

Original Article

Effects of muscle energy technique and core stability exercises on pain and disability in adults with sacroiliac joint dysfunction attending a private hospital in Lahore, Pakistan

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Abstract

Sacroiliac joint (SIJ) dysfunction is a common but frequently overlooked source of low back and pelvic pain, and the comparative value of the available conservative treatments remains uncertain. This study examined whether the muscle energy technique (MET) and core stability exercises reduce pain and disability in adults with SIJ dysfunction and whether the two differ. A quasiexperimental, nonrandomized, two-group design with assessments before and after treatment was used. Seventy-two adults with clinically diagnosed SIJ dysfunction were recruited from a private hospital in Lahore, Pakistan, by purposive sampling and allocated by an odd/even identifier system to the MET ($n = 36$) or core stability exercise ($n = 36$) group; both groups additionally received a baseline program of hot pack and transcutaneous electrical nerve stimulation over three weeks. Pain was measured with a visual analog scale (VAS, 0 to 10), and disability was measured with the modified Oswestry Disability Index (ODI, 0 to 100). Within-group changes were tested with paired t tests, corroborated by the Wilcoxon signed-rank test, and posttreatment scores were compared by analysis of covariance (ANCOVA) with adjustment for baseline. Both groups improved significantly: the modified ODI decreased from 70.67 to 17.00 in the MET group and from 56.00 to 17.67 in the core stability group, and the VAS score decreased from 6.54 to 3.38 and from 5.88 to 3.83, respectively (all $p < 0.001$). After adjustment for baseline, the groups did not differ in terms of disability ($p = 0.607$), whereas the MET group experienced significantly less pain than the core stability group did (adjusted VAS score 3.31 vs 3.89, $p < 0.001$). Both techniques reduced pain and disability in SIJ dysfunction; MET was superior for pain but equivalent for disability. Because allocation was nonrandom and the groups differed at baseline, adequately powered randomized trials with longer follow-up periods are needed.

Keywords

Core stability exercises; Low back pain; Muscle energy technique; Oswestry Disability Index; Physiotherapy; Sacroiliac joint dysfunction; Visual analog scale

1. Introduction

The sacroiliac joint (SIJ) transmits load between the spine and the lower limbs and is stabilized by a dense arrangement of ligaments and by the muscular and fascial connections linking the sacrum, pelvis, and trunk [1]. It is a true diarthrodial joint whose ridged articular surfaces and strong posterior ligaments favor stability over mobility, and disturbance of this finely balanced system can become a source of persistent pain [1]. Historically, the SIJ was regarded as a principal cause of low back pain until interverte-

bral disc pathology dominated clinical thought in the mid-twentieth century, but it is now recognized again as an important contributor to pain in the lower back and pelvic region [2,3]. Contemporary estimates suggest that it accounts for approximately 15 to 30% of cases of chronic, nonradicular low back pain [2].

SIJ dysfunction describes pain arising from the joint, which is typically attributed to either excessive or restricted movement and is often accompanied by muscular imbalance around the pelvis [2,4]. The pain is usually felt at the base of the spine and over the buttock and may be provoked by sitting, rising from a seat, climbing stairs, single-leg loading, or traveling in a vehicle [2]. Because its presentation overlaps with that of lumbar disc herniation, facet joint syndrome, and spinal stenosis, SIJ dysfunction is easily misattributed, and diagnosis relies on a combination of history, palpation, and a battery of provocation tests [2]. Recognized risk factors include leg-length discrepancy, altered gait, prior lumbar fusion [5], and pregnancy, the last of which alters pelvic biomechanics and commonly produces sacroiliac and pubic pain [6,7].

