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The Effectiveness of Low-Level LASER Therapy for Nonspecific Chronic Low Back Pain

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ABSTRACT

Background and Objectives: Recently, low level laser therapy (LLLT) has been widely used to reduce pain caused by musculoskeletal disorders as low back pain. Though it is being suggested that LLLT is an effective method to relieve pain in patients with non-specific chronic low back pain (NSCLBP) and widely utilized, therapeutic outcomes of LLLT in NSCLBP are varied and conflicting. However there is still lack of evidence regarding its effectiveness on functional outcomes. This study aims to identify the effectiveness and therapeutic efficiency of LLLT in treating NSCLBP.

Materials and Methods: In this current study, 58 participants (patients from nearby hospitals) were included in experimental (32) and control (26) groups where they received LASER + Exercises (Arm 1) and Heat Therapy + Exercises (Arm 2) respectively for consecutive three weeks, two sessions per week. Assessments were conducted for pain and AROM (forward flexion, extension, right and left side-flexion of lower back) at the baseline and at the end of the intervention. The data were analyzed with the time; baseline, and end of intervention and between two groups using two-way repeated measure MANOVA with significant at 5% significant level with 95% CI.

Results: According to the analysis, it was found that there is no statistically significance between the groups except for back extension at baseline. There is a significant improvement ($P \leq .005$) in all the variables in both the groups separately and experimental group have higher improvement than the control group.

Conclusion: It can be concluded that the LLLT is an effective treatment modality for treating NSCLBP.

Key words: Low level LASER therapy, exercises, low back pain, non-specific, chronic

INTRODUCTION

Pain in the lumbo-sacral area, commonly known as the low back pain, has lately reached the epidemic proportions in its incidence. This common musculoskeletal disorder affects 70%-85% of world population at some point in their life time [1]. Though spontaneous relieving of symptoms is observable in a majority of patients within 1-3 months, 3% - 10% of patients tend to develop chronic (lasting more than 3 months) low back pain [2]. Nevertheless, the underlying etiology of most chronic back pain is currently unclear and therefore the term, "Non-specific chronic low back pain" (NSCLBP) is used to denote this condition [3]. At present, NSCLBP is treated by drug therapy, surgery, exercise therapy, electrotherapy (Therapeutic ultrasound, Transcutaneous electrical nerve stimulation, Low level laser therapy, spinal traction, short wave diathermy), mobilization, manipulation, acupuncture, physical agents and lumbo-sacral spinal support [4].

Recently, low level laser therapy (LLLT) has been widely used to reduce pain caused by musculoskeletal disorders as low back pain. LASER are divided into classes as 1, 2, 3A, 3B, 4 and 5 according to their power, effect on the eye given the blink

reflex time and the duration of the on time if pulse. LASER used for therapeutic purposes are generally classes 2, 3A and 3B [5] which is known as low level laser therapy. They emit no heat, sound or vibration. It is mostly accepted that, LLLT provide their therapeutic properties by photobioactivation (photobiostimulation/photobiostimulation) effects [6]. Though it is being suggested that LLLT is an effective method to relieve pain in patients with NSCLBP and widely utilized, therapeutic outcomes of LLLT in NSCLBP are varied and conflicting. However there is still lack of evidence regarding its effectiveness on functional outcomes. This study aims to identify the effectiveness and therapeutic efficiency of LLLT in treating NSCLBP.

MATERIALS AND METHODS

Experimental design

The study was a single blinded study, where two treatment combinations were tested against each other. The study groups were (i) LASER + Exercises (Arm 1) and (ii) Heat Therapy + Exercises (Arm 2).

Participants

All the patients with non-specific chronic low back pain for more than three months were included in this study while excluding patients who have undergone surgery for relief back pain and patients with mental or cognitive problems. The written consent was taken from all the participants and participation for this study was voluntarily. Randomly allocated to arm 1 or arm 2 via envelops method was used to select the participants for each group. Participants were masked to the treatment group allocation and the physiotherapist who was doing the treatment was not be blind to treatment allocation.

