

Low Intensity Laser Therapy Efficacy in Chronic Sciatic Pain Syndrome

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ABSTRACT

This study has been conducted to determine the efficacy of low intensity laser therapy (LILT) for attenuation of pain in-patients with chronic sciatic pain syndrome utilizing two different techniques. Forty-two patients suffering from sciatica with no other systemic or metabolic disorders participated in this study. Their age ranged between 35 and 52 years old. They were divided randomly into two groups of equal number. Group (A) was irradiated directly by LILT on the trigger points while group (B) was irradiated on the acupuncture points related to sciatic nerve. Assessment of pain was carried out before and after treatment (10 sessions) by an objective means through estimation of serum cortisol level (S.C.L.). Data collected at the end of treatment revealed a significant reduction in the mean values of (S.C.L.) in both groups indicating attenuation of pain but there was a non-significant difference of (S.C.L.) neither before nor after treatment between the two groups. The results indicated that both techniques of application have nearly equipotent efficacy in the treatment of chronic sciatic pain syndrome.

Key words: Low intensity laser therapy, sciatica, and serum cortisol level.

INTRODUCTION

Low intensity laser therapy (LILT) is being used to an increasing extent by physicians and physical therapists for attenuation of pain. The laser's clinical application is changing from the generation of the first stage of application of its thermal effect (high energy laser) into the second stage of application of its photobioactive or photochemical effect^{7,33,41} (low energy laser), i.e without any thermal effect. LILT has recently been, reported in the treatment of pain^{9,16,26,33}, and as anti-inflammatory treatment^{4,5,9} and has yielded some promising effects on human beings.

The irradiation of acupuncture points with LILT started to be recognized as a practical effective therapy alternative to needles for auricular acupuncture treatments. Kleinkort and Foley¹⁹ recommended laser radiation to be applied to acupuncture points and it was actually a form of needless acupuncture which potentially useful in managing chronic pain syndrome. Clinicians and authors working in this field have recommended using this techniques and confirmed its effect and added that laser acupuncture was painless, safe, does not induce damage to the tissue as do non steroidal anti-inflammatory or infiltration with corticosteroid and had the advantage of sterility^{18,21,37}.

Most of the modalities used in physical therapy, including, moist heat, ultrasound, and short-wave diathermy²⁵, derive their benefit from a thermal effect upon tissues. Low level laser therapy, on the other hand, causes virtually no thermal effect and therefore works via entirely different mechanisms¹. Results have been concluded that laser have diverse and significant effects on cells and cell functions including reparative processes and neurotransmitter release^{3,14,19,22,26,38}. Clinically, this may be expressed as an enhancement of wound healing and nerve repair, as an anti-inflammatory and as an analgesic.

Pain is a major problem for individuals having sciatica and musculoskeletal disorders¹⁷. Low back pain from a variety of causes commonly affects the adult population, the majority of patients recover promptly and surgical treatment is rarely required¹². It has been reported that surgical and non-surgical treatments for sciatic patients produce similar clinical outcome after four to five years of follow up¹². Also, for many, pain is a daily experience that not only affects their performance at work and home, but also has a negative impact on their mood and the way that they view themselves, others and the future.

A majority of research for chronic pain with laser therapy involving human subjects has been based on patient - reported decreases in pain and dysfunction i.e. subjective measurement rather than estimation of serum cortisol level serum cortisol level (S.C.L.) which considered as an objective measurement of pain²². Also, due to limitations of past

research on the treatment of chronic sciatic pain syndrome by LILT, conflicting results and poor generalizability, the present study was conducted to determine the efficacy of LILT for attenuation of chronic sciatic pain syndrome utilizing two different methods of treatment.

MATERIAL AND METHODS

A) Subjects:

Forty-two patients (21 males and 21 females) referred to physical therapy out clinic with chronic sciatic pain syndrome participated in this study. Their average age ranged from 35 to 52 Years (43 ± 4.74). All patients had chronic sciatic pain syndrome (more than six months) without discogenic lesion proved by myelography or / CT, not responded well for conventional anti-inflammatory medication, had no metabolic disorders (diabetes) and had positive straight leg raising test. The sample was divided randomly into two groups of equal number. Each group consisted of 11 males and 10 females. Both groups were irradiated with LILT. Group (A) was irradiated directly on trigger points while group (B) was irradiated directly on the acupuncture points related to sciatic nerve table (1).