Among the conservative options, the muscle energy technique (MET) is a manual approach in which the patient performs a controlled voluntary muscle contraction against a precisely applied counterforce, after which the tissue is taken to a new length [8]. It is used to restore range of motion, reduce local pain, and normalize muscle function, and its benefits are thought to be mediated through neurological effects, such as reflex muscle relaxation and hypoalgesia, rather than through purely biomechanical change [9]; systematic reviews and trial evidence support its usefulness across a range of musculoskeletal complaints, including neck, shoulder, and low back pain [10,11,12]. Core stability exercise takes a different route to achieve the same goal, training the deep trunk and pelvic muscles that provide segmental control of the spine and pelvis; the rationale is that improved neuromuscular control restores support to the lumbopelvic complex and interrupts the cycle of recurrent mechanical pain [13,14,15].

Low back pain is among the leading causes of disability worldwide [16], and exercise-based rehabilitation is among the most widely recommended conservative approaches [17]; when the SIJ is the source, however, the problem is frequently overlooked, and misdiagnosis can lead to ineffective or unnecessary treatment [2]. For everyday physiotherapy practice, it therefore matters which conservative techniques are effective and whether any one of them is preferable, particularly in settings where access to advanced imaging and interventional options is limited. Despite the popularity of both approaches, evidence on their effectiveness specifically in SIJ dysfunction remains limited, and there is little guidance on how the two compare in routine practice, particularly in private-sector settings in low- and middle-income countries [4,18]. This study was therefore conducted to determine whether MET and core stability exercises reduce pain and disability in adults with SIJ dysfunction and to compare the two techniques directly.

2. Methods

This manuscript is reported in accordance with the TREND statement for nonrandomized evaluations of behavioral and public health interventions [19].

2.1. Study design

A quasiexperimental, nonrandomized, two-group study was conducted, with participants assessed at baseline and again at the end of the third week of intervention.

2.2. Setting and duration

Data were collected from a private-sector hospital in Lahore, Pakistan (Hussain Memorial Hospital), between April and August 2023.

2.3. Participants and eligibility

Adults who presented to the orthopedic, physical therapy, and outpatient departments with a clinical diagnosis of SIJ dysfunction were screened. Eligible participants were men and women aged 20 years or older with pain around the pelvic girdle. Patients were excluded if they had degenerative joint disease, a history of pelvic surgery, or trauma to the pelvic region. Written informed consent was obtained from all participants.

2.4. Sample size

The required sample size was estimated by comparing the primary pain outcome (VAS, 0 to 10) between the two independent treatment groups, using the standard formula for the difference between two independent means [20]: $n \text{ (per group)} = 2\sigma^2(Z_{\alpha/2} + Z_{\beta})^2 \div d^2$, where $Z_{\alpha/2} = 1.96$ (two-tailed $\alpha = 0.05$), $Z_{\beta} = 0.84$ (80% power), $\sigma = 1.5$ is the anticipated common standard deviation of the VAS pain score, and $d = 1.0$ is the minimum between-group difference in mean VAS considered clinically meaningful for SIJ dysfunction [21]; this threshold was set conservatively, below the minimal important change of approximately 2 points proposed by international consensus for pain in low back pain, so that the calculation would not underestimate the required sample. The assumed standard deviation was based on the VAS pain scores reported for manual therapy and exercise-based interventions in comparable SIJ dysfunction trials [22,23], and it closely matched the baseline VAS variability later observed in this sample. Substituting these values, $n = 2 \times (1.5)^2 \times (1.96 + 0.84)^2 \div (1.0)^2 = 2 \times 2.25 \times 7.84 \div 1 = 35.3$, rounded up to 36 participants per group. This estimate was cross-checked using G*Power (version 3.1.9.7) for an independent-samples t test with the same parameters [24]. No further allowance for attrition was added, as the short, closely supervised three-week protocol was expected to retain all the enrolled participants. The target enrollment was therefore 72 participants: 36 allocated to the MET group and 36 to the core stability exercise group.

2.5. Sampling and group allocation

Participants were enrolled by purposive (nonprobability) sampling. Seventy-two patients were allocated to two equal groups by a systematic, nonrandom method: each patient received an alphanumeric identifier; those with odd-numbered identifiers were assigned to Group A (MET); and those with even-numbered identifiers were assigned to Group B (core stability exercises). Because this is a systematic allocation rather than true randomization, the baseline comparability of the groups was examined explicitly and is reported below.