Procedure

Baseline measurements of pain intensity, lumbar range of motion (ROM) including flexion, extension, lateral flexion to left and right side were recorded at first session. Pain intensity was recorded using Visual Analogue Scale (VAS) and the lumbar ROM was measured using a measuring tape. All subjects were received exercises and arm 1 were received low level laser therapy and arm 2 were received heat therapy using hot pack in addition to the exercises. Both groups were received treatment twice per week for three weeks. Post treatment measurements of pain intensity and lumbar ROM were taken at the end of sixth treatment session.

Treatment methods

Hot pack: Hot pack was placed over the lower lumbar area which includes quadratus lumborum muscle, the gluteus maximus muscle, the gluteus medius muscle, the gluteus minimus muscle, and the piriformis muscle for 20 min.

LASER: Low level laser therapy, at a wave length of 810 nm wavelength with 02 - 08 Jper point and a power density of 20 $mW/cm^2$was employed. Time duration: 06 - 09 minutes

Exercises: Exercise program was comprised of Williams' exercises and McKenzie's exercise to strengthen the lumbar muscles. This was implemented in 30 min sessions, twice per week for three weeks. The Williams' exercise was composed of a posterior pelvic tilt (10 sec/1 set, 3 sets), followed by sit-ups (10 times/1 set, 3 sets), and a knee to chest exercise (10 sec/1 set, 3 sets). McKenzie's exercise involves bending the trunk back while supporting the trunk with both elbows in a prone position (trunk extension) (20 sec/1 set, 3 sets), followed by bending the trunk back while supporting the trunk with both hands with the elbow extended in a prone position (10 sec/1 set, 3 sets), and then bending the trunk back in a standing position (10 sec/1 set, 3 sets).

Outcome measurements

Pain and lumbar range of motion (ROM) was measured before and at the end of the treatment.

Statistical Methods

The data was statistically processed using SPSS (version 22) software. Descriptive analysis was conducted to find the distribution and level of normality of data in both groups at the baseline and at the end of the intervention (treatment protocol). Variation of five dependent variables; pain in lower back (VAS), and AROM (forward flexion, extension, right and left side-flexion of lower back) were analyzed with the time; baseline, and end of intervention and between two groups using two-way repeated measure MANOVA. Univariate analysis was conducted to compare variations within the groups with the time separately for each dependent variables as the MANOVA test results got significant at 5% significant level with 95% CI. Since there are 2 time points (baseline and at the end of the sixth session), 05 pairs were compared within one group. Hence total 10 pairs were analyzed at 0.005 significant level based on Bonferroni correction for multiple pairwise comparison (0.05/10) with 95% CI. Further, univariate analysis was conducted for between-group comparisons at each time for each variable (1x5x2), at 0.005 significant level based on the Bonferroni correction (0 .05/10) with 95% CI.

RESULTS

The baseline demographics and clinical characteristics for the 58 randomized participants; 32 from experimental group and 26 from control group, stratified by intervention assignment. There is no statistically significance between the groups except for back extension at baseline. (Table 1)

Table 1: Comparison of demographic and Baseline data between experimental and control group

Variable	Experimental group (n=32) mean (sd)	Control group (n=26) mean (sd)	P value
Gender (Female)			
Age	47.75 (12.814)	48.15 (11.030)	.899
Lower back pain	7.28 (1.550)	7.46 (1.334)	.641
Fwd Flx AROM	6.29 (1.680)	6.585 (1.091)	.450
Ext AROM	3.94 (.9731)	3.165 (1.004)	.004
L side Flx AROM	23.06 (7.915)	25.61 (8.155)	.083
R side Flx AROM	22.34 (8.134)	26.196 (8.432)	.233

Table 2: Two way RM MANOVA analysis of outcomes

Main effects and interactions	*P* value	Observed power
Time*Outcomes*Group	.000	1.000
Time	.000	1.000
Group	.015	0.697
Time*Group	.000	0.982

