser therapy in 1989, *J Laser Appl* **2** (1990), 57–63.
[2] J.R. Basford, P.T. Sheffield, S.D. Mair and D.M. Ilstrup, Low-energy helium neon laser treatment of thumb osteoarthritis, *Arch Phys Med Rehabil* **68** (1987), 794–797.
[3] H. Beckerman, R.A. de Bie, H.J. De Cuyper et al., The efficacy of laser therapy for musculoskeletal and skin disorders: a criteria-based meta-analysisi of randomized clinical trials, *Physical Therapy* **7** (1992), 483–491.
[4] U. Bingol, L. Altan and M. Yurtkuran, Low-power laser treatment for shoulder pain, *Photomed Laser Surg* **23** (2005), 459–464.
[5] C.S. Burckhardt, S.R. Clark and R.M. Bennett, The Fibromyalgia Impact Questionnaire, *J Rheumatol* **18** (1991), 728–733.
[6] W.W Bunchanan and N. Bellamy, Clinical evaluation in the rheumatic disease, in: *Arthritis and Allied Conditions*, W.J. Koopman, ed., London: Williams and Wilkins,1997, pp. 47–80.
[7] S. Carette, G.A. McCain, D.A. Bell et al., Evaluation of amitriptyline in primary fibrositis, *Arthritis Rheum* **29** (1986), 655–659.

[8] T.J. Codere, J. Katz, A.L. Vaccarino et al., Contribution of central neuroplastisity to pathological pain: review of clinical and experimental evidence, *Pain* **52** (1993), 259–285.
[9] J.A. Desmeules, C. Cedraschi, E. Rapiti et al., Neurophysiologic evidence for a central sensitization in patients with fibromyalgia, *Arthritis Rheum* **48** (2003), 1420–1429.
[10] L. Farber, T. Stratz, W. Bruckle et al., Efficacy and tolerability of tropisetron in primary fibromyalgia a highly selective and competitive 5-HT3 receptor antagonist, *Scand J Rheumatol Suppl* **113** (2000), 49–54.
[11] D.L. Goldenberg, Fibromyalgia, chronic fatigue syndrome, and myofascial pain syndrome, *Curr Opin Rheumatol* **9** (1997), 135–143.
[12] D.L. Goldenberg, Treatment of Fibromyalgia Syndrome, *Rheum Dis Clin North Am* **15** (1998), 61–71.
[13] D.L. Goldenberg, D.T. Felson, H. Dinerman et al., A randomized, controlled trial of amitriptyline and naproxen in the treatment of patients with fibromyalgia, *Arthritis Rheum* **29** (1986), 1371–1377.
[14] G. Goats, E. Flett, J.A. Hunter et al., Low intensity laser and phototheraphy for rheumatoid arthritis, *Physiotherapy* **82** (1996), 311–320.
[15] A. Gur, M. Karakoc, K. Nas et al., Effects of low power laser and low dose amitriptyline therapy on clinical symptoms and quality of life in fibromyalgia: a single blind, placebo-controlled trial, *Rheumatol Int* **22** (2002), 188–193.
[16] A. Gur, M. Karakoc, K. Nas et al., Efficacy of low power laser therapy in fibromyalgia: a single-blind, placebo-controlled trial, *Lasers Med Sci* **17** (2002), 57–61.
[17] E.H. Haker and T.C. Lundeberg, Lateral epicondylalgia. Report of noneffective midlaser treatment, *Arch Phys Med Rehabil* **72** (1991), 984–988.
[18] R.E. Heymann, M. Helfenstein and D.A. Feldman, double-blind randomized controlled of amitriptyline, nortriptyline and placebo in patients with fibromyalgia. An analysis of outcome measures, *Clin Exp Rheumatol* **19** (2001), 697–702.
[19] A. Honmura, A. Ishii, M. Yanase et al., Analgesic effect of Ga-Al-As diode Laser irradiation on hyperalgesia in carrageenin-induced inflammation, *Laser Surgery Med* **13** (1993), 463–469.