2.6. Interventions

Both groups received the same baseline conventional program at each visit: hot pack and transcutaneous electrical nerve stimulation (TENS) for approximately 10 minutes. Each intervention was delivered at low intensity for approximately 30 minutes per session, four sessions per week for three weeks (12 sessions in total). This dosage is consistent with the 12-session protocols commonly reported for manual therapy and stabilization exercise in patients with SIJ dysfunction [18].

2.6.1. Group A (MET)

With the patient supine and the therapist on the affected side, postisometric relaxation MET was applied to the quadratus lumborum, erector spinae, iliopsoas, and hamstrings. For each muscle, the patient produced a submaximal isometric contraction (approximately 20 to 30% of maximum) against the therapist's counterforce for 7 to 10 seconds; after relaxation, the tissue was taken gently to the new restriction barrier and held, with the sequence repeated across the session [8].

2.6.2. Group B (core stability exercises)

Patients performed a graded program of bridging, wall squats, knee-to-chest, and prone contralateral arm-and-leg raise, progressing in hold time and repetitions across the three weeks (for example, bridging progressed from a 5-second hold for 5 repetitions in week one to a 10-second hold for 10 repetitions by week three) [13].

2.7. Outcome measures

Two patient-reported outcomes were recorded at baseline and at the end of week three. Pain was assessed with a visual analog scale (VAS), a 0 to 10 scale anchored at "no pain" and "worst imaginable pain"; four dimensions were recorded (current pain, pain during activity, average pain over the preceding week, and change in pain since the start of treatment) and averaged for analysis. Disability was assessed with the modified Oswestry Disability Index (ODI), a ten-item questionnaire in which each item is scored from 0 to 5; the summed score was expressed as a percentage from 0 (no disability) to 100 (maximum disability), with higher scores indicating greater limitations [25].

2.8. Statistical analysis

The data were analyzed in SPSS version 26. Descriptive statistics were used to summarize the sample, and baseline comparability between groups was tested with independent-samples *t* tests for continuous variables and the chi-square test for categorical variables. The distribution of change scores was assessed with the Shapiro–Wilk test. Within-group changes from baseline to week three were tested with a paired *t* test for each group, with the Wilcoxon signed-rank test as a nonparametric confirmation. The two techniques were compared by analysis of covariance (ANCOVA) on posttreatment scores, with the corresponding baseline score entered as a covariate to account for baseline differences [26]; the homogeneity-of-regression-slopes assumption was checked. Statistical significance was set at $p \leq 0.05$.

2.9. Ethics

Ethical approval was obtained from the Ethics Review Committee of Hussain College of Health Sciences, Lahore, Pakistan (No. HCHS/2023/ERC/34). The study was conducted in accordance with the Declaration of Helsinki, and confidentiality was maintained throughout.

3. Results

3.1. Participant characteristics and baseline comparability

Seventy-two patients (36 in each group) were enrolled and analyzed. The mean age was 40.7 years, and 66.7% were women. Because allocation was nonrandom, baseline characteristics were compared between groups (Table 1). The groups were similar in terms of age, sex, and pain duration but differed significantly in years of education,

monthly household income, locality, baseline pain severity, and baseline disability, with the MET group being more disabled at baseline (modified ODI 70.7 vs 56.0). These imbalances were addressed in the between-group analysis by adjusting for baseline scores.

Table 1. Baseline characteristics of participants by group.