There is a significant interaction effect between time, group and dependent variables in the intervention at 5% significant level and 95% CI with higher level of observed power in respect to outcomes. (Table 2)

Pairwise comparison was carried out to compare between the groups and time for all the dependent variables as the multivariate test showed a significant result. There is a significant improvement in experimental group compared to control at post interventional stage for all the variables. (Table 3)

Table 3: Comparison of post interventional outcomes between experimental and control

Variable	Mean (sd) of experimental	Mean (sd) of control group	*P* value
Lower back pain	3.03 (1.469)	5.50 (.989)	0.000*
Fwd Flx AROM	8.77 (.769)	7.51 (.846)	0.000*
Ext AROM	4.73 (.440)	3.75 (.774)	0.000*
L side Flx AROM	17.82 (6.341)	23.25 (7.383)	0.004*
R side Flx AROM	16.26 (5.181)	23.10 (7.231)	0.000*
* = Statistically significant difference with bonferroni correction 0.005; at 95% confidence interval			

Pairwise comparison of mean values within the experimental and control groups at baseline and post intervention shows that there is a significant improvement ($P \leq .005$) in all the variables in both the groups separately. Though there is significant

improvement in both the groups, experimental group have higher improvement than the control group. (Table 4)

Table 4: Variation of outcomes with time within the experimental and control groups

Variable	Within experimental group			Within control group		
	Baseline mean (Sd)	Post Intervention mean (Sd)	*P* value	Baseline mean (Sd)	Post Intervention mean (Sd)	*P* value
Lower back pain	7.28 (1.550)	3.03 (1.469)	.000*	7.46 (1.334)	5.50 (.989)	.000*
Fwd Flx AROM	6.29 (1.680)	8.77 (.769)	.000*	6.58 (1.091)	7.50 (.846)	.000*
Ext AROM	3.94 (.973)	4.73 (.440)	.000*	3.16 (1.004)	3.76 (.774)	.000*
L side Flx AROM	22.34 (8.134)	16.26 (5.180)	.000*	25.61 (8.155)	23.25 (7.383)	.000*
R side Flx AROM	23.06 (7.914)	17.82 (6.340)	.000*	26.19 (8.432)	23.10 (7.231)	.000*

* = Statistically significant difference with bonferroni correction 0.005 ; at 95% confidence interval

Following figures showed the comparison between experimental and control groups on five dependent variables, namely: pain in VAS, lumbar AROM: flexion, extension, left lateral flexion and right lateral flexion at the baseline and post intervention.

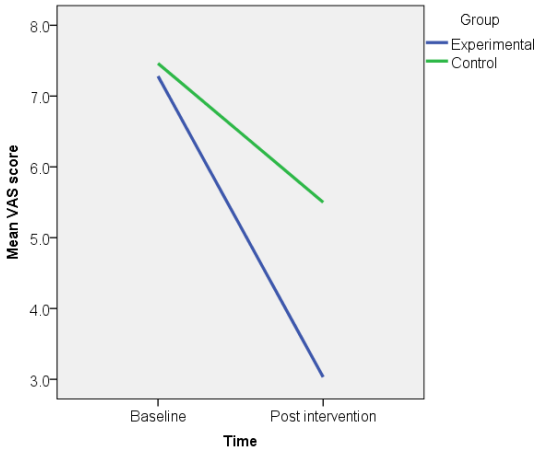

Figure 1: Mean VAS score between experimental and control groups at baseline and post intervention

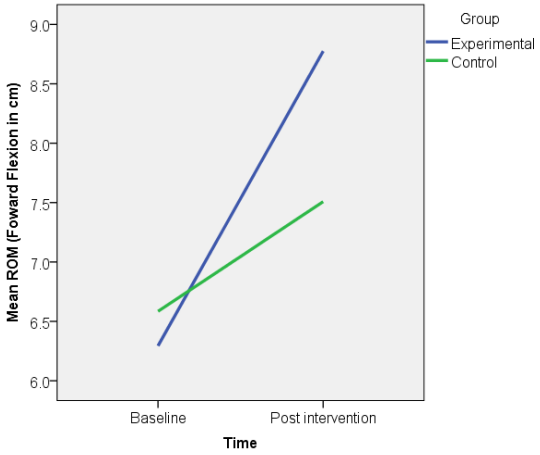

Figure 2: Mean forward flexion ROM between experimental and control groups at baseline and post intervention

