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Low Level Laser Therapy (LLLT) for Chronic Low Back Pain (LBP)

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Abstract

Background: LBP is a major health problem with enormous economic and social costs. The toll that bears on individuals, families and society make the successful management of this is common. Despite its widespread use, the effectiveness of LLLT (low level laser therapy) is still controversial. Traditional treatments include drugs, physical treatment, back exercises and education, but they are not always completely helpful. Many people seek alternative treatments, such as LLLT. Therefore main goal of this study is determine the effect of LLLT on the intensity of chronic LBP.
Method: This randomized clinical trial (RCT) has been done at medical laser center of Pastor-no hospital in Tehran. 30 patients with chronic LBP (because of lumbago) in rhea range of 30-60 years old were randomly divided to the laser treatment group and laser placebo group. Both of two groups went under treatment for 3 times in a week for 4 weeks. Applied laser in laser treatment group was continuous red light laser and pulse infrared with Mustang system with 890nm wavelength and 4-6 J/cm2 dose (energy), and was irradiated on the mentioned vertebral bodies and spinouts processes. Treatment in laser placebo group was done with off laser. Efficacies of treatment were evaluated with pain questionnaire and thermograph. Data was analyzed with chi-square ($\chi 2$) and t-student statistical tests.

Results: The laser treatment group patients have significant symptomatic relief without any side effect. Due to the pain questionnaire and thermograph, in first and second week, there was significant difference between two groups ($P<0.05$) before and after the third week, in regard to the pain questionnaire and thermograph a significant difference between two groups was found ($P<0.05$).
Conclusion: Based on the findings, if low level laser is irradiated on the mentioned area with appropriate dose, wavelength and exposure time, it will be a suitable and less aggressive method without side effect on the LBP.

Keywords: Low back pain, low level laser therapy (LLLT)

Introduction

Sixty to eighty percent of people suffer from back pain at some time in their lifetime. Of those who develop acute LBP, up to 30% probably developed chronic LBP. LBP is a major health problem with enormous economic and social costs. The toll on individuals, families and society makes the successful management of this common, but benign condition is an important point. LBP affects a large proportion of the population. LLLT is alternative therapy to pharmacological treatments for chronic pain. Despite its widespread use, the effectiveness of LLLT is still controversial. Traditional treatments include drugs, physical treatment, back exercises and education, but they do not always help. Many people seek alternative treatments, such as LLLT. We found three systematic reviews and five additional RCTs of LLLT for LBP. This is one of the most common problem related to the musculoskeletal system and is recognized to be the second most common reason for the patients to visit a doctor in the modern societies [1,2]. In a methodological research related to chronic LBP studies, it was estimated that the incidence and the annual average incidence were 19.2% and 82.7%, respectively. [2, 3] Chronic LBP is the most common expensive occupational disability in younger patients than 45 years old and two thirds (67%) of adult patients mostly in their 4^{th} and 5^{th} decades of life suffer from the disease [4]. Studies show that the causes of this pain might be referred to the ligaments, joints, vertebral, muscles, Para vertebral, blood vessels and spinal nerve roots or inter vertebral disc degeneration [4].Chronic LBP may be associated with psychological, physical, economical and social difficulty in 17% of the cases[16]. As a result, treatment of such patients seems quite challenging and the practitioner needs to employ multiple approaches in order to bring the disorder under control. Many different models of treatment such as exercise, massage, drugs, TENS, surgery and laser therapies are used to treat LBP. Laser was used in various surgeries in the 20^{th} century, but not routine for musculoskeletal disorders [7]. Low and medium energy lasers such as GaAs or HeNe with wavelengths of 600-980nm are used for various methods of physical therapy. It is shown that low level lasers can affect many cellular and sub cellular processes. There are many patients suffering from chronic pain such as those with rheumatoid arthritis and osteoarthritis whom are treated with such lasers [7-10]. On the other hand, there are some reports in the literature, which do not show such effects on the muscle and bone pathologies [11-13]. The present study has been conducted to estimate the efficacy of low level laser on chronic LBP.

Material and Methods

This study included with 15 patients to laser and 15 patients to placebo laser. Including and excluding criteria for selecting patients include of these issues: suffering from LBP more than 6 months, Age between 30-60 years, haven't pregnant, haven't any previous spine surgery history, haven't known neurological defects, haven't systemic or psychological disorder.