Characteristics	MET (n = 36)	Core (n = 36)	Baseline Comparison	
	Mean $\pm$ SD	Mean $\pm$ SD	t/ χ^2	p Value
Age (years)	39.5 $\pm$ 12.0	41.9 $\pm$ 14.8	-0.77	0.445
Education (years)	7.7 $\pm$ 6.6	11.5 $\pm$ 4.0	-2.97	0.004 **
Monthly household income (PKR)	58,333.3 $\pm$ 18,439.1	142,777.8 $\pm$ 154,385.6	-3.26	0.002 **
Duration of pain (weeks)	8.0 $\pm$ 4.7	6.7 $\pm$ 5.8	1.07	0.286
Female, n (%)	24 (66.7%)	24 (66.7%)	0.00	1.000
Married, n (%)	30 (83.3%)	24 (66.7%)	1.85	0.174
Urban, n (%)	12 (33.3%)	30 (83.3%)	16.51	< 0.001 **
Severity (mild/moderate/severe)	0/24/12	6/18/12	—	0.029 **
Baseline modified ODI (0 to 100)	70.7 $\pm$ 18.9	56.0 $\pm$ 28.8	2.55	0.013 **
Baseline VAS (0 to 10)	6.5 $\pm$ 1.5	5.9 $\pm$ 1.7	1.76	0.082

* Between-group comparisons were performed by independent-samples t tests (continuous) or chi-square (χ^2) tests (categorical), except for severity, for which Fisher's exact test was used because two expected cell counts were below 5; values are the mean $\pm$ SD or n (%) within each group. ** Statistically significant ($p \leq 0.05$). *** Abbreviations: MET, muscle energy technique; ODI, Oswestry Disability Index; SD, standard deviation; VAS, visual analog scale.

All participants reported SIJ pain, and attendance was complete across the 12 supervised sessions. The clinical and pain characteristics of the whole sample are summarized in Table 2. Pain was most often localized to the lower back and gluteal region and was commonly provoked by mechanical loading, such as stair climbing and prolonged sitting, and most participants reported difficulty with activities of daily living.

Table 2. Clinical and pain characteristics of the whole sample (N = 72).

Characteristics		n (%)
Pain localized to low back		60 (83.3%)
Pain in gluteal region		60 (83.3%)
Pain in thigh		24 (33.3%)
Pain worse climbing stairs		66 (91.7%)
Avoids prolonged sitting		60 (83.3%)
Onset in pregnancy/postpartum		24 (33.3%)
Aggravated by vehicle travel		60 (83.3%)
Painful single-leg standing		48 (66.7%)
Morning pain		42 (58.3%)
Radiation to lower leg		24 (33.3%)
Tingling/numbness in leg		24 (33.3%)
Absence from work		18 (25.0%)
Difficulty with activities of daily living (ADLs)		66 (91.7%)
Diagnosed systemic disease		24 (33.3%)
Psychological stress		54 (75.0%)
X-ray report available		66 (91.7%)
MRI report available		18 (25.0%)
Severity	Mild	6 (8.3%)
	Moderate	42 (58.3%)
	Severe	24 (33.3%)
Temporal pattern of pain	Intermittent	54 (75.0%)

Characteristics		n (%)
Nature of pain	Consistent	18 (25.0%)
	Aching	30 (41.7%)
	Burning	18 (25.0%)
	Cramping	18 (25.0%)
	Other	6 (8.3%)
Activity associated with pain	Sitting	6 (8.3%)
	Standing	30 (41.7%)
	Repetitive bending	36 (50.0%)
Main method of pain relief	Rest	42 (58.3%)
	Medication	24 (33.3%)
	Changing positions	6 (8.3%)

3.2. Within-group change

Both interventions were associated with large, statistically significant within-group improvements in pain and disability from baseline to week three (Table 3). Shapiro–Wilk tests indicated that the change scores were not normally distributed, so the Wilcoxon signed-rank test was used to corroborate the paired t tests; all comparisons remained highly significant. Effect sizes were large in both groups (Cohen’s $d \geq 1.3$).

Table 3. Within-group comparisons of pre- and postintervention scores.

