

## Low Level Laser Irradiation Effects on Joint Movements

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### Abstract:

This study tried to show an approach for joints process healing based on using of low level laser therapy (LLLT), in order to enhance the healing rate. The effect is not thermal, but rather related to photochemical reactions in the cells.

This study included 26 patients with low back pain (LBP) in range of 20-50 years old were randomly divided to the laser treatment group and laser placebo group (control group). Both of two groups were treated twice weekly for 6 weeks. The treated group exposed group to pulse infrared with diode laser (BEAM 3K00) with 904nm wavelength and 230mJ (energy) for one point, and was irradiated on the vertebral column. The same process was performed on control group but with off laser. The laser placebo group did not complete their treatment because there was no improvement or decrease pain. The treated group divided into three subgroups according to the treatment period: the first showed improvement and decrease pain where dispersed to (4) in end of the three-week treatment, and (4) in a five-week treatment, and (5) valuable six weeks treatment. Visual analogue scale (VAS), Schober test and Roland Disability Questionnaire (RDQ) were used in the clinical and functional evaluations pre and post therapeutic periods. Significant improvements were noted in all groups with respect to all outcome parameters, in comparison to placebo laser group. Efficacies of treatment were evaluated using pain relief between treated groups by the statistical significance of the differences between the three feature sets for the LBP was tested with a Bonferroni corrected analysis of variance (ANOVA) test with a significance level of 0.05. Statistically significant differences were found in all outcomes measured ( $p < 0.05$ ).

**Keywords:** Low Back Pain (LBP), Low Level Laser Therapy (LLLT), Joints.

### Introduction

Low back pain (LBP) affects a considerable proportion of the population. 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 [1]. Low level laser therapy (LLLT) has been investigated and applied clinically for more than 30 years [2]. Laser therapies have yet to receive United States Food and Drug Administration (FDA) approval, except for the treatment of carpal tunnel syndrome [3]. Many studies demonstrate the safety and efficacy of LLLT. Low level laser therapy (LLLT) is a light source treatment that generates light of a single wavelength and is thought to promote tissue regeneration, reduced inflammation, and relieve pain. Unlike many other medical laser procedures, LLLT emits no heat, sound, or vibration. Instead of producing a thermal effect, it is thought that LLLT works by eliciting photochemical reactions in cells. Although the exact mechanism of biological action is unknown, several theories have been proposed and include: increased mitochondrial ATP production, enhanced cellular proliferation, increased cellular oxygenation, increased serotonin and endorphin production, stimulation of angiogenesis, and suppression of inflammatory cytokines [4]. Low level laser therapy LLLT applications depend mainly on the tissue absorbing characteristics of the red laser light. Since the tissue penetration of the laser energy used in LLLT can be in the order of 5-10 mm, both superficial and deeper structures can be affected. However, as the energy penetrates the tissues, there is multiple scattering by erythrocytes and micro vessels, and thus both blood and the distribution of micro vessels influence markedly the final distribution of laser energy [5]. The 904 nm wavelength GaAs laser is most commonly used for pain and inflammation because it has the deepest tissue penetration. As a result, it may be less suited for wound healing. Varying treatment parameters may involve altering pulse rate, applicator placement, wavelength, irradiance (power/unit area), beam divergence, spot size, delivery (fiber optic, direct), polarity, pulse duration, and duty cycle [6].

**Material and Methods**

The samples were collected randomly from admitted patients with low back pain in medical rehabilitation and rheumatology center, Baghdad. A total of 26 patients randomly collected; among which 13 were laser group and 13 were in the placebo laser group (control group). The laser group subdivided to 4 were three week treatment, 4 were five week treatment and 5 were six week treatment . The patients were briefed about the study and consent was obtained from all patients. Inclusion criteria were Age between 20–50 years, not being pregnant for females, having no previous spinal surgery, Patients with neurological deficits, abnormal and Laboratory findings and systemic and psychiatric illnesses. The laser group went under treatment for 2 times in a week, all treatment 6 weeks, 12 sessions

