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Strain-counterstrain versus muscle energy technique in sacroiliac joint dysfunction: A randomized controlled trial

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***Abstract*---**Background: The sacroiliac joint (SIJ) has been long considered an important source of low back pain because its prevalence varies from 10% to 30% with axial low back pain. Several manual techniques were used in SIJ dysfunction (SIJD) treatment as manipulation, muscle energy technique (MET), strain-counterstrain (SCS), and mobilization. However, there is little evidence about the efficacy of MET and SCS have been reported. Design: Randomized controlled trial. Setting: Evaluation and treatment were taken at Warraq Central hospital and El-Sahel hospital in the Giza governorate, Egypt. Purpose: Examine the effect of (SCS) versus (MET) on pain pressure threshold (PPT), functional disability, and the innominate angle tilt with SIJ dysfunction. Methods: Fifty-six patients with SIJD were recruited and randomly assigned to receive treatment with either SCS or MET. The outcomes were PPT by Pressure algometer and functional disability by Oswestry Disability Index (ODI) and the innominate angle tilt by Palpation Meter (PALM). All outcomes were assessed at pre and post intervention and frequency of treatment was 3 sessions/week for 4 weeks. Results: An intra-group analysis revealed a significant improvement in all outcome measures in both groups while in inter-group analysis, there was a significant difference in frontal innominate angle tilt value and functional disability in favor of the MET group. On other hand, there were no significant differences in pain pressure threshold and sagittal innominate angle tilt between both groups. Conclusion: Both techniques SCS and MET were clinically successful in the treatment of SIJ, however, the MET was

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superior to SCS in the improvement of frontal innominate angle tilt and functional disability.

***Keywords*---**muscle energy technique, strain-counterstain, sacroiliac joint dysfunction.

Introduction

The sacroiliac joint (SIJ) has considered an important source of low back pain (LBP) because of the empirical finding that treatment targeting the SIJ can relieve pain (1). According to the European guidelines for back pain, pelvic pain is a subgroup of back pain and is characterized as pain felt between the posterior iliac crest and the gluteal fold, especially in the region of the sacroiliac joint (SIJ) (2). The prevalence of sacroiliac pain among patients with axial low back pain varies between 10% and 33.3% (3–5). A study reported that approximately 44% of cases of SIJ pain are associated with direct trauma (6). On other hand, several studies found that SIJ dysfunction may occur with sudden heavy lifting, prolonged lifting, bending, torsional strain, and arising from stooped position (7,8). Pain associated with SIJ dysfunction may be aggravated by any activities that require asymmetrical loading through the lower extremity with standing and walking, or by prolonged sitting and forward flexion in the standing position with knees fully extended (9,10).

Several manual therapy techniques are used in treatment of SIJ dysfunction including muscle energy technique (MET), strain-counter strain (SCS), myofascial release, craniosacral technique, and manipulation which aim to restore normal SIJ dynamics (11,12). A recent systematic review found a useful science-based mechanism for understanding the potential role of manual therapy in the management of SIJ pain which are inhibitory neurophysiological responses in central and peripheral nervous systems and alteration in reflex motor activity (13).

Strain-counterstrain (SCS) is a type of positional release discovered in the early 1960s based on the proprioceptive theory of somatic dysfunction. It is an indirect treatment that alleviates muscle and connective tissue tightness by the use of very specific passive positions held for 90 seconds. During the procedure, the involved tissue is slackened causing a relaxation of the spasm, which in turn allows local areas of inflammation trapped within the painful tissue to dissipate leading to an immediate reduction in pain and tension in the involved tissue (14).
Previous studies have shown the effectiveness of SCS in pain reduction and improvement of hip abduction/adduction range of motion and strength in the treatment of gluteus medius trigger points with either SIJ dysfunction patients or asymptomatic patients with hip muscle weakness (15,16). Other studies examined the effect of SCS on pain, functional disability, and lumbar ROM with acute/chronic low back pain (LBP) patients showing a significant effect on the outcome measures either in combination with therapeutic exercises and MET or in comparison with MET (17–20).

