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Effect of Pulsed Ultrasound Therapy Compared with Low Level Laser Therapy on Postpartum Sciatica: A Randomized Controlled Clinical Trail

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ABSTRACT
Background: Postpartum Sciatica is one of the most often reported symptoms that lowers social and economic efficiency and lowers quality of life.
Objective: Our objective is to evaluate the effects of ultrasound and low-level laser therapy on postpartum sciatica.
Patients and Methods: Sixty women suffering from postpartum sciatica between the ages 25 and 40 were randomly allocated to one of two equal sets. For 12 weeks, Group (A) got pulsed ultrasound therapy for 20 minutes each session, 3 times/week for 12 weeks, in addition to flexibility exercise for abdominal and back muscles. While Group (B) performed the same flexibility exercises as Group (A) but additionally got low level laser therapy for 2 minutes per point 3 times per week for 12 weeks. Both groups (A and B) were assessed before and after the treatment therapy program by evaluating hip ROM with a goniometer and pain intensity using a visual analogue scale.
Results: Our results showed that both Group (A) and Group (B) experienced significantly lower pain levels after therapy compared to before treatment (P-value 0.0001) and significantly improved hip range of motion (P-value 0.0001). When compared to Group B, Group A's hip ROM (P-value 0.001) and VAS score (P-value 0.001) significantly improved following therapy. **Conclusion:** Pulsed ultrasound treatment is better than low level laser to treat postpartum sciatica, with more reducing of pain intensity and enhancing hip range of motion.
Keywords: Postpartum sciatica, ultrasound therapy, low level laser therapy, visual analogue scale, goniometer.

INTRODUCTION

Sciatica is a common form of lumbosacral radiculopathy that is characterized by low back pain that radiates to the leg. It may also be accompanied with sensory loss, motor weakness, and/or abnormal reflexes **(1)**. Sciatic nerve injury may be caused by an undetected, long-lasting nerve entrapment carried on by an incorrect lithotomy location beneath a sensory block **(2)**. In addition to sensory complaints, limited forward lumbar spine flexion, unsteady gait, and unilateral paraspinal muscle spasm, patients may also experience coughing, which exacerbates their sciatic pain worse **(3)**.

Due to the prevalence of postoperative sciatica, statistics state that 50% of pregnant women will experience low back pain at some point throughout their pregnancies or in the postpartum period **(4)**. Prevalence rates for pregnant women were 17%, 22.1%, and 24.6%, respectively, in America, Australia, and Mediterranean countries, according to studies **(5)**.

Low intensity light therapy, also known as low level light therapy or photobiomodulation (PBM), includes low level laser therapy (LLLT). The result is photochemical rather than thermal. It activates mitochondria, increases the potential of the mitochondrial membrane, and may thus be expected to augment rather than reduce the metabolism and transit of action potentials in neurons **(6)**.

It has been shown that pulsed ultrasound can be used as a non-invasive physical stimulation for therapeutic purposes **(7)**.

In the case of sciatic nerve damage, it improves nerve regeneration. PUS may encourage the production of the neurotrophins (NT-3) gene and cell proliferation in Schwann cells **(8)**. Studies on the impact of physical therapy therapies on postnatal sciatica are few. In order to assess the efficacy of low-level laser treatment and ultrasound therapy for sciatica postnatal, this study was undertaken.

PATIENTS AND METHODS

Study Design

The investigation was planned as a randomized controlled clinical trial. It was conducted between September 2021 and February 2022.

Before the study began, it was ethically approved by the Institutional Review Board of the Faculty of Physical Therapy at Cairo University (No: P.T.REC/012/00376). Every patient signed an informed written consent for acceptance of participation in the study. The Declaration of Helsinki principles for the conduct of human research were followed in this study.

