# Low Energy Laser Therapy and Nerve Mobilization in Sciatica

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## ABSTRACT

***Objective:*** *The purpose of this study was to determine the effect of low energy laser treatment when combined with nerve mobilization in cases of sciatica due to disc lesion.* ***Background:*** *Sciatica is a common clinical problem causing pain and functional disability. There are many studies that support the efficacy of LASER as a method of pain relief, there are studies supporting the efficacy of nerve mobilization in case of LBP but there is no studies to compare the combined effect of LASER and nerve mobilization in cases of sciatica.* ***Design:*** *Thirty subjects (16 females and 14 males) diagnosed by their referring physician with sciatica due to lumbar disc prolapse participated in this study. They were randomly assigned to either the experimental group performing LASER therapy and nerve mobilization or control group performing sham laser and nerve mobilization. Before and after 4 weeks of treatment performed every other day, pain, self reported functional disability and physical performance test battery were recorded.* ***Results:*** *both groups achieved improvement in pain, functional disability and physical performance. However the experimental group achieved a significant improvement in pain and functional disability more than the control group P<0.5.* ***Conclusion:*** *the nerve mobilization technique described in this study is efficient in the treatment of sciatica and was associated with improvement in physical performance and decrease in pain and disability, the combination of laser with nerve mobilization has a better effect on pain and functional disability.*

## INTRODUCTION

Sciatica is a radiating pain in the buttocks, thigh or leg, usually on one side but occasionally on both sides[1]. Lumbar disk herniation is the main cause of sciatica. Symptoms that increase the specificity of sciatica from lumbar disk herniation include pain that is worse in the leg than in the back; a typical dermatomal distribution of neurologic symptoms (e.g., pain, numbness, cold sensation); and pain that is worse with the valsalva maneuver (e.g., coughing, sneezing, straining)[14]. A number of environmental and inherent factors thought to influence the development of sciatica, including gender, body habits, parity, age, genetic factors, occupation, and environmental factors were studied. Neither gender nor body mass had an influence on the development of sciatica. The incidence of sciatica is related to age; rarely seen before the age of 20. The incidence peaks are in the fifth decade and declines thereafter[19,34]. Nerve root pain (sciatica) is explained by two specific mechanisms, the first is mechanical deformation of the nerve roots[29,30] and the second mechanism is biologic or biochemical activity of disc tissue which affects the nerve roots[18,31].

LASER (Light Amplification of Stimulated Emission of Radiation) is one of the physiotherapy modality used to relief pain in many of musculoskeletal disorders[5]. Basford[4] reported that treatment with low intensity laser irradiation produced a moderate reduction in pain and improvement in function in patients with musculoskeletal low back pain. One suggested effect, which is the neuro-pharmacological analgesic effects of lasers, was supposed to be due to the release of serotonin and acetylcholine at the site and through higher centers[17]. Another effect is due to an elevation of endorphin levels after treatment of trigger zones in muscles by Low Intensity Laser Therapy (LILT)[39].

Nerve mobilization is the clinical application of mechanics and physiology on the nerve tisuse[34]. It has mechanical effects (include sliding, elongation, tension and alterations in pressure). These previous effects cause physiological response in the nervous system (including variations in blood flow, axonal transport and impulse traffic)[33]. It is used for treatment of adverse neurodynamics,

the primary theoretical objective is to attempt to restore the dynamic balance between the relative movements of neural tissues and surrounding mechanical interfaces thereby allowing reduced intrinsic pressures on the neural tissue and thus promoting optimum physiologic function[27]. The hypothesized benefits from such techniques include facilitation of nerve gliding, reduction of nerve adherence, dispersion of noxious fluids, increased neural vascularity, and improvement of axoplasmic flow[7,8,9]. Nerve mobilization was used in many conditions such as carpal tunnel syndrome[2,6,25,38], after spinal surgery, cervico-brachial pain[3,12], non-radicular low back pain[11], and lower extremity neurogenic pain[10]. Richard et al.,[27] revealed that there is only limited evidence to support the use of neural mobilization and at present, the positive clinically observed effect of neural mobilization is mainly based on anecdotal evidence. Therefore the purpose of this study was to determine whether nerve mobilization when combined with low-energy LASER stimulation, could produce an improvement in subjective and objective measurement of sciatic pain when compared with nerve mobilization alone.

