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Low-level laser therapy combined with postural correction exercises on postpartum sacroiliac joint pain: a randomised controlled trial

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Abstract

Introduction. Sacroiliac joint (SIJ) pain is a common problem that affects women during and after pregnancy and restricts their daily activities. It can be treated with various physiotherapy interventions, including exercises, patient education, and pain relief modalities, such as laser therapy. A randomised controlled trial study conducted between May and September 2022 to determine the efficacy of low-level laser therapy combined with posture correction exercises on postpartum sacroiliac pain.

Methods. Sixty postpartum women complaining of SIJ pain, six weeks following vaginal delivery, their ages between 25 and 35 and their BMI not exceeding 30 kg/m^2, participated in this study. They were equally and randomly assigned into three groups: A, B and C. Group A received low-level laser therapy, group B received posture correction exercises, and group C received combined low-level laser therapy and posture correction exercises. Pain level was assessed via the Visual Analogue Scale, and the pressure algometry was used to detect pain pressure threshold. Function disability was evaluated by the Oswestry Disability Index. All measurements were taken before and after 6 weeks of the intervention in all groups.

Results. MANOVA was used to detect the difference between treatments and time, and multiple pairwise comparisons with the Bonferroni correction were used to clarify within- and between-groups differences. The within-group comparison showed significant improvement in all variables within each group as $p < 0.05$. Between-groups post-treatment, there was a significant difference between groups A and B and groups B and C for all variables as $p < 0.05$, but there were no statistically significant difference between groups A and C for any variables ($p > 0.05$) except function, with $p < 0.05$.

Conclusions. Based on the study results, adding low-level laser therapy to posture correction exercises in the treatment protocol of postpartum SIJ pain provides better pain relief and functional improvement than when each intervention is used separately.

Key words: low-level laser therapy, postpartum period, pain management, sacroiliac joint

Introduction

Pregnancy, many women's most profound life event, causes a variety of biological, hormonal, and mechanical changes [1]. Weight gain and a larger uterus cause the centre of gravity to shift anteriorly, compensating for this shift with an increase in lumbar lordosis and anterior pelvic tilt, which increases the mechanical stress on the lumbosacral vertebrae and causes dysfunction of the sacroiliac joint (SIJ) [2].

Further strain is placed on the lumber spine and sacral areas (pregnancy-related postural changes), as a result of the stretched and weakened abdominal muscles brought on by uterine enlargement [3, 4]. Furthermore, joint and ligament laxity caused by an increased relaxin concentration reduces the spine and pelvic supporting mechanism [2]. As a result of all these variables, sacroiliac joint dysfunction and pain can occur throughout pregnancy and during the postnatal period, from the time following labour, and can persist from six weeks up to six months [5].

Sacroiliac joint pain affects about 26% of postpartum women, with normal vaginal delivery having a higher prevalence than occurs following caesarean section [6]. SIJ pain is felt between the gluteal folds and the posterior iliac crest, which may radiate to the lower back or the posterior aspect of the thigh. In addition to SIJ pain, dysfunction is considered a common predisposing factor of chronic mechanical low back pain. SIJ pain limits everyday activities and lowers a woman's quality of life [7].

Since improper body posture has many detrimental impacts on the musculoskeletal system, it can be extremely painful and exhausting. It also disrupts the equilibrium between the body's supporting structures and restricts their capacity to perform proper function, making even simple ordinary activities difficult. Therefore, posture correction exercises are crucial to regaining the proper balance between the muscles and skeleton, preserving the supporting structures, preventing further abnormalities, and ultimately reducing discomfort and enhancing function [8, 9]. It is regarded as a simple and cost-effective method of improving and restoring load symmetry and normal biomechanical alignment across the pelvis with no side effects or contraindications [10].

Low-level laser (LLL) therapy is a safe and noninvasive therapeutic modality. It is widely used for managing different musculoskeletal conditions due to its benefits, such as

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simplicity, ease of application, minimal or no side effects, cost-effectiveness, and the ability to safely penetrate deep into the layers of the skin up to the joints without causing skin surface damage or burning [11, 12]. It reduces pain by encouraging the production of endorphin and serotonin. Furthermore, laser has an anti-inflammatory effect because it can reduce and modulate Tumor Necrosis Factor (TNF) levels. Consequently, SIJ dysfunction-related discomfort can be relieved by low-intensity laser therapy [13, 14].