INSTRUMENTATION

- 1- IR- CEB 1 Mid laser, 1 (Ga As) infrared source with a wave length (904 nm), pulse frequency 4000 Hz, pulse duration 180 n sec. and I.R. peak power 10 W.
- 2- Pointer plus: A detector for trigger points, out put 38 mA, frequency 10 Hz, pulse width 240 μ sec, continuous wave form and have biphasic square pulse:
- 3- Non toxic indelible ink.

Table (1): Acupuncture point for sciatic nerve irradiated directly by LILT (Chaitow, 1983).

n	Point Ref.	Chinese Name	Anatomical Position
Bladder	B 49	Chih Pien	3 AUM Lateral to midline on level of the 4 th sacral foramen.
Bladder	B 25	Ta ch'ang Yü	1½ AUM lateral to lower border of spinous process of 4 th lumbar vertebra.
Bladder	B 31	Change Liao	In the 1 st sacral foramen.
Bladder	B 32	Tzü Liao	In the 2 nd sacral foramen.
Bladder	B 33	Chung Liao	In the 3 rd sacral foramen.
Bladder	B 34	Hasia Liao	In the 4 th sacral foramen.
Bladder	B 51	Yin Men	6 AUM below gluteal fold on median line of leg.
Bladder	B 54	Wei Chug	Exact centre of popliteal crease.
Gall Bladder	GB 34	Yang Ling Ch'üan	In depression antero-inferior to small head of fibula.
Gall Bladder	GB 39	Hsüan Chung	3 AUM above external malleolus between posterior border of fibula and tendons of peroneus longus and brevis.
Auricular point for sciatic nerve			On mid point of medial aspect of infra-antihelix crus.

PROCEDURES

A) Evaluation:

Estimation of (S.C.L.) was carried out before and after the treatment program. A venous blood sample of 8cc was taken in the morning centrifuged and stored at -20°C till analyzed.

B) Treatment:

For group (A), the procedures involving lasing the trigger points detected by pointer plus. The most painful points were circled with non toxic indelible ink that wore off within a week. For group (B), the procedures involving lasing the acupuncture points related to sciatic nerve. Classic chinese acupuncture points including local and distant one were detected using the anatomical landmarks and circled as group (A).

The procedure was explained to all the subjects. The skin was cleaned with alcohol to remove fat and scales, the hand probe of the

laser held perpendicular and contact to the target points with pressure applied, this make the laser beam come nearer the target tissues and great percentage of the laser energy associated with the stronger laser beam can be delivered. During the irradiation, the position of the patients was the same for both groups, (prone lying position with a bellow under the iliac bone so that the sacrum is elevated of 45°). This position helps to relax gluteal muscles and make it difficult for the patient to tense them.

Both groups has been irradiated by infra red diode laser (Ga As) for 10 consecutive days in a fixed time¹⁹. The requiredtreenenergy depends on the depth of tissues at the site of both acupuncture and trigger points (from 3 to 6 min. / point)^{5,16}.

C) Data analysis:

Collected data was fed into computer for statistical analysis. The descriptive statistical which includes: mean, standard deviation,

minimum and maximum were calculated for both groups.

The t-test was done to compare between the mean difference between the two groups and within each group.

Alpha point of 0.05 was used as a level of significance.

RESULTS

In the present study, the effect of irradiation of (Ga - As) laser utilizing two different techniques (trigger points and acupuncture points) on S.C.L. in patients with chronic sciatic pain syndrome were investigated.

As shows in table (2) and figure (1), the mean value of S.C.L. before treatment was

Table (2): Comparison of the mean value of (S.C.L.) before and after treatment in both groups.

Subjects	Before Treatment		After Treatment		P. Value
	X	SD	X	SD	
Group (A)	33.3	6.22	26.9	3.81	< 0.05 *
Group (B)	33.8	5.91	28.3	4.86	< 0.05 *