Applied laser in the laser treatment group was pulse infrared laser with a diode laser (BEAM 3K00) with 904nm wavelength. Treatments include drugs (such as analgesics, NSAIDs) and physical treatment (such as IR and massage), but they are not always completely helpful. LLLT is alternative therapy to pharmacological treatments for chronic pain. Despite its widespread use, the effectiveness of LLLT is still controversial. Suffering from Low Back Pain (LBP) diagnosed clinically, magnetic resonance imaging and radiology as acute LBP. The patient’s selection was based on their history and medical exams. 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). The patients were examined with Schober test 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. Eighteen questions with answer yes or no defined scores were asked. A score of 10 or more was considered as poor result. We used Schober test to examine the status of spinal flexion. Laser diode (BEAM 3K00) is one of the known low level lasers that can penetrate and have its effect on tissue in the depth of 2-3 cm. In this study, patients of laser treatment group were treated with laser at 2 times per week for 6 weeks. The lasers used for treatment were pulsed infrared light with wavelengths of 904nm. For one point (The energy of 230mJ was used to irradiate the tender points of the vertebrae L4, L5 and S1 and the fasciae, sacral ligaments and Ileum and gastronomies muscles). If we have 8 point the energy is 368mJ and the exposure time is 8 minutes one minute each point, when the frequency is constant 320Hz. In the placebo laser group, the procedure included 2 times per week for 6 weeks with the laser machine was turned off on the lumbar. Statistical significance of the differences between sets for the LBP was tested with a Bonferroni corrected analysis of variance (ANOVA) test with a significance level of 0.05.

**Results and Discussion**

The randomization resulted in two comparable groups and there was not any statistically significant difference between the two treatment groups with respect to demographic data such as age, gender, and Weight (Table.1).

**Table.1:** Baseline Characteristics of All Subjects with Low Back Pain

Variables		1 <sup>st</sup> laser groups	2 <sup>nd</sup> placebo laser group
Age	year	23-50	26-49
	Mean ±SD	36.07 ±7.33	36.53±6.64
Weight	Kg	57-117	66-120
	Mean ±SD	91.23±31.28	89.30±16.09
Sex (%)	woman	14.2	0
	man	85.8	100

This study found a significant difference in favor of laser treatment at the end of treatment and at 3, 5 and 6 weeks post-treatment for morning stiffness and found statistically significant difference in same group (laser group). Pre – Therapy and post-therapy values of pain, Roland disability Questionnaire, and Schober test were compared in all therapy groups, significant differences were observed between any of the

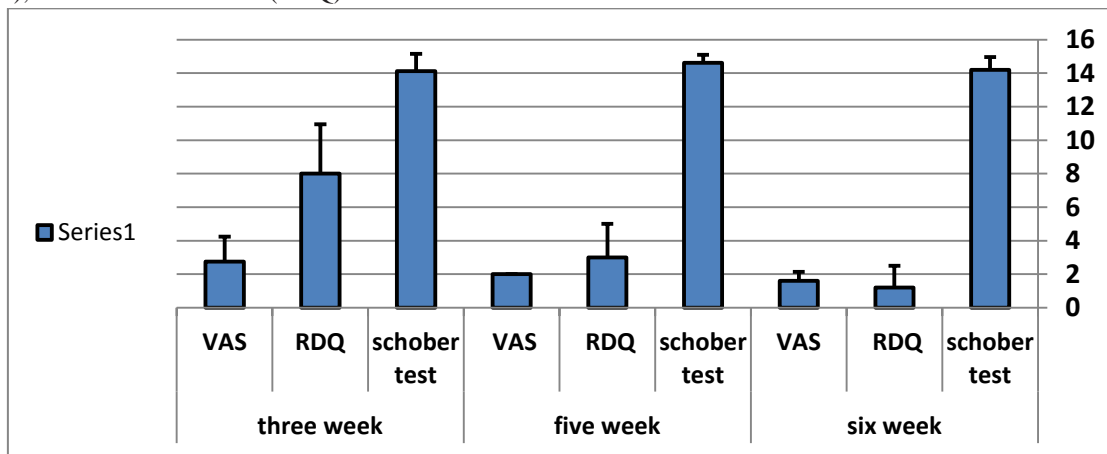
therapy groups. Pain levels in the all groups decreased significantly after therapy. Although there was significant difference between any therapy groups, pain levels in the six week and five week groups decreased more than the three week group. Additionally, measures of Schober test were significantly improved in all groups after therapy (table.2, Figure.1, 2,3and4)