Pain is considered the main factor limiting function. However, there is no obvious optimal management for postpartum sacroiliac pain specifically [15]. In practice, either low-power laser or standardised exercises are used separately in the management of SIJ dysfunction [16, 17]. However, extensive literature searches revealed that there was no previous study discussing the efficacy of low-level laser therapy combined with posture correction exercises specifically on postnatal SIJ pain. Therefore, this study aimed to relieve pain by low-level laser therapy as an initial step to augment the role of posture correction exercises in restoring normal posture and improving function, which might have valuable implications in the treatment protocol of postnatal sacroiliac pain. We hypothesised that there was no difference between the combined therapy of laser and posture correction exercises and the use of each intervention alone in the management of SIJ pain.

Subjects and methods

Study design

Study design was a single-blind, randomised controlled trial, performed between May and September 2022. The study followed the principles of the Declaration of Helsinki for the ethical conduct of human research [18].

Participants

A sample of 60 women suffering from postpartum sacroiliac pain (6 weeks after normal vaginal delivery) was recruited by the first author from Om El Masryeen Hospital in addition to the Outpatient Clinic of the Faculty of Physical Therapy, Cairo University, Egypt. They were between the ages of 25 and 35, and their BMI did not exceed 30 kg/m^2. All postpartum women had to undergo SIJ physical examination and provocation tests (compression, distraction, FABER, thigh thrust, and Gaenslen's test) by the second author to elicit pain over the affected side in order to be considered as a participant in the study [19]. To be involved in the study, the participants should show positive signs in three of the five SIJ provocation tests at a minimum. Women were excluded if they had a disc lesion, tumour, deformity, fracture, or had undergone surgery in the lumbosacral region in the past. The study procedure and objectives were explained to each participant.

Randomisation and blinding

All the participants were randomly and equally allocated into three groups (A, B, and C) using a simple randomisation method. A blinded external researcher was asked to select one card from a sealed envelope containing either a card with 'low-level laser therapy' written on it or a card with 'posture correction exercises' alone or the combination of the two. The distribution of participants among groups depended on which card was chosen. Group A included 20 postpartum women with SIJ pain who received low-level laser therapy twice weekly for 6 weeks. Group B included 20 postpartum women with SIJ pain who performed posture correction exercises twice weekly for 6 weeks. Group C included 20 postpartum women who received combined low-level laser therapy and posture correction exercises twice weekly for 6 weeks (Figure 1).