The patient's selection was based on their history and medical exams. The patients with definite radiographic pathology were excluded and only the patients with LBP due to lumbago were included. At first, demographic data such as age and sex and subsequently pain and functional specifications

were assessed and documented. Pain functional assessments were based on Visual Analogue Scale (VAS), pain questionnaire, Roland Disability Questionnaire (RDQ) and Modified Oswestry Disability Questionnaire (MODQ). The patients were examined with Schober test and flexion and lateral flexion examinations in order to measure the range of lumbar motion. The patients were examined by a physician blind to the treatment procedures. RDQ was used for functional assessment in patients during their daily activities. Twenty four questions with answer yes or no defined scores were asked. A score of 14 or more was considered as poor result. MODQ scale including 10 items expresses different aspects of human body functions. Each item has 0-5 scores and the higher the score, the more disable the patient. The final score was multiplied by 2 and expressed as percentage. This scale has a total of 50 questions. We used Schober test to examine the status of spinal flexion. GaAs is one of the known low level lasers that can penetrate and have its effect on tissue in the depth of 1-5cm. In this study, patients of laser treatment group were treated with laser at 3 times per week for 4 weeks. The lasers used for treatment were continuous red and pulsed infrared light with wavelengths of 890nm. The energy density of 2-4J/cm^2 was used to irradiate the tender points of the vertebrae L4, L5 and S1 and the fasciae, sacral ligaments and Ileum and gastronomies muscles. The exposure time was 2 minutes per point for red and 30 seconds for infrared lights. The total exposure time was 30 minutes. The trigger and acupuncture points were irradiated 1-2 J/cm^2. The power of the red and IR light were 10mW and 80W, produced by Russian diode laser device "Mustang". In the placebo laser group, the procedure included 3 times per week for 4 weeks with the laser machine was turned off on the lumbar, knee and the muscles of glottal and spinal regions were treated. Statistical analysis performed by using chi-square (χ^2), t-test with $P<0.05$ significant.

Results

The patients' specifications taking part in this study are listed in table 1. There was no statistical difference in age, sex, duration of LBP, activities and education status of the patients in the two groups. Results were analyzed as weighted mean differences (VSA) with 95% confidence intervals (CI). The causes of LBP including strain, sport injuries, sudden movements, falling, accidents, stress or idiopathic causes are shown in diagram 1.

According to chi-square test, we not found significant difference in causes ($P>0.05$). Based on thermo graphic and VAS scores a significant difference between the two groups in pain was achieved ($P<0.05$).

When the results were pooled from different pain scales used in this trial, a statistically significant difference in favor of laser treatment was found with a MODQ of - 0.28. This study also measured pain during movement and found a statistically significant difference in favor of laser treatment with a VSA of -1.16. Then found a statistically significant difference in favor of laser treatment for patient-assessed global disease activity with laser compared to placebo (RR 1.70, CI: 1.1 to 2.63). this trial evaluated the effectiveness of laser treatment in vertebrae L4, L5 and S1 and the fasciae, sacral ligaments and Ilium and astronomies muscles and found a statistically significant difference RDQ (38.69, 95% CI: 29.25 to 48.13) using the change in VAS score to measure pain.

This study found a statistically significant difference in favor of laser treatment at the end of treatment and at 3 and 4 weeks post-treatment for morning stiffness. Other outcome measures of joint tenderness and strength did not yield significant differences.

Discussion

The results of this study support the use of LLLT in the treatment of chronic LBP. Clinicians and researchers should consistently report the characteristics of the LLLT device and the application techniques used. New trial on LLLT should make use of standardized outcome measures. This analysis

lacked data on how LLLT effectiveness is affected by four important factors: 1-type of applications, 2-site of application, 3-treatment duration of LLLT, 4-optimal frequencies and 5-intensities.

This trial included showed a statistically significant difference favoring laser treatment when compared to placebo for at least one outcome measure. This may be dose not report beneficial effects. The varying results of this trial may be due to the method of laser application and/or other features of LLLT application. There is clearly a need to investigate the effects of different dosages on LLLT effectiveness for chronic LBP in future randomized, controlled clinical trials. Also, more studies should be done to investigate the anti-inflammatory action of laser as well as the appropriate parameters needed to achieve an anti-inflammatory effect. The biologic effects of such lasers are not completely known, but they can be effective on some pathobiologic processes like increasing vascularization, stimulating fibroblasts and increasing collagen synthesis, improving microcirculation and perfusion and healing the connective and neural tissues. These are observed in vitro and there are less convincing reports in human body studies [14, 15].

The advantages of using lasers are their simple application, low expense, availability and experience [14]. Most of the laser treatments are experimental and there are fewer consensuses on the details. One of the difficulties in using LLLT is the arbitrary and optional methods used by the physicians particularly in wavelength, power, and frequency and radiation time. Some authors have reported the better result of LLLT in rheumatic disease, joints disease and myofacial syndromes in comparison to drugs [7, 12].