[20] C.Z. Hong and T.C. Hsuek, Difference in pain relief after trigger point injections in myofascial pain patients with and without fibromyalgia, *Arch Phys Med Rehabil* **77** (1996), 1161–1166.
[21] L.C. Holdcraft, Complementary and alternative medicine in fibromyalgia and related syndromes, *Best Practice & Research Clin Rheum* **17** (2003), 667–683.
[22] D. Jarvis, B. Maclver and D.L. Tanelian, Electrophysiologic recording and thermodynamic modeling demonstrate that helium neon laser irradiation does not affect peripheral Ad-or-C-fiber nociceptors, *Pain* **43** (1990), 235–242.
[23] R.C. Lawrence, C.G. Helmick, F.C. Arnett et al., Estimate of the prevalence of arthritis and selected musculoskeletal disorders in the United States, *Arthritis Rheum* **41** (1998), 778–799.
[24] K. Mizutani, Y. Musya, K. Wakae et al., A clinical studt on serum prostaglandin E 2 with low level laser therapy, *Photomed Laser Surg* **22** (2004), 537–539.
[25] F. Ozdemir, M. Birtane and S. Kokino, The clinical efficacy of low-power laser therapy on pain and function in cervical osteoarthritis, *Clin Rheumatol* **20** (2001), 181–184.
[26] M. Offenbacker and G. Strucki, Physical therapy in the treatment of fibromyalgia, *Scand J Rheumatol Suppl* **113** (2000), 78–85.
[27] M. Pioro-Boisset and J.M. Fitzcharles Esdaile, Alternative medicine use in fibromyalgia syndrome, *Arthritis Care Res* **9** (1996), 13–17.
[28] I.J Russel, H. Vaeroy, M. Javors et al., Cerebrospinal fluid biogenic amine metabolites in fibromyalgia fibrositis syndrome and rheumatoid arthritis see comments, *Arthritis Rheum* **35** (1992), 550–556.
[29] S. Sarmer, S. Ergin and G. Yavuzer, The Validity and Reliability of the Turkish Version of The Fibromyalgia Impact Questionnaire, *Rheumatol Int* **20** (2000), 9–12.
[30] Z. Simunovic, Low-level laser therapy with trigger points technique: a clinical study on 243 patients, *J Clin Med Surg* **14** (1996), 163–167.
[31] Z. Simunovic, T. Trobonjaca and Z. Trobonjaca, Treatment of medial and lateral epicondylitis-tennis and golfer's elbow with-with low laser therapy: a multicenter double-blind, placebo-controlled study on 324 patients, *J Clin Med Surg* **16** (1998), 145–151.
[32] O. Vasseljen, N. Hoeg, B. Kjedstad, A. Johnson et al., Low level laser versus placebo in the treatment of tennis elbow, *Scand J Rehabil Med* **24** (1992), 37–42.
[33] P. Vecchio, M. Cave, V. King et al., A double-blind study of the effectiveness of low-level laser treatment of rotator cuff tendinitis, *Br J Rheumatol* **32** (1993), 740–742.
[34] J. Walker, Relief from chronic pain by low power laser irradiation, *Neurosci Lett* **43** (1983), 339–344.
[35] F. Wolfe, K. Ross, J. Anderson et al., The prevalence and characteristics of fibromyalgia in the general population, *Arthritis Rheum* **38** (1995), 19–28.
[36] F. Wolfe, H.A. Smythe, M.B. Yunus et al., The American College of Rheumatology 1990: criteria for the classification of fibromyalgia: Report of the Multi-Center Criteria Committee, *Arthritis Rheum* **33** (1990), 160–172.
[37] M.B. Yunus, J.W. Dailey, J.C. Aldag et al., Plasma tryptophan and other amino acids in primary fibromyalgia: a controlled study, *J Rheumatol* **19** (1992), 104–109.