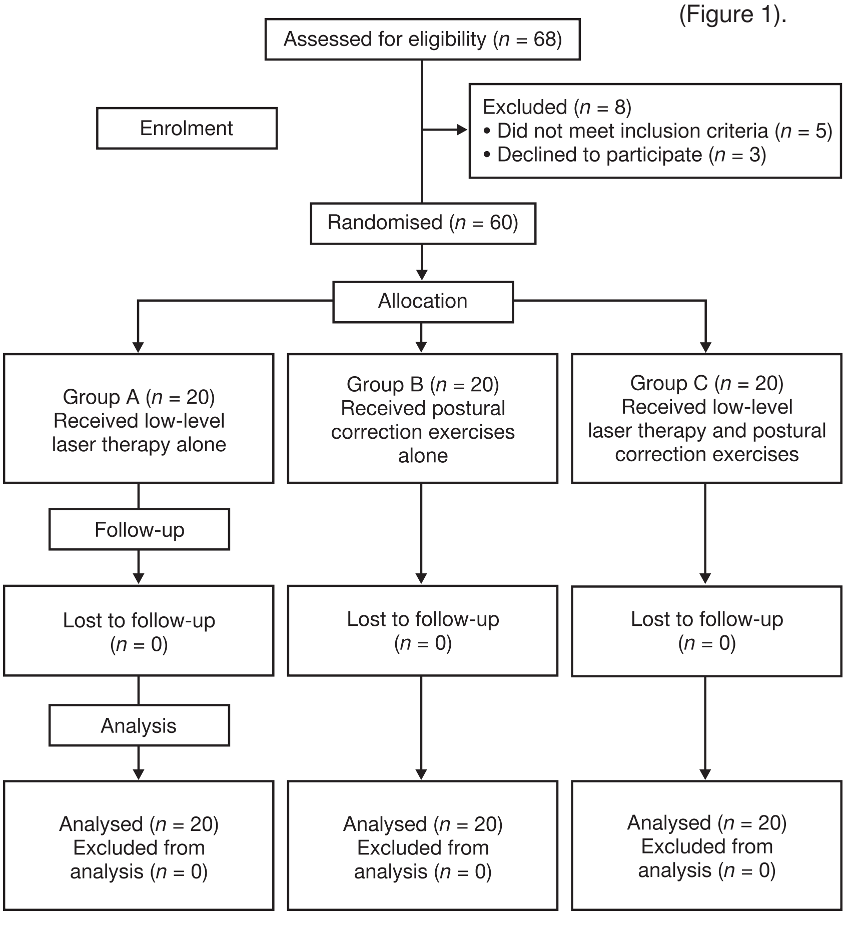

Figure 1. Study flow diagram

Procedures

Initially, before beginning any treatment procedure: the complete patient histories, including both obstetrical and gynaecological histories, were taken and recorded in the data recoding sheet. Also, the weight and height of each woman in the three groups were recorded by a universal weight height scale to determine their BMI according to this equation: BMI (kg/m^2) = weight (kg)/height (m^2) [20]. Posture was assessed using a posture grid as follows: adhesive tape was used to mark the bony prominences as the centre of the shoulder joint, anterior superior iliac spine, posterior superior iliac spine, greater trochanter, and lateral femoral epicondyle. Every participant was asked to stand in front of a posture grid. Any deviations in posture were noted on the patient evaluation sheet [21]. A comprehensive SIJ physical examination was performed. The intensity of SIJ pain was assessed via the Visual Analogue Scale (VAS), Pressure Pain Threshold (PPT) was measured via pressure algometry, and functional abilities were assessed via the Arabic version of the Oswestry Disability Index (ODI).

Treatment procedure: group A received low-level laser therapy (UNIPHY PHYACTION 740, SN:21650, made in EEC) with a wavelength of 904 nm, frequency of 1000 Hz, peak power of 75 mw and a dosage of 4 J/cm^2 [22, 23], applied twice weekly for six weeks. The participant assumed a prone position with the affected sacroiliac joint facing the therapist, and the head turned to one side and relaxed on crossed forearms (Figure 2). The lower half of the patient's body was covered by a sheet except for the sacroiliac joint region. The skin of the treated area was cleaned first with cotton and alcohol. Then, the therapist divided the affected area into 3 points that expressed the most painful points. The laser probe was applied perpendicularly at each point for 30 s, 3 times (approximately 5 min in total) [16, 22].

Group B received posture correction exercises from any comfortable position. For example, lying in a supine position, they were instructed to draw the chin in, straighten the back of the neck, retract the shoulders, inhale in through costal breathing, contract the abdominal muscles and glutei, push their back against the plinth as they tilt the pelvis posteriorly, press the knees down, and dorsiflex both ankles. This position should be maintained for 10 s, and then the women were asked to relax. The exercises should be repeated 10 times, 3 sets per day, twice weekly for 6 weeks. The women were

Figure 2. Application of LLLT on sacroiliac joint

Figure 3. Posture correction exercises from crook lying position

instructed to perform the posture correction exercises from different positions (crook, supine, sitting, and standing) (Figure 3) as a part of their home routine [9].

Group C received low-level laser therapy in addition to posture correction exercises twice weekly for 6 weeks. These women were also instructed to perform the posture correction exercises from different positions (crook, supine, sitting, and standing) as a part of their home routine.

Patients in groups B and C were given home exercises as part of their treatment. Each patient was instructed to perform three sets of posture correction exercises twice a week at home for six weeks. So, for each patient, the total number of home exercises was 36. Each week, the patients were asked to report their home exercises on a diary sheet, and the fifth author followed up with them via phone messages to ensure adherence to the programme. At the end of six weeks, 97.2% of the patients in group B and 95.7% in group C had adhered to the home exercises.