MET is a type of manual therapy for the limited mobility of the spine and extremities (21). It is a self-procedure in which the patient not the examiner controls the corrective force secondary to active muscle contraction. The patient perform series of voluntary muscle contractions of varying intensity, in a specific direction, while the examiner uses a counter-force that does not allow movement to occur (22). Although patients with SIJ dysfunction are suffering from pain, pelvic misalignment, and functional disability, few studies investigate the effects of the SCS on these variables. Strain-counterstrain (SCS) consider an excellent choice for building patient thrust as the patient is held passively in a pain-free position. SCS can facilitate treatment for the patient who has experienced pain during a treatment session by using other manual therapy techniques such as manipulation and MET or specific core stability exercises to enhance force closure of SIJ.

SCS allows normalization of the tone of tight muscles involved in SIJ dysfunction which allows a significant improvement in the recruitment of weak muscles, especially the gluteal group. SCS has shown its effectiveness in reducing pain or palpation tenderness over different musculoskeletal disorders such as acute/ chronic LBP (18,20,23,24), mechanical neck pain (25,26), and masseter trigger points (27). Although, SCS facilitate local circulations which causes more nutrient supply, metabolic waste removal, and reverse ischemia which will manifest as painful tender points (TPs) or sustain dysfunction. Current literature lacks consensus on mechanisms, contributing factors, and treatment of SIJ dysfunction. While manual therapy is a helpful tool for LBP care, few studies have focused on it's efficacy of SIJD. There is limited evidence concerning the efficacy of SCS and MET in SIJ dysfunction. Therefore, the aim of the study to examine the effect of SCS versus MET on pain pressure threshold (PPT), functional disability and the innominate angle tilt in SIJ dysfunction.

Methods

Design of study: randomized control trial.

Participants

The study was conducted on fifty-six male and female patients referred by an orthopedic surgeon with the diagnosis of SIJ dysfunction and were randomly recruited into two groups; group A who receive SCS and Ultrasound (US) and group B who receive MET and US (Figure 1). The research has been approved by the Faculty of Physical Therapy Ethical Committee, Cairo University, Egypt (P.T.REC/012/0002808) .

Subjects who met the following inclusion criteria were asked to participate in the study:1) Positive Fortin's sign (pain around PSIS and sacral sulcus). 2) Positive three posterior provocation tests of four including Thigh thrust test, Compression test, Distraction Test, and Patrick test. 3) Pain in lower back below level L5 vertebra and buttocks. 4) Self-reported disability due to SIJ pain on the Oswestry Disability Index (ODI) scores at least 30%. Subjects were excluded from the study if they had a history of any of the following conditions: Acute injury or fracture of the lower limb and spine, systemic diseases such as Rheumatoid arthritis (R.A) or ankylosing spondylitis, previous major lumbar or hip surgery, pregnancy or delivery for less than 6 months ago, lumbar stenosis or spondylolisthesis or disc disease or Congenital spinal deformity.

Randomization

The patients were assigned randomly to the 2 groups by using opaque, sealed envelopes, containing the name of one of each group (SCS or MET). A colleague who was not participating in recruiting, treating, or evaluating participants selected the envelopes. After the initial assessment but before the first therapy session, group allocation has been carried out.

The sample size calculation

Based on previous studies (28,29), it was estimated that a sample size of 56 patients (28 patients in each group as a minimum) would achieve a power of 95% with assuming a type I error (P = 0.05) to detect an effect size of 1.036061 in the outcome measures of interest.

Assessment procedure

Demographic data for age, weight, height and BMI for all subjects were collected. The patients were assessed just before and after 3 weeks of treatment (3 sessions per week). The assessment procedure included the following measures:

1) Pain Pressure Threshold (PPT) which was measured by a Pressure Algometry Device (Wagner model FDIX) that showed good inter-rater reliability with SIJ dysfunction patients (30). Two measure points were marked 2 cm cranially (first point) and 2 cm laterally (second point) from the reference point located 1 cm medially and caudally from the posterior superior iliac spine (PSIS) which shows the most painful points in SIJ patients. Anatomically, the first point is related to the attachment of the gluteus maximus to the iliac crest while the second point is related to the erector spinae muscle and posterior sacroiliac ligament. The patient was in a relaxed prone lying position and instructed to report the first sensation of pain provoked by the exerted pressure on the predefined point. Three reading was taken, and the mean value was calculated as a final score and recorded.