* Significant

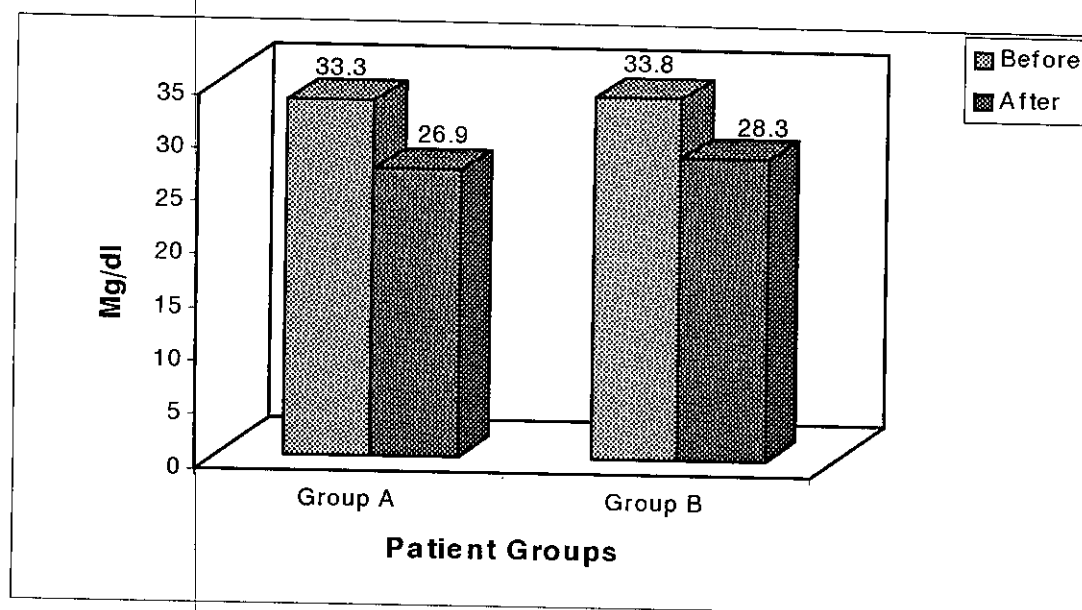


Fig. (1): Mean value of S.C.L. before and after treatment in both groups.

DISCUSSION

Pain most commonly occurs when noxious event (e.g. injury, inflammation) causes the excitation of nociceptors and increased activation of primary afferent fibers at the lesion site in response to the swelling and accumulation of local inflammatory substances such as bradykinin and prostoglandins produced by injury³². These primary afferent fibers send information to the spinal cord for processing painful stimuli. So, increased activity in dorsal horn neurons transmit the nociceptive information to higher brain centers resulting in perception, discrimination of pain²⁰ and occurrence of behaviorals and physiological events which tend to eliminate or reduce further nociception¹⁷.

Bennet⁶ had reported that reduction of inflammation which in turn reduce the incoming input from primary afferent into the spinal cord would be expected to reduce the transmission of noxious input to local dorsal horn and consequently, higher centers and thus decrease the perception of pain. So, utilizing analgesic and anti-inflammatory modality for limiting the occurrence of nociception is undoubtedly important.

The results of this study revealed a significant reduction in the mean values of S.C.L. in each group indicating attenuation of chronic sciatic pain syndrome. There was a non-significant difference in S.C.L. excited between group (A) and group (B).

Previous studies have used different types of laser and different exposure lengths, intensities and sites, making comparisons difficult. Also, no prior study of LILT using estimation of (S.C.L) as an index for chronic sciatic pain syndrome was available in the

literature for comparison nor comparative study between irradiation of trigger points and acupuncture points, therefore, multiple assumptions were necessary in the design of this study.

Lack of objective measurement was a likely cause for much of the confusion in spine care³. Endogenous opioid peptide (endorphin) has shown involved in the process of pain modulation and serum beta-endorphin level would be a criterion for stress of pain and relief^{23,31}. Secretion of β -endorphin is associated with secretion of ACTH (adrenocorticotrophic hormone) and cortisol level therefore, we used estimation of S.C.L. as a powerful, new, objective tool to determine the efficacy of laser therapy, which is considered as an objective index of the level of β -endorphine³⁴. It was reported that cortisol level normally ranged from 9-25 $\mu\text{g}/100\text{ dl}$ at morning, and stated that patients with chronic pain tended to have higher than normal S.C.L. and referred it to organic and psychological effects of pain. Also, Lush²², found that a rise in S.C.L. during pain has been dropped after analgesia. These finding were in accordance with our results. Central neurotransmitter such serotonin, endorphin and acetylcholine are closely related to the mechanism of laser acupuncture. LILT acts through the neural, hormonal and immune systems¹⁴. It activates DNA and protein synthesis and alters or controls the state of neurotransmitters, hormones, antibodies or enzymes by LILT photoenergy activation of systemic, cellular and subcellular units of these compounds¹⁵.