Outcome measures

SIJ pain intensity was assessed for all the women in the three groups via the Visual Analogue Scale (VAS). The pain intensity is represented on a 10-cm horizontal line with two ends; the right end means 'no pain' and the left end means 'worst pain'. It is simple, valid, reliable and one of the optimal tools used for assessing pain severity. Each woman was instructed to mark on the line at the point that expresses her pain level [24].

The pressure-pain threshold (PPT) was assessed via a digital pressure algometer (Wagner model FPX, Germany). It is a valid, reliable and non-invasive tool used for investigating physio-pathological factors related to muscular pain disorders [25]. The pressure pain threshold (PPT) is thought to be suggestive of SIJ pain in practical aspects. Each woman was instructed to lie prone with the affected SIJ facing the therapist, alcohol was used to clean the SIJ region, then an experienced therapist applied perpendicular pressure using a 1-cm^2 pressure probe on the examined points with a rate of 30 KPa/s. The woman was informed to say 'stop' once unbearable pain was sensed [26].

Marking PPT recording sites

The first point was located one centimetre medially and caudally from the posterior superior iliac spine (PSIS) and two centimetres laterally, medially, cranially, and caudally from the first one. The second point was located anatomically adjacent to the PSIS at the point where the gluteus maximus muscle attaches to the iliac crest. The third point was located two centimetres cranially. The fourth point was located two centimetres medially, overlying the erector spinae muscle and the deeper-located posterior sacroiliac ligament. The fifth point was located at the attachment of the gluteus maximus muscle to the facies posterior of the sacrum and posterior sacroiliac ligament. Each point was evaluated three times, with a 30-second rest in between. The mean value of the evaluated points was used for the analysis of PPT [27].

Function abilities were evaluated via the Arabic version of the Oswestry Disability Index. It is a simple, validated, and reliable questionnaire widely used by occupational health practitioners for evaluating functional disability and quality of life impairments for patients with musculoskeletal disorders such as lumbar and SIJ pain [28, 29]. It is a 10-point patient-reported outcome questionnaire assessing functional impairment, including pain severity, ease of personal care, lifting, walking, sitting, standing, sleeping, sexual activity, social life and travelling. Each question is graded from 0 to 5, giving a maximum score of 50 [28].

Sample-size estimation

Before beginning the study, the sample size was determined according to the findings of the pilot study, with 10 subjects in each group. The G*POWER (version 3.1.9.2; Franz Faul, Universität Kiel, Germany) statistical software was used to conduct F tests, MANOVA, repeated measures, and within- and between-group analyses on the primary outcome variable (pain intensity). The alpha levels were set at 0.05, $\beta = 0.2$, and the effect size = 0.33. According to these criteria, the sample size required was 48, however, due to the expectation of dropouts, the final number was raised by 25% to 60.

Statistical analysis

The Shapiro–Wilk test was used to determine the normality of each outcome measure, which were all found to be normally distributed. Levene's test for homogeneity of variances was used to test the homogeneity between groups and *p*-value > 0.05. One-way analysis of variance (ANOVA) was used to compare the physical characteristics of patients between the three groups. The effect of treatments (groups), time, and the interaction between time and treatment were examined using a mixed multivariate analysis of variance (MANOVA). Follow-up univariate ANOVA was used when the MANOVA documented statistically significant effects. To prevent a type 1 error, several pairwise comparisons with the Bonferroni correction were carried out. Partial eta square (η^2) was performed to determine the extent of the differences between the groups. SPSS version 23 (IBM Corp., New York, USA) was utilised for all analyses.

Results

Physical characteristics of subjects

According to the one-way ANOVA, there was no statistically significant difference across age, weight, height, or body mass index (BMI). The Chi-Square test was used to compare occupation activity, affected side, and associated problems between groups (Table 1).

MANOVA shows that there was a statistically significant difference between groups, as Wilks' Lambda (Λ) = 0.6, f = 2.05, p = 0.02 and η^2 = 0.22. Also, there were significant differences in time, as Λ = 0.02, f = 397.31, p = 0.001 and η^2 = 0.98. Finally, there were significant interactions between-groups and time, as Λ = 0.08, f = 18.3, p = 0.0001 and η^2 = 0.71.

