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Effect of Six Weeks Combined Protocol of Thai Massage and Core Exercises on Pain, Functional Disability and Core Endurance in Men with Sacroiliac Joint Disorder: A Randomized Clinical Trial

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Original Article

Abstract

Introduction: The aim of this study was to determine the effect of a 6 weeks combined protocol (Thai massage and core exercises) on pain, functional disability, and core endurance in people with sacroiliac joint disorder.

Materials and Methods: Twenty men with sacroiliac joint disorder were selected through convenient sampling and were randomly divided into control (n=10) and combined (n=10) groups. Pain intensity, core endurance and functional disability were reported before interventions and after 6 weeks of intervention using visual analogue scale, McGill tests and oswestry disability index respectively. The combined protocol consisted of Thai massage and core exercise while the control group only received core exercises were for 6 weeks. Shapiro-Wilk test was used to assess the normal distribution of the variables Data was analyzed using ANCOVA.

Results: The results confirmed significant difference in the post-test between the control and combined groups for pain intensity (P = 0. 01), Planck (P = 0. 03), 60 flexion (P = 0. 01) and Sorensen (P = 0. 02) test records. However, no significant difference was observed between the two groups in functional disability index (P = 0. 28), Right Planck (P = 0. 48) and left Planck (P = 0. 87).

Conclusion: The results of the present study confirmed the positive effect of Thai massage in conjunction with core stability exercises in improving pain and endurance in men suffering from sacroiliac joint disorder. Therefore, Thi massage is recommended to enhance the therapeutic effects of the core stability exercises in sacroiliac joint disorder and its complications.

Keywords: Sacroiliac joint; Pain; Endurance; Disability

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Introduction

The sacroiliac joint is a synovial joint between the sacrum and the ilium, whose articular surfaces are covered with hyaline cartilage and fibrocartilage to accommodate the loads imposed on the joint (1). Sacroiliac joint dysfunction leads to joint pain, severe movement impairment, and consequently restricted joint mobility (2). The clinical manifestations of this condition include low back pain radiating to the pelvic region, urinary frequency, and transient numbness in the lower extremities (3), which are exacerbated by activities such as sit-to-stand transitions and prolonged standing (4). Factors such as shear stress in the pelvic region, repetitive torsional forces, and inflammation may contribute to the development of pain; in addition, gait abnormalities, leg length discrepancy, scoliosis, strenuous physical activity, and trauma are considered predisposing factors for this disorder (5, 6). Sacroiliac joint dysfunction is one of the common causes of low back pain, observed in 16–30% of patients presenting with low back pain (7, 8). In general, pain relief in musculoskeletal disorders such as low back pain can

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lead to improvements in disability levels and quality of life; this improvement progresses gradually and doubles within 14 days, and in patients with acute and subacute low back pain, this increase is independent of pain duration (9).

Massage is currently a well-recognized non-surgical approach for pain relief and management of sacroiliac joint dysfunction, particularly in cases accompanied by low back pain (10). Previous studies have reported that traditional Thai massage is effective in the short-term reduction of pain and disability, perceived muscle tension, and anxiety, as well as in improving flexibility, in patients with musculoskeletal disorders, especially chronic non-specific low back pain (11, 12). Thai massage is a form of deep massage involving sustained pressure applied along energy channels combined with passive stretching, which is believed to release blocked energy and enhance awareness and vitality. Chatchawan et al. reported that Thai massage had longer-lasting effects than Swedish massage in patients with low back pain who presented with myofascial trigger points (13, 14).

Core stability exercise is another non-surgical approach for the management of sacroiliac joint dysfunction (15). Core stability refers to the capacity of the lumbo-pelvic-hip complex to prevent spinal instability and restore equilibrium following a perturbation (16). Core stabilization exercises help maintain and enhance lumbar stability through proprioceptive retraining of the lumbopelvic muscles that increase segmental stability in the lumbar region (17). Sharma observed a significant difference between stabilization exercises and trunk flexion exercises in patients with chronic non-specific low back pain, with core stabilization exercises resulting in greater pain reduction in these patients (18). Given the 15–25% prevalence of sacroiliac joint dysfunction among patients with low back pain (19), the absence of a definitive and appropriate treatment, and the challenging nature of managing this disorder (20), studies investigating the effectiveness of various therapeutic approaches on the symptoms of this condition are of considerable value. To the best of our knowledge, the effect of Thai massage on the symptoms of sacroiliac joint dysfunction has not yet been investigated. Therefore, the aim of the present study was to examine the effect of a combined protocol of Thai massage and core stability exercises on pain, functional disability, and core endurance in patients with sacroiliac joint dysfunction.

Materials and Methods

This study was a randomized clinical trial. Participants were recruited through convenience sampling from among men with sacroiliac joint dysfunction in Isfahan, Iran, who had been referred to public and private treatment and rehabilitation centers in the city. Based on the study by Nejati et al. (20), 20 men with sacroiliac joint dysfunction were assigned to two groups: a control group (n=10) and a combined group (n=10). The control group received core stability exercises, and the combined group received core stability exercises together with Thai massage, both under the supervision of the researcher.