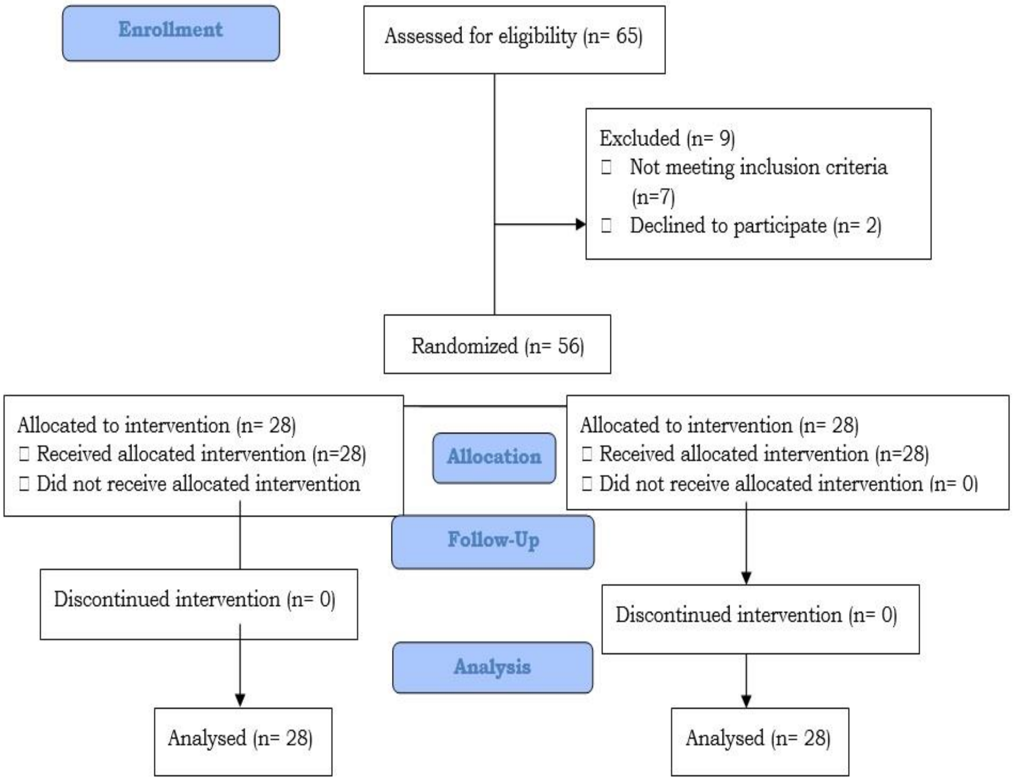

Figure 1: Flow diagram

2) Functional disability was measured by Oswestry Disability Index (ODI) in which all patients were evaluated for their pre and post-session functional status by choosing the responses representing their situation from the ODI. Copay and cher (2016) (31) showed that ODI is a valid instrument to measure disability associated with SIJ pain.

3) Pelvic tilting was measured via Palpation Meter (PALM) (Performance Attainment Associates, Saint Paul, MN, USA) which has good intertester reliability in the sagittal plane and moderate intertester reliability in the frontal plane (32,33). The patient was asked to march in place for 10 steps and then stand in a fully erect posture without bending ankles, knees, hips, feet forward 30.5 cm apart and to fold arms across the chest. The therapist stands beside the patient and marks the anterior superior iliac spine (ASIS) and posterior superior iliac spine (PSIS) then the tips of the PALM are placed on them for measuring the angle of pelvic tilting in the sagittal plane. A zero-degree measurement on PALM indicates that the line between ASIS and PSIS is horizontal.