At post-treatment, there were statistically significant effects regarding the follow-up univariate ANOVA for VAS, as $p < 0.0001$, $f_{(2,57)} = 19.32$ and $\eta^2 = 0.4$; for OSW, as $p < 0.0001$, $f_{(2,57)} = 19.09$ and $\eta^2 = 0.4$; for PPT at point (1), as $p < 0.0001$, $f_{(2,57)} = 12.83$ and $\eta^2 = 0.31$; for PPT at point (2), as $p < 0.0001$, $f_{(2,57)} = 11.08$ and $\eta^2 = 0.28$; for PPT at point (3), as $p < 0.02$, $f_{(2,57)} = 4.25$ and $\eta^2 = 0.13$; PPT at point (4), as $p < 0.01$, $f_{(2,57)} =$ 4.97 and $\eta^2 = 0.15$, and for PPT at point (5), as $p < 0.0001$, $f_{(2,57)} = 10.11$ and $\eta^2 = 0.26$ (Table 2).

Within- and between-groups analyses

Multiple pairwise comparisons revealed statistically significant differences between pre- and post-treatment for all variables in the low-level laser, postural correction, and combined groups as *p*-value < 0.05. The within-group comparisons showed significant improvement in pain with 95% CI (2.99 to 3.71) in (A), (1.14 to 1.85) in (B), and (3.69 to 4.41) in (C) and in ODI (A) (7.54 to 10.16), in (B) (6.15 to 8.75) and in (C) (12.19 to 14.8) and in PPT (point 1) (A) (–25.76 to –19), in (B) (–8.8 to –2.04) and in (C) (–28.66 to 21.95) and in PPT (point 2) in (A) (–25.9 to 18.95), in (B) (–7.68 to –0.74) and in (C) (–28.66 to 21.7) and in PPT (point 3) (A) (–21.74 to 15.4), in (B) (–7.63 to –1.27) and in (C) (–25.16 to 18.8) and in PPT (point 4) in (A) (–26.3 to 18.64), in (B) (–10.6 to –2.96), and in (C) (–34.47 to 26.83) and finally, in PPT (point 5) in (A) (–26.64 to 18.77), in (B) (–10.27 to –2.4) and in (C) (–36.8 to –28.97), as in (Table 2). In the between-groups analysis at pre-treatment, there were no statistically significant differences (Table 2), however there were statistically significant differences at post-treatment between the low-level laser and postural correction groups for all variables and also between the

Table 1. Patients' physical characteristics

Variables	Low-level laser (mean ± *SD*)	Postural correction (mean ± *SD*)	Combined (mean ± *SD*)	*p*-value
Age (years)	28.5 ± 3.15	29.25 ± 3.52	28 ± 2.34	0.43**
Weight (kg)	73.63 ± 7.28	77.88 ± 7.75	77.08 ± 4.33	0.11**
Height (cm)	163.55 ± 7.26	165.45 ± 7.32	164.35 ± 4.86	0.66**
BMI (kg/m²)	27.49 ± 1.61	28.4 ± 1.45	28.6 ± 1.95	0.1**
Occupational activity (%)	Housewife: 11 (55) Worker: 9 (45)	Housewife: 10 (50) Worker: 10 (50)	Housewife: 11 (55) Worker: 9 (45)	0.93**
Affected side (%)	Rt: 17 (85) Lt: 3 (15)	Rt: 18 (90) Lt: 2 (10)	Rt: 16 (80) Lt: 4 (20)	0.67**
Affected by associated problems (sleeping, breastfeeding, ADL) (%)	Affected: 12 (60) Not affected: 8 (40)	Affected: 11 (55) Not affected: 9 (45)	Affected: 14 (70) Not affected: 6 (30)	0.61**

BMI – body mass index, Rt – right side, Lt – left side, ADL – activities of daily living, ** no significance difference

