

Comparing the effect of thrust manipulation and muscle energy technique on pain and disability in patients with sacroiliac joint dysfunction

DOI: <https://doi.org/10.5114/pq.2020.100294>

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Abstract

Introduction. Sacroiliac joint pain is described as pain in and around the joint along with dull pain in lower back due to biomechanical dysfunction in the sacroiliac region. Manual therapy is a common treatment for patients with sacroiliac joint dysfunction. The purpose of this study was to examine the within- and between-group effects of high-velocity thrust manipulation and muscle energy technique in sacroiliac joint dysfunction.

Methods. Thirty patients with low back pain were randomized to receive either high-velocity thrust manipulation ($n = 15$) or muscle energy technique ($n = 15$) for 6 sessions over 2 weeks. The outcomes included the Modified Oswestry Disability Index (MODI) and Numeric Pain Rating Scale (NPRS). The paired t -test and two-way ANCOVA were used for within- and between-group analysis, respectively.

Results. A statistically significant difference was observed in baseline and post-treatment MODI and NPRS scores within the groups ($p < 0.001$). In turn, no statistically significant difference was found in baseline or post-treatment MODI and NPRS scores between the groups ($p < 0.001$).

Conclusions. The between-group effects were neither clinically nor statistically significant. The within-group effects were both significant and exceeded the reported minimal clinically important differences for the outcome tools of MODI and NPRS.

Key words: diagnostic techniques, low back pain, manipulation, osteopathic procedures

Introduction

Sacroiliac joint dysfunction (SIJD) is considered one of the possible sources of chronic mechanical low back pain (LBP) [1]. LBP is an increasingly severe condition that causes discoordination in some body parts, and it may arise because of incorrect posture during work, affecting the quality of life of the individuals [2–4]. Several factors intervene in the treatment of LBP, as most patients with the disorder are narrated to have no identifiable pathophysiological causes of pain, and specific interventions for LBP have little or no demonstrated effect [5]. But, fascial manipulation techniques are effective in chronic LBP [6]. There are various biomechanical factors like muscular imbalances, postural asymmetry, foot abnormalities, functional leg length discrepancies, sacral or iliac misalignment that could lead to the ilium positional faults that contribute to LBP in SIJD [7, 8]. There is enough literature supporting the motions occurring at the sacroiliac joint, unlike the sacroiliac dysfunction, which is still disputable and is not supported by any biomechanical studies. Hence, some patients may be prone to flares and others to shears or rotator components as a result of sacroiliac congruence and orientation. These dysfunctions may be possibly secondary to muscle imbalance, which leads to altered motion [9]. The ilium rotation dysfunction can be identified through inspection, history, palpation, and diagnosed by using motion tests. However, there is a dearth of literature that could assess the ilium range of motion because of its complex anatomical orientation [10].

SIJD can be addressed by various manual therapy approaches like high-velocity thrust manipulation (HVTM), soft tissue stretching, positional release technique, muscle energy technique (MET), counter-strain and myofascial release [11]. The interventions like mobilization and stabilization exercises have evidence of effectiveness mainly concentrating on the arthrokinematics of the pelvic girdle. MET and mobilization have been shown as an effective treatment in decreasing acute LBP in patients with SIJD [9].

HVTM is beneficial in altering the ilium and therefore reducing LBP. Manipulation is recognized as an effective means of treating and managing LBP with respect to SIJD along with the lumbar facet joint syndrome [12]. Studies have shown significant and clinically relevant improvements in SIJD with manipulation [13]. Unilateral manipulation techniques given at the sacroiliac joint are able to eradicate ilium asymmetry in all patients with signs of SIJD. The right and left ilium bones moved in equal and opposite direction and ilium symmetry was improved after HVTM [14]. MET has also shown to be an effective non-thrust manipulation technique and is utilized to correct biomechanical alterations due to muscular imbalances. Various studies have demonstrated that manipulation and mobilization bring analgesic effects. However, there is scarce literature found which implies that MET and HVTM application to ilium reduces LBP in patients with SIJD [9]. Therefore, the purpose of the present study was to evaluate the effect of HVTM and MET on LBP in patients with SIJD and also to compare the effectiveness of the 2 interventions.

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Received: 25.06.2020

Accepted: 07.09.2020

Citation: Fatima I, Goyal M, Singh G. Comparing the effect of thrust manipulation and muscle energy technique on pain and disability in patients with sacroiliac joint dysfunction. *Physiother Quart.* 2021;29(3):49–55; doi: <https://doi.org/10.5114/pq.2020.100294>.