## METHODS

### Subjects

Thirty subjects (16 females and 14 males) diagnosed by their referring physician with sciatica participated in this study. Prior to participation, all subjects signed an informed consent. Subjects selection criteria included (1) back and leg pain with duration from 3-6 months, (2) lumbar disc lesion confirmed by MRI, (3) age between 25 to 55 years. Subjects were excluded from the study if they had evidence of specific pathologic conditions such as piriformis syndrome, lumbar instability (spondylolithesis), bone disease or infection, sacroiliac joint pain, or any other causes of sciatica. As the subjects joined the study, each was randomly assigned to 1of 2 groups: experimental group A (N=15) or control group B (N=15).

### Outcome measures

Visual analogue scale (VAS): before and after the 12 treatment sessions given every other day under direct supervision of the investigator over 4 weeks, Pain was assessed by using visual analogue scale (VAS) which is a 10cm calibrated line with 0 (zero) representing no pain and 10 representing worst pain. The examiner illustrated the meaning of the VAS to the patient, and the patient was asked to make a mark at the point which represents his pain. The distance between zero and the mark was then measured and recorded. Reliability of VAS is found to be fair to good[28].

Self report of physical function: Self report of physical function was assessed by using Oswestry disability questionnaire (ODQ). This questionnaire gives us information as to how back or leg pain is affecting the ability to manage in everyday life. It is divided into 10 sections about pain intensity, personal care, lifting, walking, sitting, standing, sleeping, sex life, social life, and travelling. Every section has six choices, the six statements in every section are scored from 0 to 5, the patient was asked to choose the most suitable answer that represents his level of function. For each section the total possible score is 5; if the first statement is marked the section score = 0, if the last statement is marked the section score = 5. The total score of 50 represent the greater disability and zero represent the least diability. ODQ is found to be reliable and had sufficient width scale to detect improving or worsening in most subjects[15].

Physical performance assessment: By using Simmonds Physical Performance Battery (SPPB) for patients with low back pain. The patients were asked to wear a light clothes and perform 6 functional tasks; the researcher stands beside the patient to measure the outcome as following: (1) time taken in 5 repetitions sit to stand, (2) time taken in 5 repetitions trunk flexion, (3) distance of forward loaded reach, (4) time taken to walk 50 feet distance, (5) distance walked in 5 minutes, (6) time taken in 360 degree rollover. In recent years, measures of function and performance have been proposed as reliable and valid instruments to guide intervention or to assess intervention outcomes, also, he concluded that Measures of physical performance showed appropriate consistency

in evaluating these subjects with back pain[13]. Simmonds et al.,[36] revealed that the physical performance task battery appears to provide a psychometrically -reliability, responsiveness, and validities- sound and meaningful basis for physical therapy assessment, treatment, and outcome measurement.

**Treatment procedure**

All treatments were delivered by the same physical therapist. A schedule of three times per week for 4 weeks was established. All subjects received nerve mobilization as follow[10,26]; the patient lay supine and relaxed in the center of the bed, with no pillow under the head. The trunk and pelvis should be in the neutral position. With the researcher standing beside the affected side, he begin to raise the affected side perpendicular to the bed in standard SLR test with one hand placed under the ankle joint and the other placed above the knee joint until either pain in the back or referred pain to the leg restricted the movement. Then the leg is taken down few degrees from this symptomatic point. The researcher starts to stretch (mobilize) the sciatic nerve by sequence of gentle oscillation toward ankle dorsiflexion and then reassess the effect. The number of these sequences was repeated several times, through which the amplitude of the technique can be increased according to the patient response. The technique could be progressed to a point where some symptoms are reproduced, or it could be taken to a point where some resistance of the movement is encountered. The technique could be repeated with the sciatic nerve in more tension through some variations as: ankle dorsi flexion and inversion, hip adduction and medial rotation. The tension is applied for few seconds and released, the total time of applying the technique was about 5-10 min according to tolerability of the patient (if the patient can tolerate the pain, the technique is repeated; if the patient cannot tolerate the pain, the technique is stopped and repeated next session).