Relatively few studies are based upon trial, which LILT has been assessed specifically as an antinociceptive or analgesic modality.

It would be expected that the perception of pain would be reduced by techniques aimed at

increasing the concentrations of inhibitory neurotransmitters and/or reducing the concentrations of excitatory neurotransmitters^{17,20,32}. Sodium-Potassium-ATP'ase (Na-K-ATP'ase) reduces nociceptive impulse transmission²². Increased Na-K-ATPase activities was reported after LILT producing pain attenuation^{7,8,15,24}. Ohshiro³⁰, reported the importance of Na-K-ATP'ase in regulating Na-K pump activity and modulating cell membrane transfer gradients, and cited this mechanism of LILT as possible role of laser therapy in pain transmission and control. This is in agreement with the results of the present study.

Baxter⁴ reported that LILT has no effect on large diameter afferent, but reduced evoked activity in small diameter afferents. Small diameter afferents are associated with production of slow chronic pain and though to inhibit the cells in the substantial gelatinosa which inhibit pain transmission. Reduced activity of C fibers would decreased transmission and sensation of pain. This suggestion is in accordance with the results of the present study.

The observed laser-mediated suppression was suggested by walker³⁹ to be due to some direct effect upon irradiated nerves which she proposed were "photosensitive" and thus capable of generating action potentials in response to laser irradiation at appropriate parameters.

Reduction of pain may be also due to interference in sensory nerve transmission. There are similar results consistent with this idea. Synder-Mackler and Bork³⁵ reported increase in the latency of the superficial radial nerve in healthy subjects that corresponded to decrease in sensory nerve conduction velocity after He-Ne laser therapy. Also, Nissan, et al.,²⁹ found a significant increase in action

potential in the sciatic nerve with He-Ne irradiation. Similarly, Mester, et al.,²⁴ stated that laser light was responsible for prevention the repolarization of nerve fibers which transmit pain.

β -endorphin was the most important neurotransmitter substances serving auto-analgesia and is closely linked to serotonin, as they act in a tandem³¹. LILT was used by walker³⁸ in a double blind study for treating chronic sciatica and neuralgia and demonstrated pain relief associated with an increase of 24 hour urinary excretion of 5-Hydroxy indoleacetic acid (a break down product of serotonin) and degradation product of serotonin. Also, Zakovic⁴¹, et al., reported decrease in serotonin metabolism in animal model. Energisation of depleted enzymes and elevation of endorphin levels have been reported after treatment of trigger zones in muscles by LILT. This is also, in agreement with our results.

Reduction of pain in the present study may be attributed to resolution of inflammation. The evidence today indicates that laser biostimulation accelerate the inflammatory phase of the healing process by altering the level of prostoglandins^{2,10,15,24} and causes cin the cyclic adenosinemonophosphate (c-AMP) system which has been demonstrated to control both biosynthesis of DNA and RNA and realization of the biological activity of the human cell.

It is well known that mast cells are important mediators of inflammation especially in connective tissue¹⁵ and LILT was reported to cause degranulation of mast cells, release of heparin, and histamine, which aids in resolution of inflammation^{11,36}. As mast cells are rich in histamine, a well characterized powerful inflammatory and analgesic agent, their apparent degranulation as a result of laser

irradiation in Trelles, et al.,³⁶ study could also suggest a net hyperalgesic effect.

(Ga-As) infrared diode laser (904nm) is used in this study. Its wavelength has been reported to be the most widely applicable wavelength for resolution of inflammation and relief of pain^{16,26,27}. It is quite possible that the efficacy of LILT has been used in our study was due to its wavelength, intensity and specific dose. Karu¹⁵ stated that light quantum is only trigger for cellular metabolism regulation which explained the low doses and intensities needed, also, the magnitude of the biostimulation effect depends on the physiological state of the cell before irradiation which explained why the biostimulation effect is not always possible. Review of literature revealed that the problem with most studies examining the effect of LILT on low back pain and sciatica to screen patients adequately regarding the source of pain and the level of detail concerning the case may not be specific enough to predict those who would respond favorably to laser treatment.