The positive degree indicates an anterior innominate tilt while a negative degree indicates a posterior innominate tilt**.** For frontal plane measurement, the therapist was standing behind the patient and the PALM calipers were positioned on the most superior aspect of the iliac crest then the therapist asked the patient to take a deep breath in, exhale and wait to inhale again until the measurement was taken. The distance between caliper heads read to the nearest mm while the angle of inclination read to the nearest half degree. The inclinometer ball is designed to move towards the side of the shorter limb. PALM calculator was used to converting the inclination and caliper values to a corresponding pelvic obliquity value (mm). Three reading were taken, and the mean value was calculated as the final score and recorded.

Treatment Procedure

Group A received SCS and US. SCS was performed for Quadratus Lumborum (QL), Iliacus, piriformis, and erector spinae. This procedure was repeated 3 times for each muscle. For Quadratus Lumborum (QL): The patient was in a prone lying position with the trunk laterally flexed toward the tender point located at the lateral aspect of the transverse process of lumbar vertebrae L1-L5, the therapist was standing at the side of the tender point with his knee placed on the table and the patient's leg rests on it, the hip of the affected leg was in extension, abduction and slight rotation for fine-tuning. The pressure was applied over the tender point in the anterior and medial direction and was held in that position for 90 sec then the patient's leg was passively returned to a natural position (14). (Figure 2, A)

For Iliacus: The tender point was identified 3 cm medial to ASIS and deep in the iliac fossa with pressure applied in the posterior and lateral direction while the patient was in a supine lying position with a pillow under the pelvis. The therapist was standing at the tender point side and produced extreme flexion and external rotation of both hips by putting the patient ankles on his/her thigh and then holding a position for 90 sec (14). (Figure 2, B)

For Piriforms: The tender point was identified in the belly of the muscle, halfway between the inferior lateral angle of the sacrum and the greater trochanter. The pressure was applied anteriorly while the patient was in a prone lying position and the therapist sit on the ipsilateral side, patient leg hangs off the table resting on the therapist's thigh so the hip was in 60-90 degrees of flexion, with slight abduction and internal or external rotation for fine-tuning. The position was held for 90 sec (14). (Figure 2, C)

For erector spinae: The patient was in a prone lying position, and the therapist was standing as opposed to the tender point which was located at the superior medial aspect of the posterior superior iliac spine (PSIS). The therapist's leg was on the table and the patient's leg rested on it so the hip was in extension, adduction, and external rotation for fine-tuning. The pressure was applied on the tender point in the inferior and lateral direction while holding the position for 90 sec then the patient's leg passively returned to a natural position (14). (Figure 2, D)

(A) (B)

(C) (D)

Figure 2: SCS techniques

Ultrasound treatment

The patient is in a prone lying position. The sacroiliac region is covered with ultrasound gel without containing any pharmacological agents. The US is applied for both right and left sacroiliac regions in continuous circular motions at a right angle. US parameters were continuous waves, 1MHz frequency, and 1.5 watts/cm² intensity.

Group (B) received MET for the same muscles as group A and ultrasound. MET has been performed in the form of a post isometric relaxation technique for each muscle. The restriction barrier was identified then the patient was instructed to make a contraction, hold for 5-10 sec then relax for 2-3 sec for muscle recovery. This procedure was applied with breathing as in exhalation; the limb was taken into a new barrier of motion (34) and repeated 3 times per session.

For Quadratus Lumborum (QL): The patient was in a side-lying position on the unaffected side then was asked to pass his lowermost arm behind his/her trunk and rotated his upper trunk toward the table then was asked to firmly grasp the top of the table with uppermost hand. The therapist was standing behind the patient moving the uppermost leg into extension and adduction till the barrier of motion with one hand and the other hand fix the last rib. The patient was asked to lift his pelvis toward the rib cage in isometric contraction while holding his breath, at exhalation patient's leg is moved into a new barrier of motion (35). (Figure 3, A)