The inclusion criteria were: low back pain attributable to sacroiliac joint dysfunction with a minimum score of 3 on the Visual Analogue Scale (VAS), confirmed by a spine specialist; male sex; age between 25 and 50 years; positive results on at least three of the following tests: Gillet, Gaenslen, FABER, Standing Forward Bending, and Compression tests; absence of fracture; no pain radiating below the knee; absence of low back pain due to other conditions; no history of surgery or other therapeutic interventions; no use of analgesic medication within the previous 72 hours; and provision of written informed consent. The exclusion criteria were: exacerbation of acute pain during the study; unwillingness to continue participation for any reason; and the occurrence of dizziness, agitation, anxiety, or stress during test performance (22-23). The control group performed core stability exercises, and the combined group received core stability exercises combined with Thai massage, three sessions per week for 6 weeks. Pain intensity, functional disability, and core endurance were measured and recorded in both groups before and immediately after the 6-week intervention. Ethical considerations were observed throughout the study, and the study protocol was approved by the Ethics Committee of the Islamic Azad University, Isfahan (Khorasgan) Branch.

Assessment of sacroiliac joint dysfunction

In this study, pain arising from sacroiliac joint dysfunction was diagnosed by a spine specialist based on the presence of signs such as unilateral localized pain in the buttock region extending downward lateral to the coccyx (24). Subsequently, the diagnostic tests for sacroiliac joint dysfunction (Gillet, Gaenslen, FABER, Standing Forward Bending, and Compression tests) were performed on the patients by a physiotherapist. A positive result on three of the five diagnostic tests was required for inclusion in the study.

Pain assessment

Pain was assessed using the VAS. This scale consists of a 100-mm horizontal line, with one end representing 0 (no pain) and the other end representing 10 (the worst pain imaginable). The VAS is one of the most valid instruments for quantifying pain intensity, with a reported validity of 0.86 (25).

Assessment of core endurance

The McGill tests were used to assess the endurance of the trunk flexor and lateral flexor muscles; previous studies have reported a validity of 83% and a reliability of 98% for these tests. The endurance of the spinal extensor muscles was assessed using the Biering-Sørensen test. The validity of this test for assessing the erector spinae muscles has been established, and its reliability in individuals with low back pain has been reported as 88% (26).

In all McGill tests, the time each participant maintained a specified position was recorded using a stopwatch. If a test attempt was unsuccessful, the participant was allowed to rest, and the test was then repeated. For the trunk flexion test, the participant was asked to sit leaning against a board inclined at 60°, with both hips flexed to 90° and the arms crossed over the chest. The participant's feet were stabilized by an assistant. While the participant maintained this leaning position, the board was pulled back 10 cm away from the participant's back. The participant was required to hold this position for as long as possible; the test was terminated if the participant's feet lifted off the surface or if excessive flexion of the thoracic spine occurred (27). The Biering–Sørensen test was used to assess extensor muscle endurance. The participant lay prone on a table with the pelvis positioned at the edge of the table, and the legs and pelvis were secured to the table with straps. In this position, the participant was required to maintain the trunk horizontally, in line with the table. Timing was stopped when the trunk deviated from the horizontal position, and the test was repeated (28).

In the plank test, the participant lay prone, placed the forearms on the ground with the elbows flexed to 90°, lifted the knees off the ground, and attempted to maintain the trunk in a horizontal position. The test was terminated and repeated in the event of excessive scapular winging or an abnormal increase in lumbar lordosis (29). In the side plank test, the participant was supported on the right or left forearm with the trunk and legs aligned in a straight, extended line, and attempted to lift the pelvis off the ground and maintain this position. If the pelvis dropped excessively toward the ground or the trunk rotated, timing was stopped and the test was repeated (30).

Assessment of functional disability

The Oswestry Disability Index (ODI) is a standardized instrument comprising 10 items that assess the impact of low back pain on activities of daily living, scored and interpreted on a 0–100% scale. This instrument, which takes approximately 5 minutes to complete, has high test–retest reliability and good validity for the assessment of both acute and chronic conditions; it is simple to administer, reproducible, and internationally validated in more than 40 languages (31-33).

Core stability exercise program

The core stability exercise protocol was adapted from previous studies (34-44). The program consisted of 9 stretching movements and 13 basic strengthening exercises, as described in Table 1. In the first session, the basic principles of core stability training were explained, and general information about the exercises was provided to the participants.