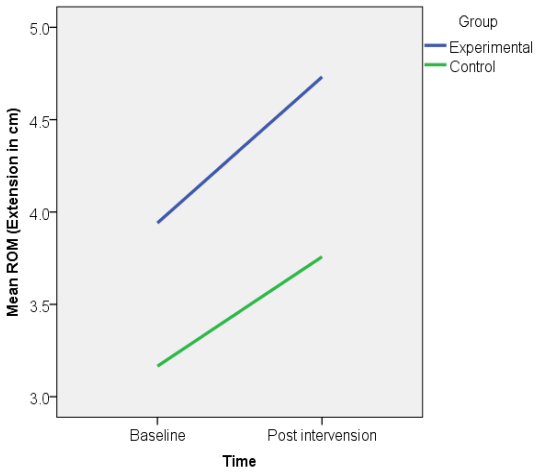

Figure 3: Mean extension ROM between experimental and control groups at baseline and post intervention

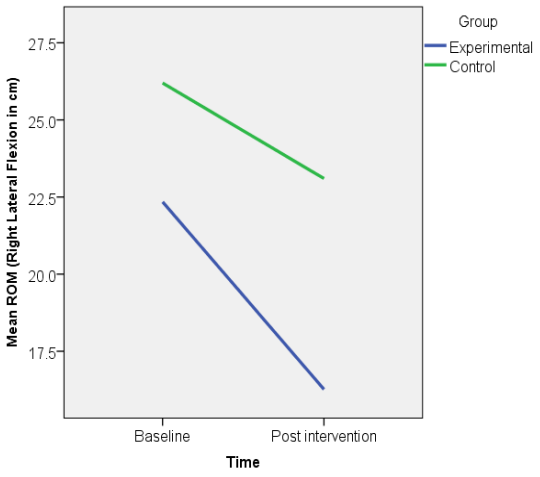

Figure 4: Mean right lateral flexion ROM between experimental and control groups at baseline and post intervention

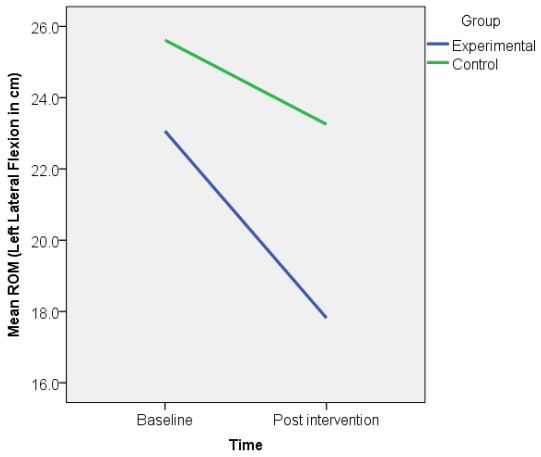

Figure 5: Mean left lateral flexion ROM between experimental and control groups at baseline and post intervention