For Iliacus: The patient was in a supine lying position with the buttocks at the edge of the table, and the unaffected leg was fully flexed at the hip and knee and held in that position by the patient's hand while the affected leg was hanging off the table. The therapist fixed the affected ilium at the anterior superior iliac spine (ASIS) with a cranial hand while a caudal hand over the anterior lower part of the affected thigh pushing it down to the barrier of motion, then the patient was asked to push against therapist's caudal hand isometrically while holding the breath for 5-10 second. After exhalation, the therapist moved the affected leg into a new barrier of motion(36). (Figure 3, B)

For Piriforms: The patient was in a supine lying position with the affected leg in flexion and adduction so that the foot rested on the table lateral to the contralateral knee. Hip flexion does not exceed 60° flexion. The therapist was standing at the affected side with one hand over the lateral aspect of the flexed knee and the other hand over the contralateral anterior superior iliac spine (ASIS) to fix the pelvis. The patient was asked to push isometrically by flexed knee against the therapist's hand while holding his breath, after exhalation a new barrier of motion is engaged (37). (Figure 3, C)

For Erector spinae: The patient was sitting on the treatment table with legs hanging over the side and arms crossed over each other. The therapist was standing behind the patient placing his one knee on the table close to the patient opposite to the affected side, and then therapist passed his arm under the patient's arms to put his hand over the contralateral patient's shoulder moving the patient into flexion, side bending and rotation away from affected side till the barrier of motion. The patient asked to push his shoulder against the therapist's hand while holding his breath for 5-10 seconds after the exhalation therapist moves the patient into a new barrier of motion(37). (Figure 3, D)

(A) (B)

(C) (D)

Figure 3: MET techniques

Statistical analysis

Data were screened, for normality assumption tests and homogeneity of variance. Normality test of data using Shapiro-Wilk test was used, revealed that the data was normally distributed (P>0.05) after removal outliers that detected by box and whiskers plots. Additionally, Levene's test for testing the homogeneity of variance revealed that there was no significant difference (P>0.05). Therefore, the data are normally distributed and parametric analysis was recommended. The statistical analysis was conducted by using the statistical SPSS Package program version 25 for Windows (SPSS, Inc., Chicago, IL). Quantitative age, weight, height, and BMI data are expressed as mean and standard deviation and qualitative gender and side effect data are expressed as number and percentage. Between groups comparisons were assessed by independent t-test for age, weight, height, and BMI variables and chi-square test for gender and side effect variables. Multivariate analysis of variance (MANOVA) was used to compare the tested major variables of interest in different tested groups and measuring periods. A mixed design 2 x 2 MANOVA-test was used, the first independent variable (between-subject factors) was the tested group with 2 levels (group A vs. group B). The second independent variable (within the subject factor) was measuring periods with 2 levels (pre-and post-treatment). Bonferroni correction test was used to compare pairwise within and between groups of the tested variables which F was significant from the MANOVA test. All statistical analyses were significant at the level of probability (P ≤ 0.05).

Results

In the current study, a total of 56 patients of both genders (32 male and 24 female) were assigned randomly into two groups (28patients/group). No significant differences (P>0.05) in demographic data for age (P=0.170), weight (P=0.405), height (P=0.235), BMI (P=0.955), side effect (P=0.575), and gender (P=0.405) between group A and group B (Table 1).

Table (1)
Comparison of general characteristics between groups A and B

Items	Groups		*P*-value
	Group A (n=28)	Group B (n=28)	
Age (year)	34.35 ±9.69	38.50 ±11.75	0.170
Weight (kg)	83.07 ±10.87	79.85 ±16.16	0.405
Height (m)	173.27 ±16.79	170.92 ±17.26	0.235
BMI (kg/m^2)	27.62 ±4.53	27.55 ±5.47	0.955
Gender (males: females)	15 (53.57%): 13 (46.43%)	17 (61.71 %): 11 (39.29%)	0.575
Side effect (right: left)	15 (83.57%): 13 (46.43%)	12 (42.86%): 16 (57.14%)	0.405

Quantitative data (age, weight, height, BMI) are expressed as mean ±standard deviation and compared by a t-independent test.
Qualitative data (gender and side effect) are expressed as numbers (percentage) and compared by the chi-square test. P-value: probability value NS: non-significant