Study Participants

Sixty postpartum women with postpartum sciatic pain were chosen from the Obstetrics and Gynaecology Outpatient Clinic at the Police Academy New Cairo Hospital. Six months after giving birth, 60 sedentary, non-smoking, multiparas' mothers with two or more children to participate in the study. Every participant had postnatal sciatica according to visual analogue scale (VAS), their ages varied from 25 to 40 and their BMI ≤ 30kg/m^2. Those with severe fungal infections, acute viral diseases, active TB, polyneuropathy, thyroid issues, pregnancy, implanted cardiac rhythm devices, or skin conditions that interfered with ultrasonography or laser treatment were excluded from the study. To ensure

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inclusion, each participant had a thorough history interview, clinical examination, and investigation.

Randomization

Every woman was made aware of the nature, goal, and research applicability as well as her ability to reject or withdraw from it at any time and the confidentiality of any data acquired. Participants were split evenly into two equal groups using a computer-based randomization technique (A and B). There was no participant withdrawal from the study following randomization.

Interventions

Group (A) involved 30 women with postpartum sciatica got pulsed ultrasound therapy for 20 minutes every session, 3 times every week for a period of 12 weeks, along with flexibility workouts for abdomen and back muscles. While Group (B) involved 30 women with postpartum sciatica got low level laser therapy for 20 minutes each point 3 times every week for 12 weeks, along with the same flexibility workouts for abdomen as well as back muscles.

Flexibility exercise program:

All postpartum women in groups (A) and (B) got flexibility exercise program that included hamstring, piriformis and lower back stretches (three times every session with hold for 30 seconds and 30 seconds rest). As well as Strengthening exercises for abdominal, gluteal and back muscle (2 sets per session. Every set has 5 repetitions with 1 minute rest between every repetition and 5 counts hold before the patient returned to the starting position). Every participant was required to carry out the stretching and strengthening exercises during sessions then asked to apply it at home for 12 weeks [(9)].

Ultrasound therapy for group (A)

All postpartum women in Group (A) obtained pulsed ultrasound therapy (Chattanooga, USA) with frequency 3 MHz, an intensity of 0.8 W/cm2 and a pulsed mode of 1:1 for 20 minutes every session, 3 times every week for a period of 12 weeks**.** Patient was asked to assume comfortable prone position. A coupling gel was applied to the treated area and Ultrasound head was placed on the skin and rotated in a circular motion over the paraspinal muscles of the L4 to L5 and L5 to S1 for 5 minutes at each site [(10)].

Figure (1): Therapeutic use of ultrasound therapy.

Low level laser treatment for Group (B)

Each postpartum woman in Group (B) got low level laser treatment (Level Infrared laser, Italy) for three times each week for 12 weeks. Parameters: Wavelength: 904nm, Laser probe power density: 15 J/cm^2, Pulse repetition frequency: 5000Hz, contact technique, Time: for 8 min every session, 2 min per point. Patient was asked to assume comfortable prone position. To ensure their safety during therapy, patients and physiotherapist were encouraged to wear 98 protective glasses. Contact technique was used for the optimum laser treatment using diode systems (hand held probe) the tip of the probe was hold perpendicular in contact of the skin. This technique allowed deeper penetration of laser and maximized the power density on the target tissues as reflection is minimized.it was done at twice across the paraspinal muscles of the L4 to L5 and L5 to S1 for two minutes at each location [(11)].

Figure (2): Application of low-level laser therapy.

Outcome measures:

Visual analogue scale (VAS)

The VAS was utilized to assess each postpartum woman's level of postnatal sciatic pain both before and after the treatment program. In addition to its ratio scale properties, it is the ideal scale for determining pain intensity since it is straightforward, dependable, and valid. It is a 10-cm horizontal line on which a mark between the extremes of "no pain at all" and "worst agony conceivable" was used to reflect the patient's level of discomfort. The VAS is the best instrument for describing pain intensity because to its ease of use, reliability, validity, and ratio scale features. Then, the distance between the left end of the line and the designated point was measured in order to obtain the VAS score for the intensity of postnatal sciatic pain [12].

Hip joint range of movement (ROM)

Each female in both groups had her affected hip joint's range of motion (ROM) assessed before and after the course of therapy using a goniometer (Hip Flexion ROM, Hip extension ROM, Hip adduction ROM, Hip abduction ROM., Hip internal rotation ROM and Hip external rotation ROM).