Table 2. Within- and between-group analysis

Variables	Low-level laser	Postural correction	Combined	*p*-value between	*f*-value between	η^2
VAS						
Pre-treatment (mean ± *SD*)	7.75 ± 1.16	7.15 ± 0.99	7.85 ± 0.81	0.07**	2.87	0.09
Post-treatment (mean ± *SD*)	4.4 ± 0.59	5.65 ± 0.97	3.8 ± 0.83	0.0001*	19.32	0.4
p-value (within)	0.0001*	0.0001*	0.0001*			
MD	3.35	1.5	4.05			
95% CI	2.99 to 3.71	1.14 to 1.85	3.69 to 4.41			
ODI						
Pre-treatment (mean ± *SD*)	35.65 ± 2.3	37.7 ± 3.57	36.3 ± 3.1	0.1**	2.38	0.07
Post-treatment (mean ± *SD*)	26.8 ± 2.93	30.25 ± 4.59	22.8 ± 3.73	0.0001*	19.09	0.4
p-value	0.0001*	0.0001*	0.0001*			
MD	8.85	7.45	13.5			
95% CI	7.54 to 10.16	6.15 to 8.75	12.19 to 14.8			
PPT (point 1) N						
Pre-treatment (mean ± *SD*)	74.39 ± 13.14	76.49 ± 12.35	79.79 ± 9.24	0.5**	0.69	0.02
Post-treatment (mean ± *SD*)	96.8 ± 15.86	81.89 ± 10.25	104.79 ± 8.96	0.0001*	12.83	0.31
p-value (within-group)	0.0001*	0.0001*	0.0001*			
MD	–22.41	–5.4	–25.3			
95% CI	–25.76 to –19	–8.8 to –2.04	–28.66 to –21.95			
PPT (point 2) N						
Pre-treatment (mean ± *SD*)	74.38 ± 12.26	78.76 ± 12.3	78.05 ± 8.19	0.41**	0.9	0.03
Post-treatment (mean ± *SD*)	96.81 ± 14	82.98 ± 12.22	103.24 ± 15.3	0.0001*	11.08	0.28
p-value	0.0001*	0.008*	0.0001*			
MD	–22.43	–4.21	–25.19			
95% CI	–25.9 to –18.95	–7.68 to –0.74	–28.66 to –21.7			
PPT (point 3) N						
Pre-treatment (mean ± *SD*)	77.43 ± 10.6	81.05 ± 14.17	74.8 ± 7.69	0.21**	1.59	0.05
Post-treatment (mean ± *SD*)	95.99 ± 13.2	85.5 ± 13.75	96.77 ± 13.94	0.02*	4.25	0.13
p-value	0.0001*	0.0007*	0.0001*			
MD	–18.56	–4.45	–21.97			
95% CI	–21.74 to –15.4	–7.63 to –1.27	–25.16 to –18.8			
PPT (point 4) N						
Pre-treatment (mean ± *SD*)	82.58 ± 11.12	85.86 ± 14	76.56 ± 13.33	0.08**	2.64	0.08
Post-treatment (mean ± *SD*)	105 ± 13.95	92.64 ± 15.06	107.21 ± 17.9	0.01*	4.97	0.15
p-value	0.0001*	0.0001*	0.0001*			
MD	–22.46	–6.78	–30.65			
95% CI	–26.3 to –18.64	–10.6 to –2.96	–34.47 to –26.83			
PPT (point 5) N						
Pre-treatment (mean ± *SD*)	78.98 ± 11.15	81.8 ± 12.28	75.78 ± 12.92	0.3**	1.23	0.04
Post-treatment (mean ± *SD*)	101.69 ± 17.13	88.14 ± 13.12	108.69 ± 13.5	0.0001*	10.11	0.26
p-value	0.0001*	0.0002*	0.0001*			
MD	–22.71	–6.34	–32.91			
95% CI	–26.64 to 18.77	–10.27 to –2.4	–36.8 to –28.97			

PPT – pressure pain threshold, ODI – Oswestry Disability Index, VAS – Visual Analogue Scale, CI – confidence interval, MD – mean difference, η^2 – partial eta square, N – Newton.
** no significance difference, * significant difference, *p*-value – significance level set at 0.05