The experimental group (A) received true LASER therapy with A "Lasermed 2100" (made in Italy) infra red laser device with Wave length of 904nm, Peak power of 75 mw, and Frequency 10000Hz was used in the treatment with a 4joule/$cm^2$ dosage. The patient laid prone and the researcher applied true laser therapy by putting the laser probe paravertebrally near to the intervertebral foramen for a total of 4 points with a total time 4 minutes (every point received one minute).

Control group (B) received sham laser, the researcher used the same laser device with same settings (i.e. The device produce same beep sound and used for the same time of application completely the same as true laser, sham laser is applied over the trigger points in the lumbar region as indicated by the patient). Probe of the laser device was covered by a suitable plastic cap which prevents laser beam penetration to the patient skin.

**Data Analysis**

Between group comparisons on all descriptive and dependent variables were done at baseline and after treatment using two tailed, independent sample t tests for age, height, weight, VAS, ODQ and physical performance battery. Baseline to post-treatment comparisons was done with two tailed paired sample t test for VAS, ODQ and physical performance battery. 95% confidence intervals were set for group differences.

## RESULTS

Both groups were similar in age, height and weight (table 1). At the beginning of the study, there were no differences between groups on the dependent variables of VAS, ODQ and physical performance. Following treatment there was no significant difference in physical performance tests between groups. The experimental group (A) demonstrated improvement in pain intensity (measured by VAS) and improvement in self report of physical function (measured by ODQ) at post treatment compared with the control group (B) (table 2, figure 1 and figure 2).

***Table (1): Means ± SD, and t value at baseline for age, weight and height.***

| Items | Group A (Experimental) | | Group B (Control) | | Comparison | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | t-value | P-value |
| Age (yrs) | 42.26 | 7.62 | 39.6 | 4.99 | 1.13 | 0. 26* |
| Weight (Kg) | 76.13 | 7.55 | 75.06 | 2.54 | 0.51 | 0.6* |
| Height (cm) | 167.13 | 7.47 | 167.73 | 4.35 | 0.26 | 0.79* |

*Not significant

***Table (2): Means ± SD, and t value forVAS, ODQ and Physical Performance at baseline and following treatment in both groups.***

| Variable | Baseline | Post-treatment | t value |
|---|---|---|---|
| VAS | | | |
| Experimental (N=15) | 7.0 (±1.3) | 3.46 (±0.91) | 11.52 |
| Control (N=15) | 7.46 (±0.83) | 4.93 (±1.43) | 5.82 |
| P value | 0.25* | 0.002** | |
| ODQ | | | |
| Experimental (N=15) | 52.0 (±9.55) | 27.76 (±8.29) | 8.83 |
| Control (N=15) | 54.98(±9.91) | 37.48 (±10.2) | 7.18 |
| P value | 0.4* | 0.008** | |
| Sit to stand | | | |
| Experimental (N=15) | 17.02 (±6.39) | 12.4 (±4.38) | 4.01 |
| Control (N=15) | 15.99 (±4.87) | 12.76 (±2.1) | 3.38 |
| P value | 0.62* | 0.78* | |
| Trunk flexion | | | |
| Experimental (N=15) | 15.37 (±5.23) | 10.82 (±2.84) | 5.26 |
| Control (N=15) | 16.04 (±5.54) | 12.83 (±4.89) | 3.96 |
| P value | 0.73* | 0.18* | |
| Loaded reach | | | |
| Experimental (N=15) | 0.3 (±0.03) | 0.35 (±0.05) | 4.44 |
| Control (N=15) | 0.28 (±0.04) | o.33 (±0.03) | 5.39 |
| P value | 0.19* | 0.27* | |
| 50 feet walk | | | |
| Experimental (N=15) | 20.35 (±4.76) | 15.84 (±3.43) | 4.95 |
| Control (N=15) | 21.59 (±6.73) | 16.77 (±4.89) | 3.1 |
| P value | 0.56* | 0.55* | |
| 5 minutes walk | | | |
| Experimental (N=15) | 211.28 (±36.53) | 257.13(±46.73) | 4.27 |
| Control (N=15) | 213.08 (±49.07) | 249.42 (±37.92) | 4.72 |
| P value | 0.91* | 0.62* | |
| 360 degree rollover | | | |
| Experimental (N=15) | 13.66 (±2.69) | 9.43 (±3.04) | 5.14 |
| Control (N=15) | 14.39 (±3.53) | 10.31(±3.19) | 5.61 |
| P value | 0.52* | 0.44* | |