**Table 2 :** Comparisons of Outcome Measures Pre- and Post-Treatment in Laser Groups

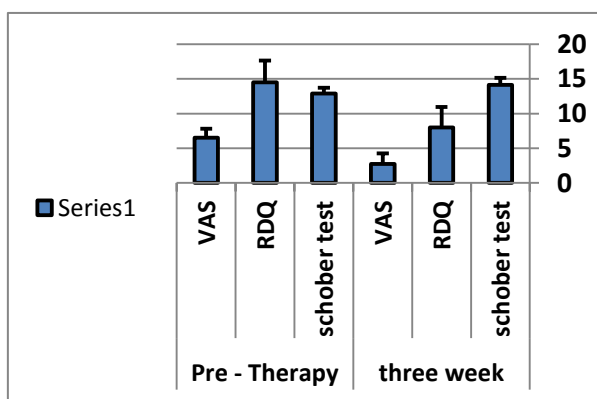
Outcome Measures	Three Week Treatment		Five Week Treatment		Six Week Treatment	
	Pre-therapy	Post-therapy	Pre-therapy	Post-therapy	Pre-therapy	Post-therapy
<b>Visual Analogue Scale(VAS)</b>	6.5+1.29	2.75+1.5	6.75+1.25	2+0	7.8+.83	1.6+0.54
<b>Roland Disability Questionnaire(RDQ)</b>	14.5+3.109	8+2.94	14.75+2.5	3+2	13.8+2.94	1.2+1.303
<b>Schober Test</b>	12.875+0.853	14.125+1.03	13.75+0.5	14.625+0.47	12.2+1.35	14.2+0.758

According to a Bonferroni corrected analysis of variance (ANOVA), we not found significant difference in causes ( $P>0.05$ ). Based on schober test, RDQ and VAS scores a significant difference among the groups in pain was achieved ( $P<0.05$ ). In three laser group statistically significant improvements were detected in the pain levels (VAS), functional evaluation (RDQ) and the

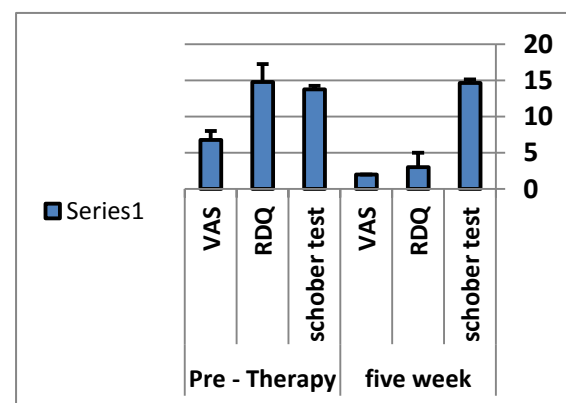
evaluation of lumbar range of motion (Schober Test) later compared with baseline for each one. We found significant improvements in patients in laser therapy group with respect to all of the parameters such as pain, functional evaluation, and evaluation of lumbar range of motion.



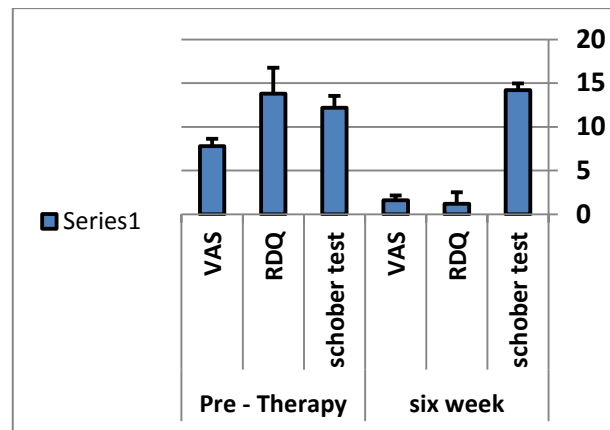
**Figure 1:** 3, 5 and 6 Week Following Laser Treatment (Laser Group)