It was suggested that pain suppression by laser acupuncture technique with group (B) may be due to many mechanisms including bio-immunescence bioplasma. Living cells emits coherent light energy called biophotons, when a group of cells are functioning in harmony they emit biophotons at the same wavelength and rhythm, when there is a damage, disturbances or disease, this harmony is lost⁹. Also, it has been suggested that, acupuncture points emit light by themselves. This is called bioimmunescence²⁸, which follow 24-hour rhythm. This is comparable to the flow of ch'i' or Qi through meridians every 24 hours. Giulio¹³, suggested a mechanism of bioresidence between energy sources such as laser and biosystem, that is turned to a complex pattern of resident frequencies. The

media for interaction is said to be bioplasma.

It has been well documented that, acupuncture points are superior areas of skin, having measurably reduced electric resistance. It was also suggested that, a possible of acupuncture analgesia through local point stimulation by laser is via segmental spinal reflexes called sherrington's short reflexes. Stimulation of the distant acupuncture points may be act via intersegmental spinal reflexes called shirrington's long reflexes²⁸.

Yamada et al.,⁴⁰ concluded that clinical application of LILT, such as contact and/or laser acupuncture, is non-invasive and not painful for animal (horses) and is effective in pain suppression and improvement of inflammatory reaction (chronic inflammation of tendon and/or ligament that had not responded well to conventional medicine and methodologies). He revealed his results to the photochemical and photobioactivating effect of LILT on the living body explaining that the photoactivation effect increases the activity of the biological, high density molecules such as blood type substances, gamma globulin, kimotrypsin and lymph.

Many authors reported that laser acupuncture was an effective modality for relief of chronic pain with various origins^{19,21} and their results matches with the results of the present study. De-Min¹⁰, proved that laser acupuncture has a similar effect on the defence immunofunction of organisms as traditional acupuncture, it could regulate the off-balance of immune networks and reinforce the function of T lymphocytes. Synder-Mackler and Bork³⁵ have been found a significant increase in radial nerve conduction latency. The efficacy of laser therapy in radicular and pseudoradicular pain syndrome was found a significant reduction of pain¹⁸.

CONCLUSION

The objective data generated in this study give strong support to the importance of LILT in the treatment of chronic sciatic pain syndrome.

Data collected at the end of treatment revealed a significant reduction in the mean values of S.C.L in both groups indicating attenuation of pain but there was a non-significant difference of S.C.L. neither before nor-after treatment between both groups. Both techniques of application (trigger points and acupuncture points) have nearly equipotent efficacy in the treatment of chronic sciatic pain syndrome.

The incorporation of laser as an accepted modality of treatment in the physical therapy profession holds great promise now as well as in the future.

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الملخص العربي

كفاءة العلاج بأشعة الليزر المنخفض الشدة للآلام المزمنة لمرضى عرق النساء

يهدف هذا البحث دراسة كفاءة العلاج بأشعة الليزر المنخفض الشدة لتقليل الآلام المزمنة المصاحبة لمرضى عرق النساء مع استخدام طريقتين مختلفتين في التطبيق . اشترك في الدراسة ٤٢ مريضا من الجنسين تتراوح أعمارهم بين ٣٥ إلى ٥٢ عاما مع عدم وجود أمراض مصاحبة . تم تقسيم المرضى عشوائيا إلى مجموعتين متساويتين في العدد ثم ألحقت كل مجموعه بأحدى طريقتي العلاج . تم علاج كل المرضى باستخدام أشعة الليزر المنخفض الشدة . المجموعة (أ) بطريقة الإشعاع النقطي على أكثر النقاط إثارة للألم الخاصة بعرق النساء . أما المجموعة (ب) فتم علاجها بطريقة الإشعاع النقطي مباشرة على الأماكن المخصصة للإبر الصينية الخاصة بالعصب . تم تقييم انخفاض الألم قبل وبعد انتهاء فترة العلاج (١٠ جلسات) باستخدام قياس مستوى الكورتيزول في الدم وقد أظهرت النتائج انخفاضا ملحوظا في مستوى الكورتيزول في الدم في المجموعتين مما يدل على انخفاض نسبة الألم لدى المرضى . وبمقارنة نسبة التحسن في المجموعتين أظهر التحليل الإحصائي عدم وجود فرق ذو دلالة إحصائية بين النتائج في المجموعتين لذا يوصى بتطبيق أي من الطريقتين عند استخدام أشعة الليزر المنخفض الشدة في علاج الآلام المصاحبة لمرضى عرق النساء .