Ethical consent:

An approval of the study was obtained from Cairo University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical analysis

The collected data were coded, processed and analyzed using the SPSS (Statistical Package for Social Sciences) version 25 for Windows® (IBM SPSS Inc, Chicago, IL, USA). The information was shown as a mean/median with a standard deviation. Data distribution's normality was examined using the Shapiro-Wilk test, and group homogeneity was examined using the Levene's test for homogeneity of variances. The mean values of the hip ROM and VAS were compared between Group A and Group B using independent student's t-test. A paired t-test was used to compare each group's pre- and post-treatment data. P value ≤0.05 was considered significant.

RESULTS

Patients' characteristics

Baseline characteristics, including age, BMI, as well as all outcome variables did not differ significantly between the two groups at the beginning of the study (p>0.05) (Tables 1-2).

Table (1): Comparison of subject characteristics between groups A and B.

Variable	Group A Mean ± SD	Group B Mean ± SD	MD	t-value	P-value
Age (years)	32.7 ± 3.88	33 ± 4.21	-0.3	-0.28	0.77
BMI (kg/m²)	26.66 ± 2.33	26.93 ± 2.74	-0.27	-0.41	0.68

SD, Standard deviation; MD, Mean difference; P-value, Probability value

Effect of treatment on VAS and hip joint ROM:

- *Within group comparison:*

There was a significant decrease in VAS and a significant increase in hip ROM in the group A and B post treatment compared with that pre- treatment (p <0.001). The percent of change in VAS in group A and B was 57.51 and 47.84%, respectively.

The percent of change in hip ROM in group A was 25.1, 20.3, 39.81, 39.28, 36.99 and 56.97% for flexion, extension, adduction, abduction, internal and external ROM respectively and that in group B was 21.89, 13.27, 34.26, 36.46, 30.22 and 45.39% respectively (Table 2).

- *Between groups comparison:*

There was no significant difference between groups pre-treatment (p >0.05). Comparison between groups post treatment revealed a significant decrease in VAS and a significant increase in flexion, extension, adduction, abduction, internal and external ROM of the group A compared with that of the group B (p <0.01) (Table 2).

Table (2): Mean VAS, flexion, extension, adduction, abduction, internal rotation and external rotation ROM pre and post treatment of the groups A and B:

Variable	Group A (Mean ± SD	Group B (Mean ± SD)	MD	t-value	P-value
VAS					
Pre treatment	6.66 ± 1.26	6.96 ± 1.54	-0.3	-0.82	0.41
Post treatment	2.83 ± 0.94	3.63 ± 0.85	-0.8	-3.43	0.001
MD	3.83	3.33			
% of change	57.51	47.84			
t- value	18.8	13.29			
	p = 0.001	***p = 0.001***			
Flexion ROM (degrees)					
Pre treatment	74.9 ± 6.41	73.86 ± 5.66	1.04	0.66	0.51
Post treatment	93.93 ± 5.63	90.03 ± 4.31	3.9	3.01	0.004
MD	-19.03	-16.17			
% of change	25.41	21.89			
t- value	-22.21	-16.51			
	p = 0.001	***p = 0.001***			
Extension ROM (degrees)					
Pre treatment	21.03 ± 2.77	20.8 ± 2.01	0.23	0.37	0.71
Post treatment	25.3 ± 3.03	23.56 ± 2.37	1.74	2.46	0.01
MD	-4.27	-2.76			
% of change	20.3	13.27			
t- value	-10.87	-8.02			
	p = 0.001	***p = 0.001***			
Adduction ROM (degrees)					
Pre treatment	21.5 ± 1.96	20.9 ± 1.68	0.6	1.27	0.21
Post treatment	30.06 ± 2.63	28.06 ± 1.81	2	3.41	0.001
MD	-8.56	-7.16			
% of change	39.81	34.26			
t- value	-20.81	-21.78			
	p = 0.001	***p = 0.001***			
Abduction ROM (degrees)					
Pre treatment	27.93 ± 5.36	26.33 ± 4.88	1.6	1.21	0.23
Post treatment	38.9 ± 3.82	35.93 ± 3.53	2.97	3.12	0.003
MD	-10.97	-9.6			
% of change	39.28	36.46			
t- value	-13.31	-19.48			
	p = 0.001	***p = 0.001***			
Internal rotation ROM (degrees)					
Pre treatment	24.06 ± 3.33	23.16 ± 2.7	0.9	1.14	0.25
Post treatment	32.96 ± 2.56	30.16 ± 3.08	2.8	3.82	0.001
MD	-8.9	-7			
% of change	36.99	30.22			
t- value	-14.47	-12.08			
	p = 0.001	***p = 0.001***			
External rotation ROM (degrees)					
Pretreatment	25.1 ± 3.91	24.3 ± 4.19	0.8	0.76	0.44
Post treatment	39.4 ± 5.04	35.33 ± 4.89	4.07	3.17	0.002
MD	-14.3	-11.03			
% of change	56.97	45.39			
t- value	-27.09	-18.88			
	p = 0.001	***p = 0.001***			