Multiple pairwise comparison tests (time effect) for PPT variables within group A and group B (Table 2) showed that there was a significantly (P<0.05) increase in right-point 1 (P=0.008 and P=0.025, respectively), right-point 2 (P=0.005 and P=0.027, respectively), left-point 1 (P=0.014 and P=0.004, respectively), and left-point 2 (P=0.011 and P=0.002, respectively) at post-treatment compared to pre-treatment within group A and group B. Moreover, group A improved higher on right-point 1 and point-2 (19.03% and 24.68%, respectively) than group B (15.73% and 18.48%, respectively), while left-point 1 and point 2 had improved higher with group B (23.96% and 30.00%, respectively) than group A (17.79% and 20.89%, respectively).

Multiple pairwise comparison tests (group effect) for PPT variables between group A and group B at pre- and post-treatment (Table 2) showed no significant differences (P>0.05) in right-point 1 (P=0.812 and 0.850, respectively), right-point 2 (P=0.460 and 0.891, respectively), left-point 1 (P=0.103 and 0.237, respectively), and left-point 2 (P=0.171 and 0.482, respectively).

Table (2)
Mixed MANOVA within and between groups comparison for PPT

Variables	Items	Groups (Mean ±SD)		Change	*P*-value
		Group A (n=28)	Group B (n=28)		
Right (Point 1)	Pre-treatment	3.31 ±0.97	3.37 ±1.08	0.06	0.812
	Post-treatment	3.94 ±0.48	3.90 ±0.71	0.04	0.850
	change	0.63	0.53		
	Improvement %	19.03%	15.73%		
	P-value	0.008*	0.025*		
Right (Point 2)	Pre-treatment	3.16 ±1.11	3.36 ±1.32	0.20	0.460
	Post-treatment	3.94 ±0.54	3.98 ±0.79	0.04	0.891
	change	0.78	0.62		
	Improvement %	24.68%	18.45%		

	P-value	0.005*	0.027*		
Left (Point 1)	Pre-treatment	3.26 ±1.06	2.88 ±0.95	0.38	0.103
	Post-treatment	3.84 ±0.66	3.57 ±0.55	0.27	0.237
	change	0.58	0.69		
	Improvement %	17.79%	23.96%		
	P-value	0.014*	0.004*		
Left (Point 2)	Pre-treatment	3.16 ±1.16	2.80 ±1.16	0.36	0.171
	Post-treatment	3.82 ±0.61	3.64 ±0.61	0.18	0.482
	change	0.66	0.84		
	Improvement %	20.89%	30.00%		
	P-value	0.011*	0.002*		

Data are expressed as mean ± standard deviation (SD) P-value: probability value * Significant (P<0.05)

Multiple pairwise comparison tests (time effect) for PALM frontal, PALM sagittal, and ODI variables within group A and group B (Table 3) revealed that there were significantly (P<0.05) decreased in PALM frontal (P=0.0001 and P=0.0001, respectively), right PALM sagittal (P=0.001 and P=0.002, respectively), left PALM sagittal (P=0.004 and P=0.0001, respectively), and ODI (P=0.0001 and P=0.0001, respectively) at post-treatment compared to pre-treatment within group A and group B. Moreover, group B improved higher PALM frontal, left PALM sagittal, and ODI than group B (64.62, 13.90, and 65.43%, respectively) than group A (51.72, 10.18, and 55.40%, respectively), while right PALM sagittal had improved higher with group A than group B (10.80% vs. 10.67%).