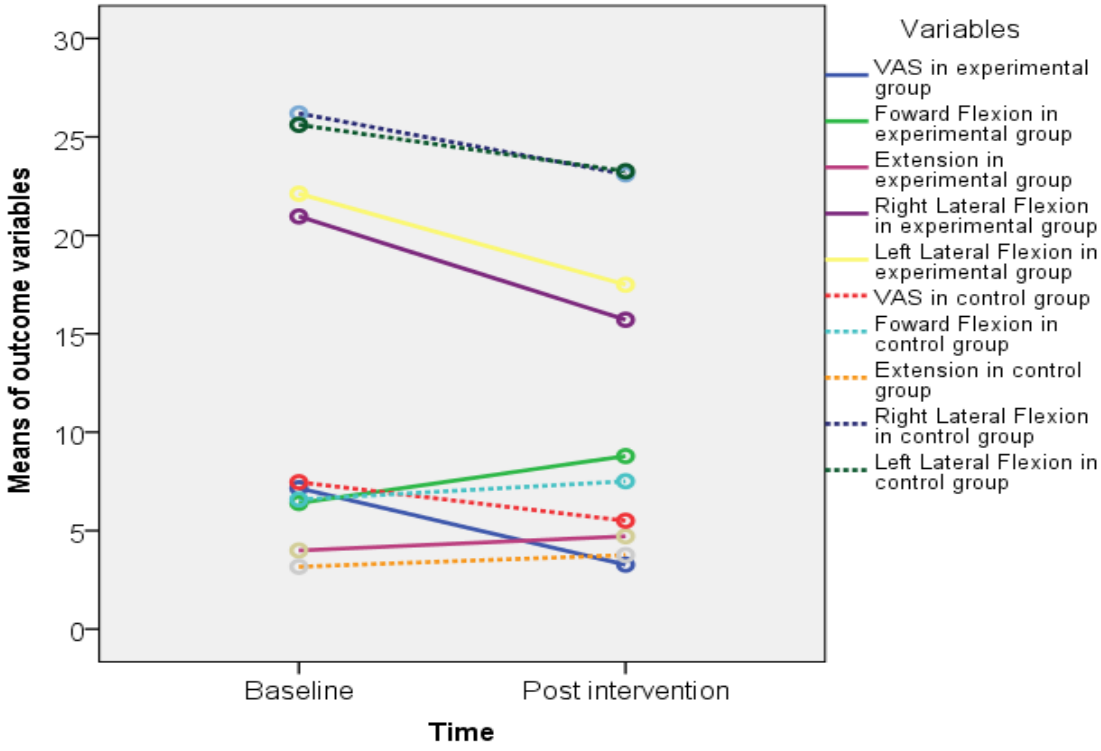

Figure 6: Means of all outcome variables between experimental and control groups at baseline and post intervention

DISCUSSION

- There is no statistically significance between the groups except for back extension at baseline.
- There is a significant interaction effect between time, group and dependent variables in the intervention at 5% significant level and 95% CI with higher level of observed power in respect to outcomes.
- There is a significant improvement in experimental group compared to control at post interventional stage for all the variables.
- There is a significant improvement ($P \leq .005$) in all the variables in both the groups separately. Though there is significant improvement in both the groups, experimental group have higher improvement than the control group.

In this current research, any statistically different decline in VAS between experimental and control groups at the baseline was not found. But at post intervention, both the groups showed a

significant decline in VAS and experimental group was higher compared to control group. Supporting this findings, randomized controlled trials conducted in 2007 [7] and 2014 [8, 9] had revealed significantly greater decline in VAS pain in response to LLLT compared with placebo treatment. Opposing the study results of current project; no significantly greater decline in VAS pain in response to LLLT compared with placebo treatment had been observed by some previous randomized control trials in 1990 [10], 1998 [11], 1999 [12] and 2003 [13].

It was found that a statistically significance between the groups for back extension at baseline. The study also revealed that all the ROM were improved at the post intervention assessment, comparing two groups; experimental group has higher scores. Supporting the current results, an Egyptian researcher in 2015 [14] found that LLLT has better outcomes for increase ROM. He also found a statistically significant improvement in pain and lumbar ROM. Supporting the current findings, previously conducted meta-analysis in 2015 [4] stated that pain reduction and increasing lumbar ROM is evident with LLLT.

CONCLUSION

By this current study it can be concluded that the low level LASER therapy is an effective therapeutic modality for non-specific chronic low back pain to reduce pain and increase lumbar range of motion.

*Ethical approval was obtained for this study from the Ethics Review Committee, Faculty of Allied Health Sciences, University of Peradeniya, Sri Lanka

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