Subjects and methods

Participants recruitment and assessment

All the patients were initially qualified from the orthopaedic outpatient department of a tertiary care hospital after screening for any lumbar pathology. The recruitment and study procedure is presented in Figure 1. The study procedures were explained to each participant. The inclusion criteria involved age of 20–40 years [15], a chief complaint of reproducible pain below L₅ and around the posterior superior iliac spine, chronic pain for the previous 3–6 months, a score of > 20% in the Modified Oswestry Disability Index (MODI), hypo-mobility in the pelvic girdle during motion testing or functional leg length discrepancy (indicated with the tape measure method) [16], and 3 positive out of 5 tests for pain provocation (compression, distraction, thigh thrust, sacral thrust, and Gaenslen’s test) [17]. A comprehensive physical therapy examination was performed to assess the sacroiliac joint, which involved joint play motion, paraspinal muscles and posterior superior iliac spine palpation, special tests (Gillet’s test, standing flexion test, supine-to-sit test, modified Schober’s test) [18, 19]. Some of the patients with history of LBP or hip fractures, dislocations, surgery, peripheral neuropathy, and nerve root entrapment were excluded. Patients were also excluded if their Numeric Pain Rating Scale (NPRS) score was < 2/10 or if the history or examination revealed any red flags, i.e. aortic aneurysm, fracture or dislocation, disc prolapse with neurologic deficit, bone tumour, bone infection, severe sacral nerve root compression, pain intolerance, space-occupying lesion. Neurological examination (reflex testing, myotomal assess-

ment, nerve tension tests) was also performed to exclude the ineligible participants.

Study design and sampling

The study was a single-blinded 2-group pretest-posttest randomized clinical trial, conducted over a 2-week period (exclusive of assessment). Sampling was performed with the purposive sampling method. The sample size was calculated by using the G*Power 3.1 software. Cohen’s *d* was used to establish the effect size and was calculated as 0.96 for MODI from a previous study [20]; the significance level was set at 0.05 with 80% power. The minimum sample size indicated with G*Power was found to be 30, randomized equally into 2 groups, with 15 participants in each group. All the assessment and intervention were conducted in the outpatient department of a recognized institute. MODI and NPRS outcomes were recorded before and after the intervention by a blinded assessor.

Randomization

A randomized sequence was generated by an independent researcher using the IBM SPSS statistical software, version 20. A total sample size of 30 was randomly allocated into 2 groups. The participants were blinded to their group allocation: numbered opaque sealed envelopes were distributed by an administrator to patients sequentially as they completed their clinical examination and assessment for outcome measures. The envelope was opened once the baseline assessment was completed.