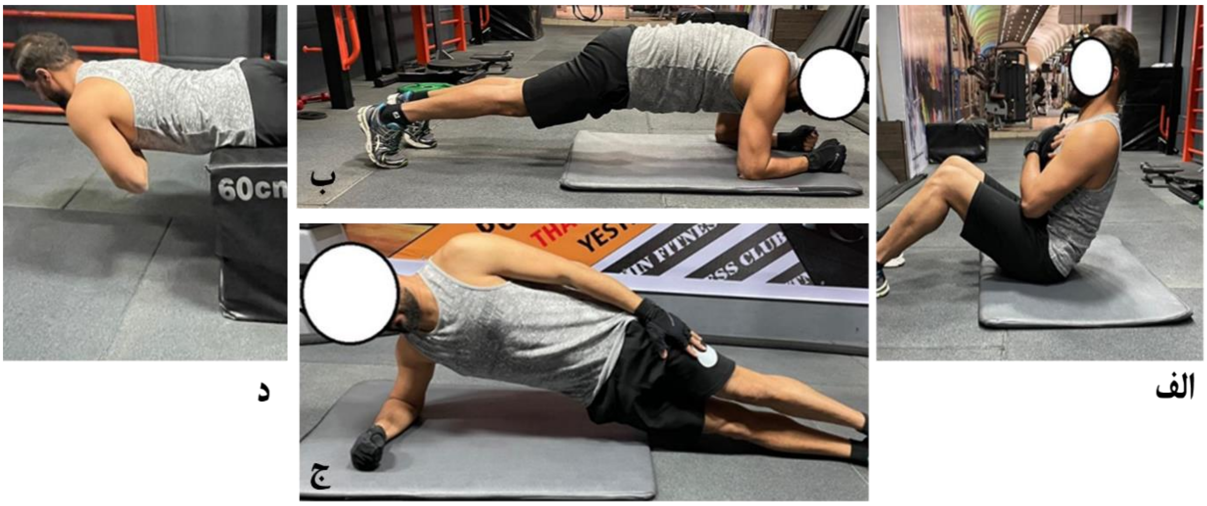


Figure 1. McGill tests for the assessment of core muscle endurance: a) trunk flexion test, b) plank test, c) side plank test, d) Biering–Sørensen test

Table 1. Core stability exercise program

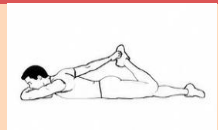
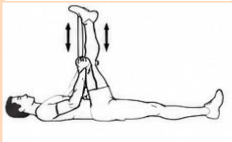
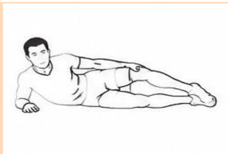
Activity			1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
Prone quadriceps stretch	The participant lies in a prone position, grasps the ankle, and pulls the heel toward the buttock.		*	*	*	*	-	-
Hip flexor stretch in lunge position (Lunge hip flexor stretch)	The participant places one leg forward and the other leg back, then shifts the pelvis forward.		*	*	*	*	-	-
Standing hip adductor stretch	The participant stands with the legs apart and bends to one side, creating a stretch along the inner thigh.		*	*	*	*	-	-
Standing hamstring stretch (forward bend)	The participant places one leg forward, keeps the knee straight, and bends the trunk forward from the hips.		*	*	*	*	-	-
Supine dynamic hamstring stretch	The participant lies supine and moves one lower limb, kept straight, up and down.		*	*	*	*	-	-
Side-lying tensor fasciae latae (TFL) stretch	The participant lies on the side and guides the upper leg backward and downward to create a stretch along the outer thigh.		*	*	*	*	*	*
Standing cross-legged tensor fasciae latae (TFL) stretch	The participant crosses one leg behind the other and bends the trunk laterally (to the opposite side).		*	*	*	*	*	*

Table 1. Core stability exercise program (continue)

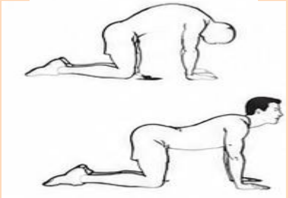
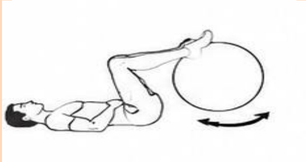
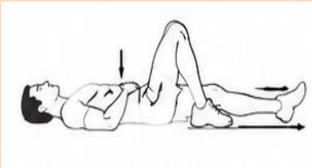
Activity			1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
Standing gluteal stretch (knee-to-chest, front)	The participant places the ankle of one leg over the opposite knee (figure-4 position) and bends the supporting knee to create a stretch in the gluteal muscles.		*	*	*	*	*	*
Cat stretch (Cat–Camel exercise)	The participant assumes a quadruped position and moves the spine into flexion in a controlled manner.		*	*	*	*	*	*
Supine hip rotation with a ball	The participant lies supine, holds a ball between the knees, and moves the lower limbs from side to side.		*	*	*	*	*	*
Supine abdominal draw-in maneuver (ADIM)	The participant lies supine and, by activating the deep abdominal muscles, draws the abdominal wall inward.		*	*	-	-	-	-
Supine abdominal draw-in with knees flexed to the chest	The participant maintains abdominal muscle activation while holding the flexed knees close to the chest.		-	-	*	*	-	-
The participant maintains abdominal muscle activation while holding the flexed knees close to the chest.	The participant, after drawing in the abdomen, slides the heels forward and backward along the floor in a controlled manner. (Heel slide with abdominal draw-in)		-	-	-	-	*	*

Table 1. Core stability exercise program (continue)