Group	Outcome	Preintervention (A)	Postintervention (B)	Change (A-B)	<i>p</i> (Paired t)	<i>p</i> (Wilcoxon)	Cohen’s dz
		Mean ± SD	Mean ± SD				
MET	Modified ODI	70.67 ± 18.91	17.00 ± 13.39	53.67	< 0.001 ***	< 0.001 ***	2.44
MET	VAS	6.54 ± 1.47	3.38 ± 0.54	3.17	< 0.001 ***	< 0.001 ***	2.52
Core	Modified ODI	56.00 ± 28.80	17.67 ± 12.36	38.33	< 0.001 ***	< 0.001 ***	1.29
Core	VAS	5.88 ± 1.73	3.83 ± 0.38	2.04	< 0.001 ***	< 0.001 ***	1.39

* Within-group change from baseline to week 3. ** *p* (paired t test), paired-samples t test; *p* (Wilcoxon test), Wilcoxon signed-rank test (nonparametric confirmation); dz, Cohen’s *d* for paired samples. *** All improvements were statistically significant ($p \leq 0.05$). **** Abbreviations: ODI, Oswestry Disability Index (0 to 100); VAS, visual analog scale (0 to 10); MET, muscle energy technique; SD, standard deviation.

3.3. Between-group comparisons

When the two techniques were compared by ANCOVA, adjusting the posttreatment scores for baseline, the homogeneity-of-regression-slopes assumption was satisfied for both outcomes (Table 4). With respect to disability, the adjusted posttreatment modified ODI did not differ between groups ($p = 0.607$), indicating that the greater improvement in the raw score in the MET group was largely explained by its higher baseline score. With respect to pain, however, compared with core stability exercise, MET resulted in a significantly lower adjusted posttreatment VAS score (3.31 vs 3.89, $p < 0.001$), a difference that persisted after baseline adjustment. In absolute terms, this difference in pain was modest (approximately half a point on the 0 to 10 scale), with both groups ending in the mild range.

Table 4. Between-group comparisons by ANCOVA (posttreatment score adjusted for baseline).

Outcome	Adjusted MET	Adjusted Core	Adjusted Difference (MET – Core)	95% CI (Lower–Upper)	F (1,69)	p Value	Partial η^2
Modified ODI	16.51	18.15	-1.64	-7.97, 4.69	0.27	0.607	0.004
VAS	3.31	3.89	-0.58	-0.76, -0.40	42.00	< 0.001 **	0.378

* Between-group comparisons were performed by analysis of covariance (ANCOVA) on posttreatment scores adjusted for the corresponding baseline score; adjusted means were estimated at the pooled baseline mean. ** Statistically significant ($p \leq 0.05$): the groups differed in pain (VAS) but not disability (modified ODI). *** Abbreviations: CI, confidence interval; MET, muscle energy technique; ODI, Oswestry Disability Index; VAS, visual analog scale; η^2 , partial eta squared.

4. Discussion

In this quasiexperimental study, both MET and core stability exercises, each delivered alongside a baseline program of hot pack and TENS, were associated with significant reductions in pain and disability in adults with SIJ dysfunction over three weeks. When the two were compared directly with adjustment for baseline, they were equivalent for disability, but MET was significantly better for pain. This more precise picture supersedes any simple claim that one technique is uniformly superior: the advantage of MET was specific to pain and modest in absolute size, while disability improved comparably with either approach.

These findings are broadly consistent with the existing, if limited, literature. MET has previously been shown to reduce pain and disability in patients with SIJ dysfunction [18], and this is supported by systematic review evidence that MET is a safe adjunct for musculoskeletal and low back pain [10]. The improvement seen with core stability exercise likewise echoes earlier work in which strengthening of the stabilizing musculature reduced sacroiliac and nonspecific low back pain [13,27,28]. That both approaches produced clinically meaningful gains supports the broader observation that more than one exercise-based or manual strategy can help this population and that the choice may reasonably be guided by clinician skill, available equipment, and patient preference [4,18].

Direct comparisons with individual trials are complicated by differences in comparators, dosages, and outcome measures. A recent randomized trial reported additional benefits when a quadratus lumborum MET was combined with gluteus medius strengthening in SIJ dysfunction [18], whereas other recent studies, one comparing manipulation with stabilization exercise and another combining motor control training with balance training, reported comparable improvements in the same population [23,28]. The present finding of broad equivalence for disability, with a modest pain advantage for MET, sits within this emerging picture rather than contradicting it and adds a head-to-head comparison of the two techniques that the earlier single-arm or placebo-controlled studies did not provide.