*Not significant **Significant difference

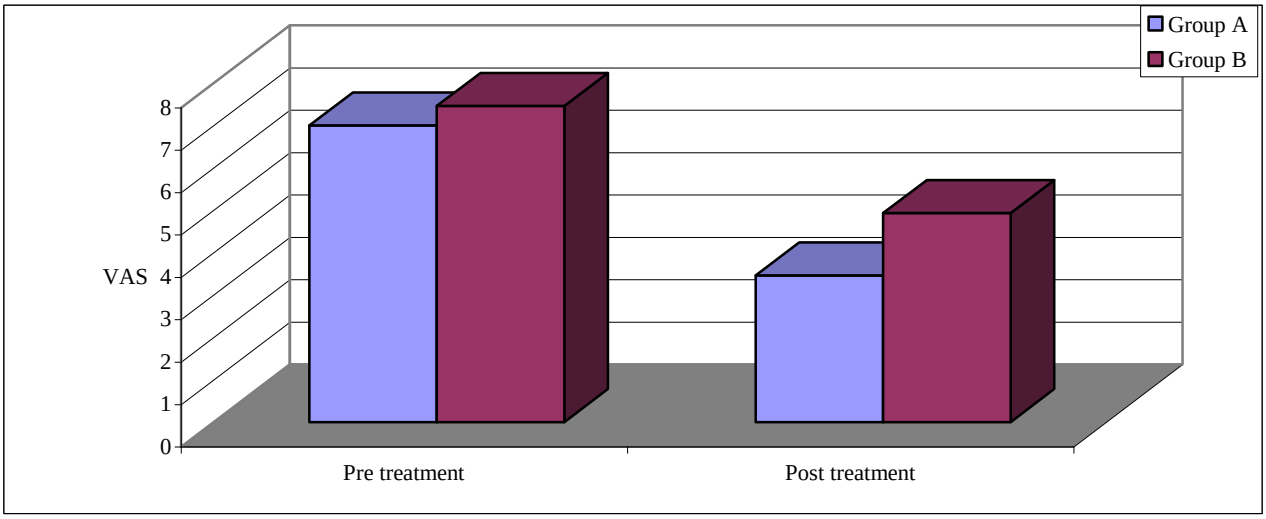


***Fig. (1): Comparison of VAS pretreatment and posttreatment in the experimental group (A) and the control group (B).***