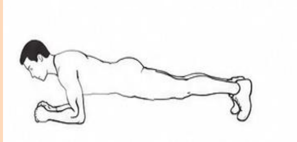
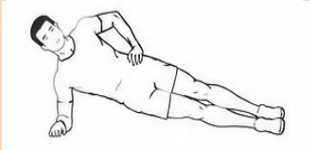
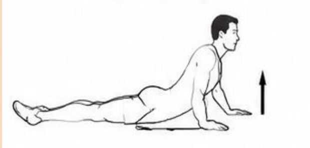
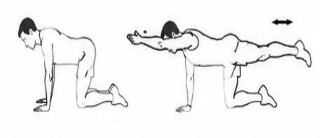
Activity			1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
Supine abdominal draw-in with knees flexed to the chest	The participant, while maintaining abdominal muscle contraction, brings both knees toward the chest.							
Supine lower-trunk rotation (with legs)	The participant lies supine with knees flexed and moves the legs to each side in a controlled manner.		*	*	*	*	*	*
Bridge on elbows (Elbow-supported bridge)	The participant, supported on the forearms and toes, holds the body in a straight line.		*	*	*	*	*	*
Side bridge on elbow (Side plank on forearm)	The participant, supported on one forearm and the outer edge of the foot, maintains the body in a straight, side-lying line.		-	*	*	*	*	*
Prone press-up (McKenzie extension)	The participant lies prone and, pressing through the hands, lifts the trunk off the floor.		*	*	*	*	*	*
Prone Cobra	The participant assumes a prone position and lifts the trunk to produce lumbar spine extension.		-	-	*	*	*	*
Prone Superman exercise	The participant lies prone and simultaneously lifts the arms and legs off the floor.		-	-	*	*	*	*

Table 1. Core stability exercise program (continue)

Activity			1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week
Quadruped contralateral arm and leg raise (Bird-Dog)	In quadruped, the participant simultaneously raises one arm and the contralateral leg, holding them in line with the trunk.		-	-	*	*	*	*
Supine bridge (Glute bridge):	In supine with knees flexed, the participant lifts the pelvis off the floor.		-	-	*	*	*	*

*Exercise performed during that week.
–Exercise not performed during that week.
Rest interval between sets: 45 seconds. Rest interval after each exercise: 90 seconds.

These basic principles were observed in all sessions. Each session began with preparatory activities, including postural checks (of the pelvis and spine) and stretching movements accompanied by the instructor's explanations (approximately 10 minutes). The session continued with the performance of the modified specific exercises (approximately 40 minutes) and concluded with a cool-down and return to baseline (approximately 5 minutes).

Thai Massage Protocol (English Summary): The Thai massage was administered by the researcher (5 years of massage experience). The patient first lay prone in a fully relaxed position. The protocol consisted of gentle, rhythmic pressure and slow passive muscle stretches, totaling 25 minutes per treatment session for the combined group (Ref 44). Techniques included:

1. Therapist positioned between the recipient's legs; with external rotation of the thighs, applied palmar pressure upward/downward from above the knee to the anterior iliac crest (3 repetitions per leg).
2. From the recipient's side, one hand pressed the ankle downward while the other pressed below the anterior iliac crest in the opposite direction (30 repetitions per leg).
3. Located the femoral artery, occluded it with both palms for 30 seconds, then released.
4. Right knee flexed, sole against opposite knee; pressure applied on the flexed-leg thigh with one hand and the extended-leg thigh with the other.
5. Butterfly-hand pressure along the flexed thigh from above the knee to the anterior iliac crest.
6. Knee flexed with external hip rotation; therapist's sole pressed the posterior thigh while pulling the ankle.
7. Flexed leg rested on the therapist's leg; knee held with the right hand while the inner thigh was massaged with the opposite elbow.
8. Therapist's shin pressed against the recipient's shin with external hip rotation, sole against posterior thigh, pulling the thigh toward the therapist.
9. Recipient's shin held between the therapist's legs; counter-directional bilateral hand pressure applied on the quadriceps.
10. Knee and thigh pulled toward the therapist.
11. Knee flexed, sole to chest; therapist's knee pressed the posterior thigh while the other foot applied a stretch to the opposite leg.
12. Seated facing the recipient, the therapist pressed the dorsum/ball of the foot to the posterior right thigh and pulled the leg.
13. Right leg abducted and held by the therapist's leg; butterfly palmar pressure on the thigh. Repeated for the opposite leg.
14. Side-lying: therapist massaged gluteal and piriformis muscles with the palm. Repeated on the opposite side.
15. Side-lying with leg abducted: ankle held by the therapist's foot while both hands pulled the thigh. Repeated on the opposite side.
16. Prone with knees flexed: therapist sat on the soles and applied palmar pressure to the lower back.
17. Prone: therapist placed both knees below the gluteal folds, applying pressure to the posterior thighs while massaging the lower back (Ref 45).

Statistical Analysis: Shapiro–Wilk test assessed normality. ANCOVA tested the research hypotheses (significance level: 0.05). All analyses were performed in SPSS v24 (IBM Corp., Armonk, NY).

Results

Of the eligible volunteers, 14 participants were allocated to the combined group (Thai massage + trunk stabilization exercises) and 14 to the control group (trunk stabilization exercises only). Four participants in the combined group withdrew due to irregular attendance, and four in the control group withdrew for personal reasons. Participant characteristics (age, height, weight, BMI) are presented in Table 2.