Notably, these results reveal a dissociation between pain and disability outcomes. Although MET produced a statistically greater reduction in pain, the two techniques were indistinguishable for disability once the baseline difference was taken into account, and the absolute pain advantage amounted to only approximately half a point on the 0 to 10 scale. Clinically, these findings suggest that either technique can be offered with a reasonable expectation of meaningful functional recovery and that MET may be preferred when rapid pain relief is the main treatment goal. The basis of the pain advantage cannot be established from these data, but it is consistent with the proposed neurological and hypoalgesic effects of MET acting relatively quickly, whereas the functional gains from either approach may depend more on the gradual restoration of neuromuscular control that accrues similarly over the treatment period [9,10,13]. The modest absolute size of the

difference is also in keeping with broader evidence that exercise-based and conservative treatments for low back pain tend to produce real but limited average effects [17].

The sample was predominantly female (66.7%), and a substantial proportion reported the onset of symptoms during pregnancy or the postpartum period, which is consistent with the recognized link between altered pelvic biomechanics during pregnancy and sacroiliac pain [6,7]. The heavy reliance on plain radiography, the near-absence of advanced imaging, and the high burden of activity limitation and psychological stress reflect the realities of managing a largely clinical diagnosis in a resource-constrained private-sector setting and reinforce the value of low-cost conservative interventions of the kind evaluated here.

Several limitations should be borne in mind when these findings are interpreted. Allocation was systematic rather than truly random, and the groups consequently differed at baseline in terms of education, income, locality, pain severity, and disability. ANCOVA adjusts only for the baseline outcome score and cannot eliminate confounding from these other imbalances, so residual confounding cannot be excluded; the marked imbalance in locality is of particular concern because urban and rural participants were unevenly distributed between the two techniques. There was no untreated or sham comparison group, so improvement could not be fully separated from natural recovery, the coadministered conventional program, or the nonspecific effects of attention and supervised adherence. The change scores were not normally distributed, although nonparametric testing confirmed the within-group results. The follow-up period ended at three weeks, so the durability of the improvements is unknown; the outcomes were self-reported; and the participants were drawn from a single hospital in one city, limiting generalizability. Complete session attendance, while encouraging, is unusual and may reflect the close supervision of a study protocol rather than routine care. The study also has strengths: outcomes were analyzed on the full sample of 72 patients with complete data, the analysis explicitly modeled the baseline imbalance rather than ignoring it, and the within-group findings were confirmed with nonparametric testing, which lends robustness to the conclusions despite the nonrandomized design.

5. Conclusions

MET and core stability exercises, each combined with a baseline conventional program, produced statistically significant improvements in pain and disability in patients with SIJ dysfunction over three weeks. After adjustment for baseline, the two techniques were equivalent for disability, whereas MET was superior for pain, albeit with a modest absolute margin. Because allocation was nonrandom and the groups differed at baseline, these findings should be regarded as preliminary. Adequately powered randomized controlled trials with a true between-group comparison, an untreated or sham comparator, and longer-term follow-up are needed to confirm these findings and to define the optimal technique and dosage.

6. Recommendations

Future studies should use randomized allocation with concealment and a direct, baseline-adjusted comparison between techniques; add supplementary neuromuscular training to enhance muscle activation and rebalancing; extend follow-up to capture longer-term outcomes; and account for potential confounders such as sleep, stress, and physical activity. An investigation of other sacroiliac dysfunction patterns, such as upslip, downslip, and rotational dysfunctions, would broaden the applicability of the results.

Abbreviations: ADLs, Activities of daily living; ANCOVA, Analysis of covariance; CI, Confidence interval; MET, Muscle energy technique; MRI, Magnetic resonance imaging; ODI, Oswestry Disability Index; PKR, Pakistani rupees; SD, Standard deviation; SIJ, Sacroiliac joint; SPSS, Statistical Package for the Social Sciences; TENS, Transcutaneous electrical nerve stimulation; TREND, Transparent Reporting of Evaluations with Nonrandomized Designs; VAS, Visual analog scale.

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Consent to publication: Not applicable.

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