This may be due to various ways of LLLT application in bone and joint diseases. The positive effect of LLLT in diminishing LBP may be the result of increased chondrite and matrix components [3, 8]. Skinner and et al reported that GaAs laser has great effect on fibroblast function and increases the healing of connective tissue. They assume that these changes are due to bio-stimulative effect of laser at the cellular level [14].In his opinion, LLLT can activate cytoplasmic enzymes, increase O_2 consumption, produces more ATP, nucleic acids and proteins. Furthermore, LLLT can decrease prostaglandin and inflammation as well. Due to inhibiting effect on prostacyclin, it can inhibit the exacerbation of inflammation and pain in arthritis and bone disease [14]. In the present study, chronic LBP was diminished in the 3rd and 4th week after treatment according to thermograph and VAS scales. But, we observed no change in the 1st or 2nd week. This may be due to the complexity of the bone and joint diseases. It may be necessary to change the parameters of the treatment (table 1).

In a study complete by Kelin and his colleagues, they postulated that there was significant difference in results for pain treatment in the two groups treated by laser or placebo laser [16].

Also, Basford and et al demonstrated that LLLT can decrease LBP soon after treatment, but has less effect for longer durations [17].

As mentioned in the results section, we did achieve significant differences in RDQ and MODQ scales and schober tests between the groups. These may be the result of few problems such as examiner faults or exhaustion of the patients. This resembles the results reported by Basford and Kelin [16, 17]. Finally, there remain many other questions demanding answers, necessitating further studies. Some of the questions may be cited as:

1) What is the main mechanism of LLLT in improving the pain?
2) What are the suitable wavelengths, exposure points and dosage in treating LBP?
3) What is the best scale to evaluate LBP?

Anyhow, it was shown in this study that choosing appropriate area, wavelength and dosage in LLLT may be effective in decreasing LBP.

Table 1: Baseline characteristics of all subjects with chronic LBP.

Variables	Laser treatment group	Laser placebo group
Age(year), mean±SD Sex(%) Married (%)	(30-60) 34±7.58 (59) woman (41) man (28) unmarried (72) married	(30-60) 36±6.83 (55) woman (45) man (32) unmarried (68) married
Duration of LBP, Months	17.8±10.5	15.3±9.58
Occupational activity(%)	Hovewives (32) Not working or retived (8) Student (4) At desk mainly (16) At desk and movement (28) Physical labor (12)	Hovewives (30) Not working or retived (8) Student (6) At desk mainly (14) At desk and movement (24) Physical labor (18)
Educational level (%)	Elementury (48) High School (38) University (14)	Elementury (44) High School (40) University (16)

Table 2: Comparison mean results and thermograph number before and after treatment laser group

Criteria	Pre Therapy	First week Therapy	Second week Therapy	Third week Therapy	Forth week Therapy	One month after Therapy
VAS (Pain)	6+2	5/5+1/8	4+1/8	2/1+1/5	1/7+1/4	2+1/3
RDQ	14+4/5	13/5+4	10+3/2	5/3+2/8	6+2/4	6/5+3
MODQ	30+10/6	30+10	25+9/8	25+9	17+8	17+7/6
Schober (CM)	15+2	15/3+1/7	16/5+1/5	18+1/5	18+3/1	18+2/8
Ant Pos-Flox(CM)	27+14	27+15	24+15/3	15+5/6	19+4/5	18+5/1
Lat Flex (CM) (Right)	28+15	28/5+15/7	29+15/8	29+15/7	31+15	30+13
Lat FlexCM) (Left)	26+15	27+15/3	27/5+16/7	26/8+16/2	27/5+15/3	26+14/8
Thermograph	0	2	4	10	10	7

Table 3: Comparison means results and thermograph number before and after laser placebo group

Criteria	Pre Therapy	First week Therapy	Second week Therapy	Third week Therapy	Forth week Therapy	One month after Therapy
VAS (Pain)	6/5+2/1	6/4+1/4	4/2+1/5	4+1/3	3/1+6/1	4/5+1/8
RDQ	15+4/9	14+5	17/8+3/5	13+4	12+3/9	15+3/8
MODQ	30/5+10/5	28/5+10/8	32+10/2	27+10	27+11/2	31+10/8
Scho- ber (CM)	17+1/8	17+1	15/3+2/1	18+1/2	16+1/5	18+1/3
Ant Pos-Flox (CM)	32/5+15/8	30+15	19+4/6	18+5	16+5/1	18+5/3
Lat -Flex (CM) (Right)	29+14	30+15/2	30+13/8	29+15	29/5+15/2	27+14/3
Lat -Flex (CM) (Left)	27+16/6	26+15/3	27+15	27+16/9	27+15/5	26/5+15

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