Overall ANCOVA results are presented in Table 3.

Discussion

This study aimed to determine the effect of Thai massage on outcomes of core stability training in men with sacroiliac joint (SIJ) dysfunction.

Table 2. Demographic characteristics of participants

Variable	Group	Mean ± SD	Median	Min–Max	t	P
Age (years)	Combined	39.18 ± 8.46	41.50	25–50	0.69	0.42
	Control	39.75 ± 9.35	40.50	25–50		
Height (m)	Combined	1.75 ± 0.06	1.745	1.70–1.80	0.78	0.31
	Control	1.76 ± 0.05	1.76	1.70–1.83		
Weight (kg)	Combined	73.50 ± 3.12	74.00	68–79	0.63	0.52
	Control	74.00 ± 4.37	74.50	70–84		
BMI (kg/m²)	Combined	24.01 ± 6.16	24.00	20–28	0.64	0.47
	Control	23.98 ± 4.92	24.30	19–27		

Table 3. ANCOVA results (English translation)

Variable	Group	Pre-test	Post-test	Observed change	Adjusted mean	F	P
Pain score	Combined	4.90 ± 0.87	2.60 ± 0.69	88.46	3.39	5.63	0.01*
	Control	4.50 ± 0.97	3.30 ± 1.05	36.36	2.50		
Functional disability score	Combined	70.30 ± 6.60	64.00 ± 6.16	9.84	61.37	1.60	0.28
	Control	72.00 ± 12.36	61.70 ± 6.56	16.69	64.32		
Plank (s)	Combined	18.67 ± 1.60	25.99 ± 4.63	28.16	22.37	3.69	0.03**
	Control	19.74 ± 2.36	22.20 ± 2.79	11.08	25.83		
Right side plank (s)	Combined	21.41 ± 1.55	27.19 ± 4.35	21.25	26.63	0.09	0.48
	Control	22.20 ± 1.92	26.65 ± 2.50	16.69	27.21		
Left side plank (s)	Combined	20.49 ± 1.55	25.69 ± 1.35	20.24	25.69	0.004	0.87
	Control	20.19 ± 2.47	25.61 ± 4.50	21.16	25.61		
60° flexion test (s)	Combined	18.54 ± 3.55	20.28 ± 3.35	8.57	18.36	6.92	0.01***
	Control	17.34 ± 1.92	17.74 ± 1.50	2.25	19.66		
Sørensen test (s)	Combined	14.35 ± 1.55	15.19 ± 1.35	5.52	16.77	6.37	0.02
	Control	14.47 ± 1.92	16.81 ± 1.50	13.92	15.23		

*Pain: P = 0.01; **Plank: P = 0.03; ***Flexion: P = 0.01; ****Sørensen: P = 0.02

Overall, both training programs significantly reduced pain and improved core endurance ($P \leq 0.05$).

Results showed that adding Thai massage in the combined group produced significant differences in pain and endurance, although core endurance improved significantly from pre-test in both groups.

Prior studies show SIJ manipulation/mobilization combined with home exercise significantly reduces pain and disability; combining manual therapy with SIJ-specific exercises yields greater and more durable effects, particularly long-term (46–47). Jonely et al. reported that a multimodal approach (manipulation + exercise therapy) reduced pain and improved function in a patient with SIJ dysfunction (48). Al-Subahi et al. found physiotherapy interventions effective for pain, disability, and pelvic asymmetry, with manipulation the most effective and most common approach, though evidence quality was low-to-moderate (49).

Stabilization exercises recruit spinal stabilizer muscles to teach correct movement patterns. These muscles—with a higher proportion of type I fibers, greater capillary density, and abundant mitochondria—show increased endurance with training (50), which underlies their function during daily activities.

SIJ dysfunction is a common cause of low back pain (prevalence 15–30%) (51). Chronic pain induces structural and functional brain changes (52). Patients likely alter lumbar movement patterns to reduce pain; repeated uncontrolled compensations may become faulty motor patterns disrupting correct movement control, of which patients remain unaware, and poor movement control may overload the lumbar spine (53). This may explain why exercise significantly improves proprioception, motor control, and neuromuscular coordination while reducing pain in chronic non-specific LBP (54). Stabilization exercises likely reduce ligament/joint stress by increasing trunk muscle strength and endurance (55). The transversus abdominis is key to spinal support; its retraining is a first step in LBP rehabilitation (56). Spinal stability arises from the interaction of neuromuscular control, passive (ligaments/bones), and active (muscles) subsystems (57–59), and depends on adequate sensory input providing feedback for movement correction (60–61). In the present study, stabilization exercises probably reduced pain by raising the pain threshold, strengthening deep muscles (multifidus, transversus abdominis), and improving coordination and position/movement sense — although mechanisms were not examined.

Physical stimulation from Thai massage can improve LBP-related pain and disability (62). Massage may have promoted muscle relaxation, circulation, relief of spasm and fatigue, and increased muscle activity/perfusion — though spasm and blood flow were not measured, so the mechanism remains undetermined.

Limitations

Psychological status of participants (63), small sample size, and convenience sampling could not be controlled. Data were collected immediately after the final session, so durability of effects is unknown.