Table 3. Multiple pairwise comparison

Variables	Low-level laser vs. postural correction (MD)(CI (95%) / *p*-value)		Low-level laser vs. combined (MD)(CI (95%) / *p*-value)		Postural correction vs. combined (MD)(CI (95%) / *p*-value)	
VAS	–1.25(–1.99 to –0.5)	0.001*	0.6 (–0.15 to 1.34)	0.1**	1.85 (1.1 to 2.6)	0.001*
ODI	–3.45 (–6.4 to –0.47)	0.01*	4(1.02 to 6.97)	0.001*	7.45 (4.47 to 10.4)	0.001*
PPT (point 1) N	14.91 (3.59 to 26.22)	0.006*	–7.98 (–19.3 to 3.3)	0.26**	–22.89 (–34.2 to –11)	0.001*
PPT (point 2) N	13.83 (2.98 to 24.67)	0.008*	–6.43 (–17.28 to 4.41)	0.45**	–20.3 (–31 to–9)	0.001*
PPT (point 3) N	10.5 (–0.2 to 21)	0.04*	–0.7 (–11.4 to 9.8)	0.99**	–11.3 (–22 to –0.6)	0.03*
PPT (point 4) N	12.4 (0.1 to 24.69)	0.04*	–2.17 (–14.5 to 10.12)	0.99**	–14.6 (–27 to –2.3)	0.015*
PPT (point 5) N	13.54 (2.08 to 25)	0.01*	–7 (–18.45 to 4.45)	0.41**	–20.5 (–31.9 to –9)	0.001*

ODI – Oswestry Disability Index, VAS – Visual Analogue Scale, CI – confidence interval, MD – mean difference,
PPT – pressure pain threshold, N – Newton
** no significance difference, * significant difference, *p*-value – significance level set at 0.05

postural correction and combined group, but there were no statistically significant differences between the low-level laser and combined groups in all variables except ODI (Table 3).

Discussion

The current study was carried out to investigate the effect of adding low-level laser therapy as a preliminary step to augment the role of posture correction exercises in relieving postpartum SIJ pain. The results of this study showed that there was a statistically significant decrease in VAS and ODI, and a significant increase in PPT of all points in all groups post-treatment when compared with pre-treatment. These findings illustrate that either low-level laser therapy or posture correction exercises can be used effectively for relieving SIJ pain and improving function in affected postpartum women, while better results and improvement in function are achieved when posture correction exercises are augmented by low-level laser therapy.

The improvement of the LLL group may be attributed to its anti-inflammatory effect and that laser can improve circulation around the sacroiliac joint, inhibit pain sensory nerve fibres, and stimulate the secretion of endorphin and enkephalin [30]. Also, the reduction of pain intensity and the increase in pain pressure threshold in LLL may be due to the direct application of LLL on the tender points in the sacroiliac region that were previously detected by pressure algometry, which confirmed the analgesic effect of LLL in SIJ pain.

These findings were confirmed by Ohkuni et al. [16], who reported a significant improvement in pain and lumbar mobility in individuals with SIJ dysfunction in the LLL group. Also, Aydin et al. [31] applied a laser on the L3 to S1 supraspinous ligaments and sacroiliac joints bilaterally in patients with ankylosing spondylitis, concluding that laser therapy relieved pain and improved function in those patients. Additionally, Elbandrawy et al. [22] found that LLL was more effective than ultrasound in relieving postnatal low back pain. Furthermore, Longo et al. [32] and Soriano and Rios [33] confirmed that LLL was very efficient in alleviating pain and functional limitations in patients with low back pain.

The improvement in the postural correction exercises group may be due to the exercises that are presented as an effective treatment for SIJ dysfunction, either by improving pain and functional ability or by recovering normal pelvic symmetry and kinematics [15]. Postural changes related to pregnancy and the postnatal period, such as changes of pelvic alignment and hormonal changes that lead to increased mechanical stress on bony structures and the surrounding soft tissues, are suggestive causes of SIJ pain [2, 7]. Generally, exercise has been documented as the gold standard modality for improving strength, reducing fatigue, and improving quality of life in postpartum women [34]. Posture education has an integral role in restoring normal posture and reducing pain related to various musculoskeletal disorders [9].