Multiple pairwise comparison tests (group effect) for PALM frontal, PALM sagittal, and ODI variables between group A and group B at pre-and post-treatment (Table 3) showed no significant differences (P>0.05) in right (P=0.130and 0.184, respectively) and left PALM sagittal (P=0.919 and 0.329, respectively). No significant differences (P>0.05) in PALM frontal (P=0.095) and ODI (P=0.114) between groups A and B at pre-treatment. However, there were significant differences (P<0.05) in PALM frontal (P=0.002) and ODI (P=0.002) between groups A and B at post-treatment

Table (3)
Mixed MANOVA within and between groups comparison for PALM frontal and sagittal

Variables	Items	Groups (Mean ±SD)		Change	*P*-value
		Group A (n=28)	Group B (n=28)		
PALM Frontal	Pre-treatment	2.32 ±0.36	2.12 ±0.46	0.19	0.095
	Post-treatment	1.12 ±0.47	0.75 ±0.36	0.37	0.002*
	change	1.20	1.37		
	Improvement %	51.72%	64.62%		
	P-value	0.0001*	0.0001*		
Right PALM Sagittal	Pre-treatment	12.32 ±1.99	11.71 ±1.68	0.61	0.130
	Post-treatment	10.99 ±0.84	10.46 ±0.90	0.53	0.184
	change	1.33	1.25		
	Improvement %	10.80%	10.67%		

	P-value	0.001*	0.002*		
Left PALM Sagittal	Pre-treatment	12.18 ±1.87	12.23 ±2.10	0.04	0.919
	Post-treatment	10.94 ±0.74	10.53 ±0.70	0.41	0.329
	change	1.24	1.70		
	Improvement %	10.18%	13.90%		
	P-value	0.004*	0.0001*		
ODI (%)	Pre-treatment	55.79 ±9.52	52.50 ±7.46	3.29	0.114
	Post-treatment	24.88 ±7.89	18.15 ±3.64	6.73	0.002*
	change	30.91	34.35		
	Improvement %	55.40%	65.43%		
	P-value	0.0001*	0.0001*		

Data are expressed as mean ± standard deviation (SD) P-value: probability value * Significant (P<0.05)

Discussion

The purpose of this study was to compare the effects of Strain-counterstrain (SCS) versus Muscle energy technique (MET) on pain pressure threshold (PPT), functional disability, and the innominate angle tilt in SIJ dysfunction. An intra-group analysis revealed a significant improvement in all outcome measures in both groups while in inter-group analysis, there was a significant difference in frontal innominate angle tilt value and functional disability in favor of the MET group. On other hand, there were no significant differences in pain pressure threshold and sagittal innominate angle tilt between both groups.

The finding of the present study regarding pain was in agreement with Kannabiran who investigated the effect of MET versus SCS in mechanical low back pain showing a significant improvement in pain and lumbar range of motion after 8 days of intervention, however, there was no significant difference between both groups (20). Likewise, a randomized control trial showed a significant improvement in pain in both MET and SCS in acute low back pain although the present study showed the effect of both techniques on SIJ dysfunction not on acute low back pain (38).

On the other hand, a study found that MET across piriformis, erector spinae and quadratus lumborum was more beneficial than mobilization in post-partum patients with SIJ dysfunction after 4 weeks in terms of pain and functional impairment which is in the agreement with the present study that found MET over same muscles have a substantial improvement in PPT and disability (37). Similarly, there was a significant improvement in pain and functional disability when MET was applied over erector spinae muscle combined with McKenzie therapy in 48 patients diagnosed with chronic LBP after 2 weeks of intervention (39).

A pressure algometer is considered a reliable device to measure PPT in musculoskeletal disorders to evaluate the effectiveness of different manual therapy techniques on pain intensity and has shown good inter-rater reliability with SIJ dysfunction (30). In this study, it was used to measure PPT on both sides over two points, point 1 which is related to the attachment of the gluteus maximus, and point 2 which is related to the erector spinae muscle and posterior sacroiliac ligament which is considered the most painful points in SIJ dysfunction patients. The analysis of each group revealed a significant increase of PPT on both points of the right and left sides post-treatment; however, between analysis revealed no significant difference in both points post-treatment.