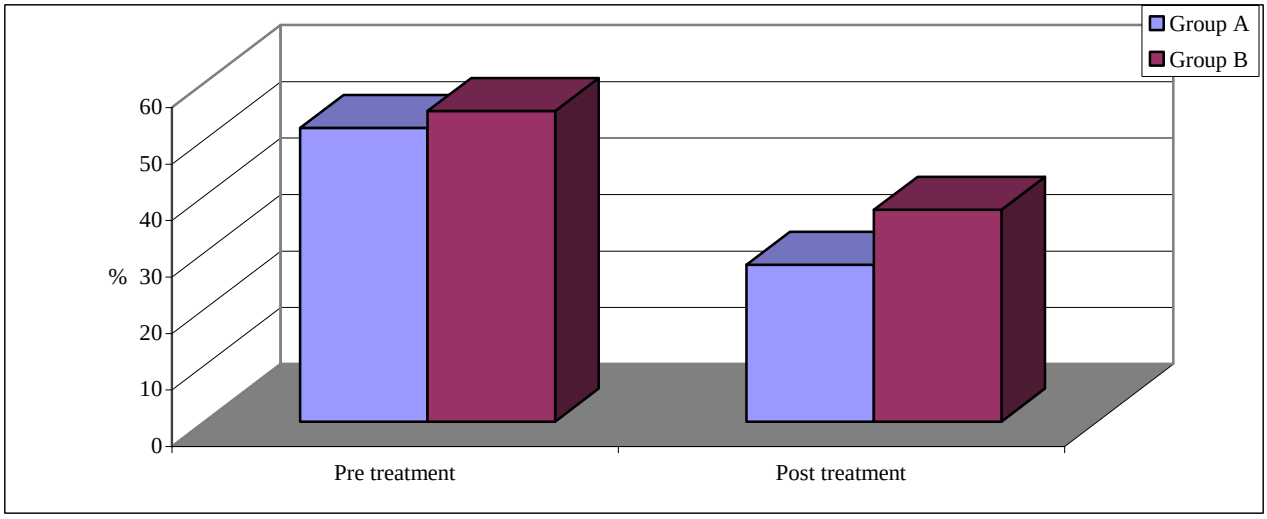


***Fig. (2): Comparison of ODQ pretreatment and posttreatment in the experimental group (A) and the control group (B).***

## DISCUSSION

This study compared the effect of laser as an adjunct therapy to nerve mobilization technique with nerve mobilization alone in people with sciatica due to lumbar disc lesion. We found improvement in VAS score, ODQ score and physical performance tests in both groups with significant improvement in VAS and ODQ in experimental group who received true laser therapy in combination with nerve mobilization technique.

The significant improvement of self reported pain taken by VAS and self reported functional disability taken by ODQ in the experimental group, suggested to be referred to the analgesic effect of laser which come in agreement with Ozdemir et al.,[24] who reported that Laser irradiation was suggested to provide analgesia by decreasing the spasm in muscle arterioles, which is essential for tissue oxygenation, and by increasing ATP formation with a consequent normalization in metabolic rate of the tissues with diminished energy levels, the other mechanisms may he related with its effects on endorphin levels and gate control of pain. By all these mechanisms it can interrupt the vicious cycle of pain. Another study revealed that one suggested effect, is the neuro-pharmacological analgesic effects of lasers, produced by the release of serotonin and acetylcholine at the site of application and through higher centers[17]. Another study conducted in patients with chronic myofascial pain syndrome (MPS) in the neck to evaluate the effects of infrared low level Gallium-Arsenide (Ga-As) laser therapy with 904 nm wave length, on clinical and quality of life (QOL) revealed that short-period application of LLLT is effective in pain relief and in improving functional ability and QOL in patients with MPS[21]. Another study designed to compare low level laser therapy, exercise and laser combined with exercise to determine whether laser therapy is useful or not for the treatment of chronic LBP,[20] found that LLLT seemed to be an effective method in reducing pain and functional disability in the therapy of chronic LBP. LLLT does not bring any additional benefits to exercise therapy and exercise therapy is of primary importance in the therapy of the patients with chronic LBP. Another study agrees with our study done by Djavid[16] who studied the effect of laser combined with exercise compared to exercise alone in cases of low back pain, the trial showed that low level laser therapy plus exercise could decrease pain, increase lumbar flexion, and reduce disability more than exercise alone in the long-term. We suggested that the analgesic effect of laser (in the experimental group) caused the sense of pain relief and consequently the sense of decreased functional disability which is more than in the control group treated with sham laser.