These findings were confirmed by Elhosary et al. [10], who investigated the effect of posture correction exercises on postpartum women. They found a significant decrease in VASs score after 4 weeks and significant improvements in patients' level of function using the Back Pain Function Scale (BPFS). In addition, Kumar et al. [35] found that posture correction exercises were effective in reducing VAS scores and improving levels of function, as measured by the ODI in patients with chronic LBP.

Our results support the previous research works that reported the superiority of combined therapies. Monticone et al. [36] found that a combined program of specific exercises and postural education is an effective treatment for reducing SIJ pain. Similarly, Ohkuni et al. [16], who suggested that in spite of the beneficial effect of LLL on reducing SIJ pain, it has a short-term effect and recommended the importance of advising and educating patients on the correct postures and how to avoid awkward positions to get a prolonged treatment effect. Also, Gur et al. [37] investigated the effect of adding low-power laser to exercises on chronic low back pain and concluded that, even though pain levels were reduced in all groups, with no significant difference between any therapy groups, pain was improved more in the combined laser and exercise group than in the exercise-only group. They concluded that laser therapy should be suggested as an effective pain-relieving modality in chronic low back pain. Additionally, posture education is probably more effective when added to specific training programs as strengthening and stretching exercises than when exercises are used in isolation to relieve back pain, as informed by Kumar et al. [35], who found a significant improvement in pain intensity and functional abilities in a combined exercise group (posture education plus strengthening and stretching exercises) based on scores obtained from the VAS and ODI, respectively, than postural education group only.

Furthermore, Elhosary et al. [10] investigated the efficacy of adding extracorporeal shockwave therapy to posture correction exercises on postpartum SIJ pain and found that although the postural correction exercises provided a significant decrease in the level of pain on the VAS scale and improvement in the back pain function scale (BPFS), adding shockwave therapy as a pain relief modality to posture exercises provided further improvement in the VAS and BPFS, which confirms that posture correction exercises should be augmented by a pain relief modality to provide better results.

In contrast, Monticone et al. [36] investigated the symptomatic effect of stabilising treatment versus laser therapy for sub-acute low back pain with sacroiliac joint dysfunction and concluded that pain was reduced, negative provocation and stability tests are detected only in the stabilising group who received mesotherapy, sacroiliac support and exercises (stabilising exercises and postural control advice), and not in the laser group, but this study involved only 22 patients (11 males and 11 females) who received HE-NE laser for only 2 weeks. The relatively small sample size, the different physical characteristics of the patients, and the shorter time of laser application can explain those different results.

Also, Djavid et al. [38] studied the combined effect of laser and exercises in chronic back pain and discovered that there was no additional beneficial effect of laser therapy added to exercises in the short term (after six weeks), but there was significantly more improvement in pain, function, and lumbar mobility in the laser plus exercise group than in the placebo laser plus exercise group after 12 weeks with no intervention as patient follow-up, concluding that the combined therapy of laser and exercises was effective.

Limitations

There are some limitations to this study as it was conducted over only a short term (6 weeks) with no patient follow-up. Also, pain tolerance varies between women and hormonal changes and psychological aspects of postpartum women could affect their responses and, consequently, the evaluation and treatment outcomes. So, further studies are needed to investigate the long-term effects of the combined therapy of laser and posture correction exercises on postpartum SIJ pain with patient follow-up.

Conclusions

The study results show statistically significant differences post-treatment between the postural correction and combined groups in all variables, but there were no statistically significant differences between the low-level laser and combined groups in pain intensity and PPT. Therefore, low-level laser therapy and traditional posture correction exercises are both separately effective in relieving pain and improving function ability in postpartum women with SIJ pain, however adding low-level laser therapy to posture correction exercises provides further improvement in pain and function than when each intervention is used separately. So, the combined therapy of low-level laser and posture correction exercises should be considered in the management protocol of postpartum SIJ pain.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by institutional review board of Cairo University's Faculty of Physical Therapy (approval No.: 012/003492). It also prospectively received ClinicalTrials.gov registry number (NCT05306236).

Informed consent

Informed consent has been obtained from all individuals included in this study. Each participant signed a written consent form after a detailed description of the study's nature and objectives, and confirmation of the confidentiality of any obtained data. They could withdraw and discontinue at any time.

Disclosure statement

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Conflict of interest

The authors state no conflict of interest.

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