This finding was supported by Dayanlr and his colleges whom found that the application of integrated neuromuscular inhibition, SCS, and MET techniques over quadratus lumborum, iliocostalis lumborum, gluteal muscle group was clinically effective in reducing PPT and pain intensity in chronic non-specific LBP after 6 weeks of intervention (2 sessions per week). On other hand, the between-group analysis revealed no significant difference in pain intensity, PPT, lumbar AROM and functional disability (40). Furthermore, SCS over iliocostalis lumborum has demonstrated a marked improvement of PTT in patients with acute non-specific LBP after 2 weeks of intervention(one session per week) and 6 weeks of follow-up (41). These results are inconsistent with a present study which has shown that both SCS and MET were effective in the improvement of PPT of SIJ dysfunction tender points.

The analgesic effect of MET was explained through gate control theory, which states that activation of mechanoreceptors of SIJ causes a decrease in corticospinal and spinal reflex activity (42). On the other hand, the SCS analgesic effect was explained via proprioceptive theory that is based on neurophysiological reset of muscle spindle activity through passively shortening the dysfunctional muscle in a specific manner that allows restoration of local circulation and removal of the metabolic waste product which enhances the myofascial mobility and force transmission through SIJ (43,44). Both SCS and MET may be are effective in reducing spindle neural activity over the target muscles of the present study which are contributing to SIJ dysfunction.

Pelvic asymmetry is a common feature of SIJ dysfunction which occurs due to muscle imbalance such as piriformis, erector spinae, quadratus lumborum, and iliacus which are attached to the sacrum and ilium leading to aberrant shearing stress over SIJ. PALM is considered a valid and reliable device to measure pelvic obliquity in both the sagittal and frontal planes.MMET was recommended for the treatment of lumbopelvic muscle imbalance, like pelvic asymmetry. The concept behind MET assumes that the technique is employed to remedy asymmetry by targeting hamstring or hip flexor contractions on the painful side of the lower back and moving the innominate in the right direction. It is crucial to note, though, that research indicates that non-symptomatic people have also been shown to possess pelvic asymmetries.

In this study, each group analysis revealed that there was a significant decrease in frontal innominate pelvic tilt angle at post-treatment compared to pre-treatment with an improvement percentage of 51.72% in the SCS group and 64.62% in the MET group. However, between groups analysis revealed that there was a significant difference (MD= 0.37; P=0.002; P<0.05) in the mean ±SD values at post-treatment in favor of MET group. Concerning sagittal innominate pelvic tilt, each group analysis revealed a significant decrease in right and left sides values at post-treatment compared to pre-treatment with improvement percentages of 10.80% and 10.18% in the SCS group and 10.67% and 13.90% in the MET group, respectively; however, in between-group analysis revealed no significant difference in the mean ±SD values of the right side and left side at post-treatment. Regarding previous results, an anterior innominate rotation was found on the affected side among the patients which were caused by spasm of the iliacus, quadratus lumborum, and erector spinea muscles. Hence, both MET and SCS techniques have a direct and indirect effect, respectively, on neural reset of muscle spasm via spinal and supraspinal loops which enhance muscle excitability and play a role in correcting of pelvic obliquity caused by SIJ dysfunction.

These results are consistent with Mohammed and their coworkers who found that MET for erector spinae, hamstring, iliopsoas, and quadratus lumborum had a significant effect in decreasing anterior pelvic tilt angle in thirty patients with chronic SIJ dysfunction after 4 weeks of intervention (45). In contrast, a randomized controlled trial has found no significant change in a sagittal innominate pelvic tilt with MET in comparison to gluteus maximus activation in 48 patients with SIJ dysfunction after 4 weeks of intervention (2 sessions per week) (46).

Several variations in the results associated with application of similar manual techniques may be attributed to either examiner skills or weight of limb or degree of pressure or resistance applied which represent inherent limitation in all manual therapy techniques.

Limitations of the study

This study has some limitations such as the lack of a control group which decreases the internal and external validity. Furthermore, long-term follow-up was needed to confirm the results of the study, and no specific populations were selected who have high-risk factors for SIJ dysfunction such as athletes.

Conclusion

Both techniques SCS and MET were clinically successful in the treatment of SIJ concerning PPT, functional disability and innominate angle tilt. However, the MET was superior to SCS in the improvement of frontal innominate angle tilt and functional disability.

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