Recommendations

Future studies using animal models or precise instruments should examine tissue changes in lumbar/SIJ structures after stabilization exercise and massage (including Thai massage) to clarify mechanisms. Studies with follow-up phases or biomechanical assessment during gait/daily activities are recommended.

Conclusion

Core stability exercises combined with Thai massage reduced pain, improved trunk endurance, and reduced disability in patients with SIJ dysfunction; this combination may be recommended for men with SIJ dysfunction.

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Authors' Contribution

Study design and ideation: Mohammad Saeed Mokhtari, Gholamali Ghasemi
Support and executive and scientific study services: Mohammad Saeed Mokhtari, Gholamali Ghasemi
Providing equipment for study samples: Mohammad Saeed Mokhtari, Gholamali Ghasemi
Data collection: Mohammad Saeed Mokhtari, Gholamali Ghasemi
Data analysis and interpretation: Mohammad Saeed Mokhtari, Gholamali Ghasemi
Specialized scientific evaluation of the manuscript: Mohammad Saeed Mokhtari, Gholamali Ghasemi
Confirm the final manuscript to be submitted to the journal website: Mohammad Saeed Mokhtari, Gholamali Ghasemi
Manuscript preparation: Mohammad Saeed Mokhtari, Gholamali Ghasemi
Maintaining the integrity of the study process from the beginning to the publication and responding to the refers comments: Mohammad Saeed Mokhtari, Gholamali Ghasemi

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Conflict of Interest

The authors did not have a conflict of interest.

References

1. McLauchlan G, Gardner D. Sacral and iliac articular cartilage thickness and cellularity: relationship to subchondral bone end-plate thickness and cancellous bone density. Rheumatology. 2002; 41(4): 375-8.
2. Vleeming A, Schuenke M, Masi A, Carreiro J, Danneels L, Willard F. The sacroiliac joint: an overview of its anatomy, function and potential clinical implications. Journal of anatomy. 2012; 221(6): 537-67.
3. Cohen SP, Chen Y, Neufeld NJ. Sacroiliac joint pain: A comprehensive review of epidemiology, diagnosis and treatment. Expert Rev Neurother. 2013; 13: 99-116.
4. Hertling D, Kessler R. Sacroiliac joint and lumbar-pelvic-hip complex. Management of common musculoskeletal disorders: Physical therapy principles and methods 4th ed Philadelphia: Lippincott. 2006: 935-87.
5. Schuit D, McPoil TG, Mulesa P: Incidence of sacroiliac joint malalignment in leg length discrepancies. J Am Podiatr Med Assoc, 1989, 79: 380-3.
6. Hansen HC, McKenzie-Brown AM, Cohen SP, et al.: Sacroiliac joint interventions: a systematic review. Pain Physician, 2007, 10: 165-84.
7. Bernard TN Jr, Kirkaldy-Willis WH. Recognizing specific characteristics of nonspecific low back pain. Clin Orthop Relat Res. 1987; (217): 266-80.
8. Erhard R, Bowling R: The recognition and management of the pelvic component of low back and sciatic pain. J Am Phys Ther Assoc, 1977, 2: 4-15.
9. Kovacs FM, Abraira V, Zamora J, del Real MTG, Llobera J, et al. Correlation between pain, disability, and quality of life in patients with common low back pain. Spine. 2004; 29(2): 206-10.
10. Toshe Krstev. Physical therapy approaches in treatment of sacroiliac joint dysfunction. Acta Kinesiologica. 2015. Suppl. 1: 24-7.
11. Keeratitanont K, Jensen MP, Chatchawan U, Auvichayapat P. The efficacy of traditional Thai massage for the treatment of chronic pain: A systematic review. Complement Ther Clin Pract. 2015; 21(1): 26-32.
12. Juntakarn C, Prasartritha T, Petrakard P. The Effectiveness of Thai Massage and Joint Mobilization. Int J Ther Massage Bodywork. 2017; 10(2): 3-8.
13. Buttagat V, Eungpinichpong W, Chatchawan U, Kharmwan S. The immediate effects of traditional Thai massage on heart rate variability and stress-related parameters in patients with back pain associated with myofascial trigger points. J Bodyw Mov Ther. 20110.
14. Chatchawan U, Thinkhamrop B, Kharmwan S, Knowles J, Eungpinichpong W. Effectiveness of traditional Thai massage versus Swedish massage among patients with back pain associated with myofascial trigger points. J Bodyw Mov Ther. 2005; 9(4): 298-309.
15. Kamali F, Zamanlou M, Ghanbari A, Alipour A, Bervis S. Comparison of manipulation and stabilization exercises in patients