The improvement of physical function is believed to be due to usage of sciatic nerve mobilization technique, this come in agreement with a study done to determine if slump stretching results in improvement in

pain, centralization of symptoms, and disability in patients with non-radicular low back pain with mild to moderate neural mechanosenstivity, the results suggested that slump stretching is beneficial for improving short-term disability, pain, and centralization of symptoms[11]. Another study supported the use of neural mobilization with patients presenting with lower extremity neurogenic pain disorders, they found that neural mobilization (done through a modified SLR position), provided effective management strategy to reduce pain and increase range of motion of hip flexion during straight leg raising (SLR)[10]. In contrast, in a study to investigate the effect of neural mobilization after spinal surgery, the authors reported that, there were no statistically significant or clinically significant benefits provided by the neural mobilization treatment for any outcome[32].

The use of self reported functional disability in addition to measured physical performance tests has additional benefits, this come in agreement with Lee et al.,[22] as they reported that, there were moderate correlations between self reported activity limitation and corresponding clinician-measured performance tests. The unique perspective each method provides appears to be useful for a comprehensive understanding of physical function in patients with LBP. In a study to establish a correlation between different measures Cunha et al.,[13] reported that, the pain measures were moderately and significantly correlated with disability and function, meaning that both the intensity and perception of pain may have an impact on the patient's perception of disability and function. However, the pain measures were poorly correlated with physical performance tests (6 functional tests). They concluded that this finding is clinically relevant because it demonstrates the usefulness of physical performance tests in the evaluation of patients with LBP, in addition to their report and perception of pain. This study come in agreement with our study in which the self report of pain (VAS) and self report of functional disability (ODQ) improved significantly in experimental group more than in control whilst, the clinician measured physical performance tests improved the same in both groups. This means that LASER main effect is on perceived pain and physical disability not physical performance.

## Conclusion

The nerve mobilization technique described in this study is efficient in the treatment of sciatica and is associated with improvement in physical performance and decrease in pain and disability. The combination of laser with nerve mobilization has a better effect on pain and perceived functional disability.

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**الملخص العربي**

## العلاج بالليزر منخفض الطاقة وتمرينات تحريك العصب في حالات عرق النسا

الهدف من هذه الدراسة معرفه تأثير العلاج بالليزر منخفض الشدة إضافة إلى تحريك العصب في حالات عرق النسا بسبب إصابات الغضروف على الألم واستبيان أوستري للإعاقة واختبارات الأداء البدني . الخلفية العلمية : عرق النسا مشكله عمليه شائعة تسبب الألم والإعاقة الوظيفية . توجد العديد من الدراسات التي تدعم تأثير الليزر كطريقه لتخفيف الألم ، كما توجد العديد من الدراسات التي تدعم تأثير تحريك العصب في حالات الآم الظهر لكن لا توجد دراسات تقارن التأثير المجمع لليزر مع تحريك العصب في حالات عرق النسا . تصميم الدراسة : ثلاثون شخصا (16 إناث و 14 ذكور) تم تشخيصهم بواسطة الطبيب المحول بعرق النسا بسبب الانزلاق الغضروفي شاركوا في هذه الدراسة . تم تخصيصهم عشوائيا للمجموعة التجريبية التي تأخذ الليزر وتحريك العصب والمجموعة الحاكمة التي تأخذ الليزر الخادع و تحريك العصب قبل وبعد 4 أسابيع من العلاج تؤدى يوم بعد يوم ، تم تسجيل الألم والإعاقة الوظيفية والبطارية الاختبارية للأداء البدني . النتائج : كلتا المجموعتين حصلوا على تحسن في الألم ، الإعاقة الوظيفية والأداء البدني . على الرغم من أن المجموعة التجريبية حققت تحسن اكبر في الألم والإعاقة الوظيفية أكثر من المجموعة الحاكمة . الاستنتاج : طريقه تحريك العصب الموصوفة في هذه الدراسة فعاله في علاج عرق النسا ورافقها تحسن في الأداء البدني وتقليل في الألم والإعاقة ، تجمع الليزر وتحريك العصب له تأثير أفضل على الألم والإعاقة الوظيفية .