SD, Standard deviation; MD, Mean difference; P-value, Probability value

DISCUSSION

There was a highly statistically significant difference in mean value of visual analog scale and in hip range of motion of group (A) when compared with its corresponding value in group (B).The results of this study confirmed that there was a highly statistically significant increase in hip range of motion and decrease in pain intensity in the group (A) who received ultrasound therapy and flexibility exercises when compared to group (B) who received low level laser therapy and flexibility exercises.

The results of this study agreed with those of **Boyraz *et al.*** [13] who looked at the effectiveness of laser and ultrasound therapy in 65 patients with lumbar disc herniation. The patients were randomly divided into three groups: Group 1 gotten sessions of laser to the lumbar region, Group 2 gotten sessions of ultrasound, and Group 3 received medical therapy for 10 days and isometric lumbar exercises. He discovered that laser treatment, ultrasound, and workout were all effective treatments for lumbar disc pain; however LT and ultrasound had longer-lasting impact on some parameters.In women with non-specific chronic low back pain, **Rubira *et al.*** [14] shown that the pulsed low-power laser and pulsed and continuous ultrasound have substantial short-term benefits on pain relief and functional impairment. But when outcomes for functional disability improvement were compared among the groups, the PUSG outperformed the LG, CUSG, and CG.

These results disagreed with **Asmaa *et al.*** [15] who comparing the effectiveness of ultrasound treatment versus low level laser treatment on 30 women who had been were diagnosed with postpartum low back pain, LLLT was better than ultrasound in lowering pain severity and enhancing lumbar flexion, extension and lateral side bending range of motion.

Ultrasound has a stimulating effect on the mast cells, platelets, white cells with phagocytic roles and the macrophages. Application of ultrasound induces the degranulation of mast cells, causing the release of arachidonic acid which itself is a precursor for the synthesis of prostaglandins and leukotriene which act as inflammatory mediators [16].

The impact of LLLT is based on a variety of modes of action, such as its capacity to impede the transmission of the pain stimuli and to boost the production of morphine-mimetic substances in the body. Additionally, it could have an immediate impact on nerve cells, which might quicken the recovery from a conduction block or stop the transmission of A and C fibres. Additionally, the therapy raises cell metabolism, blood flow, and vascular permeability [17].

Exercises that promote flexibility are crucial in therapy to reduce mechanical stress brought on by the limitation of hip or sacroiliac joint range of motion brought on by an increase in hamstring strain as a result of sciatic nerve stimulation. By enhancing the activities of the nervous system activity to boost nervous system adaptability and reduce sensitivity, using flexibility techniques on the sciatic nerves may aids healing of the soft tissues and alleviate discomfort [18].

CONCLUSION

In conclusion, pulsed ultrasound therapy is an effective modality than low level laser in treating postnatal sciatica through decreasing pain intensity as well as improving hip ROM.

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