with sacroiliac joint dysfunction patients: a randomized clinical trial. J Bodyw Mov Ther. 2019; 23(1): 177-82. [In Persian].
16. Willson JD, Dougherty CP, Ireland ML, Davis IM. Core stability and its relationship to lower extremity function and injury. JAAOS- J Am Acad Orthop Surg Glob Res Rev. 2005; 13(5): 316-25.
17. Celenay ST, Mete O, Akan S, Yildirim NU, Erten S. Comparison of the effects of stabilization exercise plus kinesio taping and stabilization exercise alone on pain and well-being in fibromyalgia. Complementary Therapies in Clinical Practice. 2020; 38: 10107.
18. Sharma RCSK. Comparison of core muscle strengthening exercise program versus spinal flexion exercises on pain in chronic low back pain patients. 2018.
19. Cohen SP. Sacroiliac joint pain: a comprehensive review of anatomy, diagnosis, and treatment. Anesth Analg. 2005; 101(5): 1440-53.
20. Hamidi-Ravari, B., Tafazoli, S., Chen, H. et al. Diagnosis and Current Treatments for Sacroiliac Joint Dysfunction: A Review. Curr Phys Med Rehabil Rep. 2014; 2: 48-54.
21. Nejati P, Safarcherati A, Karimi F. Effectiveness of Exercise Therapy and Manipulation on Sacroiliac Joint Dysfunction: A Randomized Controlled Trial. Pain Physician. 2019; 22(1): 53-61.
22. Safdari S, khayambashi KH, Ghasemi GA, Falah A, Sakhavat E. Effects of Selected Core Stabilization Exercise Protocol on Pain and Functional Disability in Subjects with Chronic Nonspecific Low Back Pain. J Res Rehabil Sci 2014; 10(1): 56-66. [In Persian].
23. Nejati P, Karimi F, Safarcherati A. The Effect of Manipulation in Sacroiliac Joint Dysfunction. J Isfahan Med Sch. 2016. 34(402): 1218-24. [In Persian].
24. Zelle BA, Gruen GS, Brown S, George S. Sacroiliac joint dysfunction: evaluation and management. Clin J Pain. 2005; 21(5): 446-55.
25. Chiarotto A, Maxwell LJ, Ostelo RW, Boers M, Tugwell P, Terwee CB. Measurement properties of visual analogue scale, numeric rating scale, and pain severity subscale of the brief pain inventory in patients with low back pain: a systematic review. J. Jpain.
26. Suh JH, Kim H, Jung GP, Ko JY, Ryu JS. The effect of lumbar stabilization and walking exercises on chronic low back pain: A randomized controlled trial. Medicine (Baltimore). 2019; 98(26): e16173.
27. McGill SM, Childs A, Liebenson C. Endurance times for low back stabilization exercises: clinical targets for testing and training from a normal database. Arch Phys Med Rehabil. 1999; 80(8): 941-4.
28. Biering-Sørensen F. Physical measurements as risk indicators for low-back trouble over a one-year period. Spine (Phila Pa 1976). 1984; 9(2): 106-19.
29. "Green M. The prone bridge test: Performance, validity, and reliability among older and younger adults. Journal of Bodywork and Movement Therapies. 2017.
30. McGill SM, Childs A, Liebenson C. Endurance times for low back stabilization exercises: clinical targets for testing and training from a normal database. Arch Phys Med Rehabil. 1999; 80(8): 941-4.
31. Fairbank JC, Couper J, Davies JB, O'Brien JP. The Oswestry low back pain disability questionnaire. Physiotherapy. 1980; 66(8): 271-273.
32. Fairbank JC, Pynsent PB. The Oswestry Disability Index. Spine (Phila Pa 1976). 2000; 25(22): 2940-52.
33. Yates M, Shastri-Hurst N. The Oswestry Disability Index. Occupational Medicine. 2017; 67: 241-2.
34. Almasi S,Shojaedin Ss, karimi z. Effect and durability of eight weeks of central stability and Pilates exercises on sensory function, quality of life and pain in women with non-specific chronic low back pain. Anesthesiology and Pain. 2020; 10(4): 36-49.
35. Jonely H, Brismée JM, Desai MJ, Reoli R. Chronic sacroiliac joint and pelvic girdle dysfunction in a 35-year-old nulliparous woman successfully managed with multimodal and multidisciplinary approach. J Man Manip Ther. 2015; 23(1): 20.
36. added man, de freitas dg, kasawara kt, martin rl, fukuda ty. Strengthening the gluteus maximus in subjects with sacroiliac dysfunction. int j sports phys ther. 2018; 13(1): 114-20.
37. Javadov A, Ketenci A, Aksoy C. The Efficiency of Manual Therapy and Sacroiliac and Lumbar Exercises in Patients with Sacroiliac Joint Dysfunction Syndrome. Pain Physician. 2021;24(3): 223-33.
38. Nejati P, Safarcherati A, Karimi F. Effectiveness of Exercise Therapy and Manipulation on Sacroiliac Joint Dysfunction: A Randomized Controlled Trial. Pain Physician. 2019; 22(1): 53-61.
39. Fatemi R, Javid M, Najafabadi EM. Effects of William training on lumbosacral muscles function, lumbar curve and pain. J Back Musculoskelet Rehabil. 2015; 28(3): 591-7. [In persian]
40. Tenney HR, Boyle KL, Debord A. Influence of Hamstring and Abdominal Muscle Activation on a Positive Ober's Test in People with Lumbopelvic Pain. Physiother Can. 2013; 65(1): 4-11.
41. Kasunich NJ. Changes in low back pain in a long distance runner after stretching the iliotibial band. J Chiropr Med. 2003; 2(1): 37-40.
42. Naidu saitej. Effect Of Iliotibial Band Stretching Versus Hamstrings And Abdominal Muscle Activation On A Positive Ober's Test In Subjects With Lumbopelvic Pain: A Randomized Clinical Trial," International Journal of Therapies and Rehabilitation Research, 2015.
43. Goom TS, Malliaras P, Reiman MP, Purdam CR. Proximal Hamstring Tendinopathy: Clinical Aspects of Assessment and