**Figure 2:** Three Week Group



**Figure 3:** Five Week Group



**Figure 4:** Six Week Group

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 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 [7, 8]. Placebo-controlled clinical trials of NSAIDs for ankle injuries also show significant pain relief during the first few days, but this is also associated with impaired edema absorption for several weeks [9]. LLLT can be advantageous because its therapeutic window for anti-inflammatory actions overlaps with its ability to improve tissue repair [10]. In the present study, LBP was diminished in the 3rd and 5th week after treatment according to VAS scales. But, we observed no change in the 1st or 2nd week. This may be due to the complexity of the bone and joints diseases. It may be necessary to change the parameters of the treatment. 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 [11]. As mentioned in the results section, we did achieve significant differences in RDQ scales and schober tests between the groups. These may be the result of few problems such as examiner faults or exhaustion of the patients. Whenever a disc

bulges or herniates, the cells making up the outer ring of the disc become weakened and damaged. As laser light reaches the damaged disc, it stimulates the cells to start producing ATP. ATP is the “fuel” or energy source that all cells need to function and repair. Interestingly, laser therapy has no effect on healthy cells. The advantages of using lasers are their simple application, low expense, availability and experience [7]. 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. This may be due to various ways of LLLT application in bone and joints diseases. The positive effect of LLLT in diminishing LBP may be the result of increased chondrite and matrix components [5, 12]. In the planning stage of this study, we had difficulty in finding readings in the literature related to the use of laser therapy in LBP. We found that there were no standard therapy programs regarding the dose and duration of the laser, and the current work revealed various results. These varieties in the study may have arisen from the selection of patients, application of the therapy, and dose, period.

### Conclusion

This study presents usage of LLLT in treatment of low back pain, by diagnoses the patient on the back and treated by low level laser diode applied on back for 1 minutes for each point and diameter 1mm. we found that the active diode laser has more effect than placebo laser diode regarding to the enhancing the process of low back pain healing. This indicates that placebo laser therapy group has a delayed period in low back pain healing properly due to its decrease affects of cell proliferation and vascularization. There was no side effect/ negative effect of laser

on the targeted joints site or on surrounding soft tissue. The results of this study support the use of LLLT in the treatment of 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.

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## تأثير اشعة الليزر ذو القدرة الواطنة على حركة المفاصل

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## الخلاصة

تظهر هذه الدراسة عملية علاج المفاصل باستخدام الليزر واطى المستوى يكون تأثير الليزر غير حراري لكن من التفاعلات الكيميائية الضوئية في الخلايا ويكون العلاج بدون تدخل جراحي. استخدم 26 مريض مصابون بالألم أسفل الظهر بعمر ما بين 20-50 سنة قسمت بشكل عشوائي إلى مجموعة عولجت بالليزر ومجموعة بعلاج ليزر مموه. كلا المجموعتين تم معالجتهما مرتين بالأسبوع ولمدة ستة أسابيع. في هذا العمل تم استخدام الدايدود الليزري ذو الأشعة النبضية بطول موجي 904 نانو متر على مجموعة الليزر. أما مجموعة الليزر المموه فقد تم إطفاء جهاز الليزر أثناء المعالجة. طبق الليزر على أجسام الفقرات المصابة. وبعد المباشرة بالعلاج في كلا المجموعتين لم تكمل العلاج مجموعة الليزر المموه وذلك لكونهم لم يشعروا بتحسن أو انخفاض بمستوى الألم أما مجموعة العلاج بالليزر فقد انقسموا إلى ثلاثة مجموعات حسب فترة العلاج وذلك لشعورهم بالتحسن وانخفاض مستوى الألم لديهم .

استخدمت ثلاث متغيرات للتقييم هي (مقياس مستوى الألم , واستبيان العجز رولاند, واختبار شوبر). لوحظت تحسينات في مجموعات الليزر بكل المتغيرات ماعدا مجموعة الليزر المموه وقد تم استخدام التحليلات الإحصائية لمعرفة أهمية التحسن (الكفاءة) بين المجموعات التي عولجت بالليزر واستخدم لذلك اختبار بونفيروني في برنامج الماتلاب مع مستوى أهميه 0.05. من النتائج وجدنا فروق ذات دلالة إحصائية في جميع نتائج المتغيرات (P>0.05).