Management. J Orthop Sports Phys Ther. 2016; 46(6): 483-93.
44. Buttagat V, Eungpinichpong W, Chatchawan U, Kharmwan S. The immediate effects of traditional Thai massage on heart rate variability and stress-related parameters in patients with back pain associated with myofascial trigger points, J Bodyw Mov Ther, 2011; 15(1): 15-23.
45. Gold R. Thai massage: a traditional medical technique: Elsevier Health Sciences; 2006.
46. Nejati P, Karimi F, Safarcherati A. The Effect of Manipulation in Sacroiliac Joint Dysfunction. J Isfahan Med Sch. 2016. 34(402): 1218-24.
47. Javadov A, Ketenci A, Aksoy C. The Efficiency of Manual Therapy and Sacroiliac and Lumbar Exercises in Patients with Sacroiliac Joint Dysfunction Syndrome. Pain Physician. 2021; 24(3): 223-33.
48. Jonely H, Brismée JM, Desai MJ, Reoli R. Chronic sacroiliac joint and pelvic girdle dysfunction in a 35-year-old nulliparous woman successfully managed with multimodal and multidisciplinary approach. Journal of Manual & Manipulative Therapy. 2015; 23(1): 20-6.
49. Moayad Al-subahi et al.The effectiveness of physiotherapy interventions for sacroiliac joint dysfunction: a systematic review. J. Phys. Ther. Sci. 2017. 29: 1689-94.
50. Richardson C, Hides J, Hodges P. Principles of the'segmental stabilization'exercise model. 2004.
51. Cohen SP, Chen Y, Neufeld NJ. Sacroiliac joint pain: a comprehensive review of epidemiology, diagnosis and treatment. Expert Rev Neurother. 2013; 13(1): 99-116.
52. Tracey I, Bushnell MC. How neuroimaging studies have challenged us to rethink: is chronic pain a disease?. J Pain. 2009; 10(11): 1113-20.
53. Luomajoki H, Kool J, De Bruin ED, Airaksinen O. Reliability of movement control tests in the lumbar spine. BMC musculoskeletal disorders. 2007; 8(1): 1-11.
54. Nazarzadeh Deh-bozorgi M, Letafatkar A, Sabounchi R. Efficacy of sensorimotor training on proprioception and neuromuscular coordination in patients with chronic nonspecific low back pain. Studies in Sport Medicine. 2014; 6(15): 71-88. [In Persian].
55. Ya'ghoubi Z, Kahrizi S, Parnian-Pour M, Ebrahimi-Takmajani E, Faghih-Zadeh S. The short effects of two spinal stabilization exercise on balance tests and limit of stability in men with non–specific chronic low back pain: randomized clinical trial study. Archives of Rehabilitation. 2012;13(1): 102-13.
56. Karimi N, Golpour MR, Arab A, Ezzati K, Talimkhani K, Zarvar M. Compact core stabilization exercises on pain and disability in women with chronic non-specific low back pain. Specific Physical Therapy Journal. 2011; 1(1): 35-42.
57. Wirth, K., Hartmann, H., Mickel, C. et al. Core Stability in Athletes: A Critical Analysis of Current Guidelines. Sports Med. 2017; 47: 401–14.
58. Selkow NM, Eck MR, Rivas S. Transversus abdominis activation and timing improves following core stability training: a randomized trial. International journal of sports physical therapy. 2017; 12(7): 1048.
59. Farragher JB, Pranata A, Williams G, et alEffects of lumbar extensor muscle strengthening and neuromuscular control retraining on disability in patients with chronic low back pain: a protocol for a randomised controlled trialBMJ Open 2019; 9: e028259.
60. Riva D, Fani M, Benedetti MG, Scarsini A, Rocca F, Mamo C. Effects of High-Frequency Proprioceptive Training on Single Stance Stability in Older Adults: Implications for Fall Prevention. Biomed Res Int. 2019; 2019: 2382747.
61. Poole H, Glenn S, Murphy P. A randomised controlled study of reflexology for the management of chronic low back pain. European Journal of Pain. 2007; 11(8): 878-87.
62. Juntakarn C, Prasartritha T, Petrakard P. The Effectiveness of Thai Massage and Joint Mobilization. Int J Ther Massage Bodywork. 2017; 10(2): 3-8.
63. Cecchi F, Pasquini G, Paperini A, et al. Predictors of response to exercise therapy for chronic low back pain: result of a prospective study with one year follow-up. Eur J Phys Rehabil Med. 2014; 50(2): 143-51.
64. Erhard R, Bowling R: The recognition and management of the pelvic component of low back and sciatic pain. J Am Phys Ther Assoc, 1977, 2: 4–15.