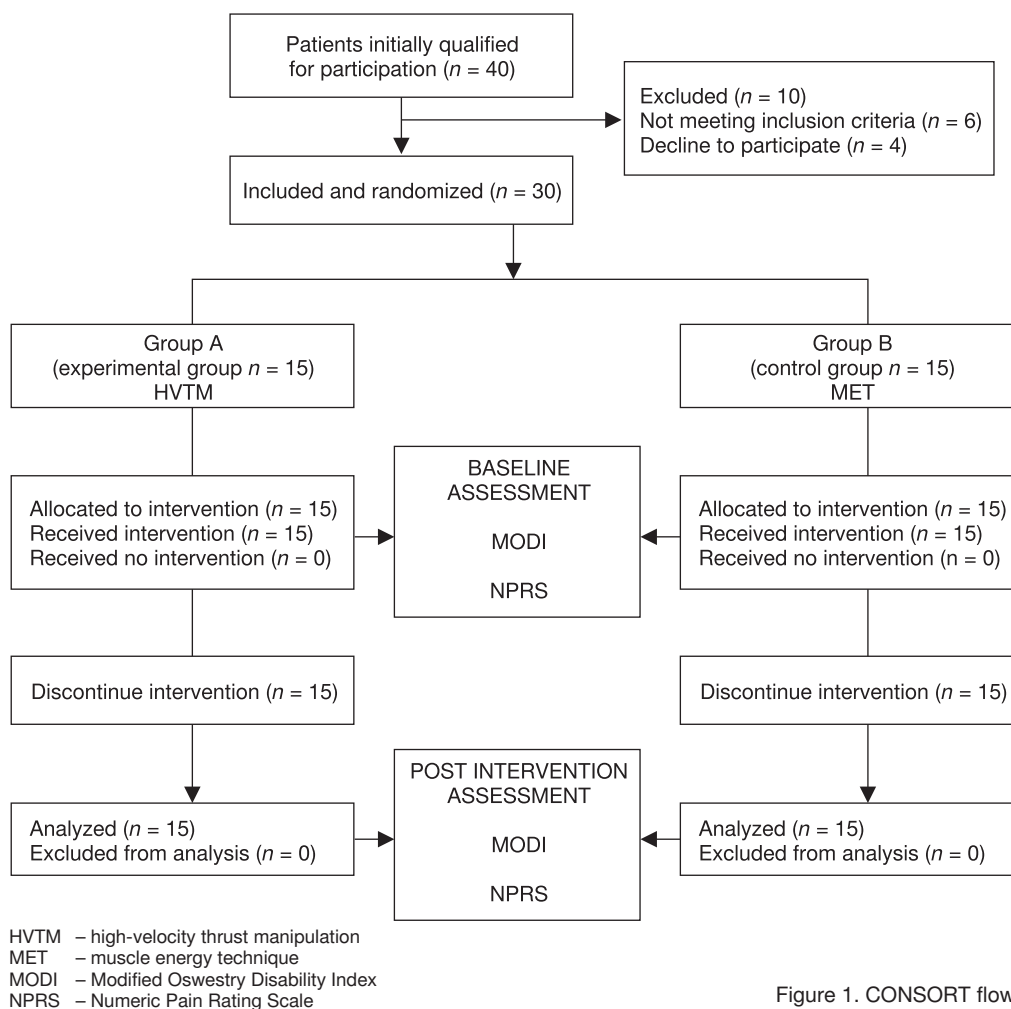


Figure 1. CONSORT flowchart of the study

Interventions

The patients in each group underwent 2-week treatment with 3 sessions in a week. The therapist identified the SIJD and targeted the correction of ilium by either HVTM or MET. The interventions were applied by a trained professional (certified in osteopathy and advance postural biomechanical spine correction). In addition to the treatment, the patients in each group also received moist heat pack for 10 minutes prior to intervention.

Detailed description of HVTM technique

HVTM for anterior ilium correction

The patient was in a supine lying position and the therapist stood at the opposite side of the involved joint. The lower extremities were crossed together, with the affected leg placed above the non-affected one. The patient was asked to hold their opposite side shoulders. The therapist passively created convexity at the side of involvement and placed one hand inferior to the anterior superior iliac spine of the involved side and the other hand on the posterior aspect of the scapula of the affected side. The upper trunk was rotated to the contralateral side of the involved joint. As the therapist reached the barrier, thrust was applied from the inferior aspect of the anterior superior iliac spine directed posteriorly, superiorly, and laterally to place the ilium at its original position [21] (Figure 2A).

HVTM for posterior ilium correction

The patient was in a side lying position, with the therapist standing in front, facing the patient. The caudal hand of the therapist grasped the anterior thigh just proximal to the knee and the hypothenar eminence of the cranial hand was used to contact the posterior superior iliac spine with the

fingers pointing towards the patient's thigh (to keep the hands off the lumbar spine). The pelvis was rotated to the front and, at the barrier, thrust was applied [22] (Figure 2B).

HVTM for upslip ilium correction

The therapist stood at the lower end of the couch and performed a tug pull grasp (placing the thumb of one hand in the third web space of the other hand) above the ankle and pulled it caudally; once a barrier was felt, thrust was applied (Figure 2C).

HVTM for downslip ilium correction

The patient was in prone lying position at the edge of the couch. The therapist stood at the side of the couch inferior to the pelvic complex. The affected side hip was taken for about 40° of flexion and 30° of abduction. The clinician supported one knee with one hand and the heel of other hand of the therapist was placed at the ischial tuberosity. Thrust was applied in the cephalic direction (Figure 2D).

HVTM for inflare ilium correction

The patient was in side lying, with the affected hip facing upwards. The therapist stood behind the patient and placed their palm on the lateral aspect of the anterior ilium. The thrust was applied in the anterior and medial direction (Figure 2E).

HVTM for outflare ilium correction

The patient was in crook lying position. The therapist stood at a side of the couch, inferior to the pelvis, placing one palm at the medial aspect of the anterior superior iliac spine of the normal side and the other palm medial to the anterior superior iliac spine of affected side. The thrust was applied in the posterior and lateral direction (Figure 2F).



Figure 2. High-velocity thrust manipulation for (A) anterior ilium correction, (B) posterior ilium correction, (C) upslip ilium correction, (D) downslip ilium correction, (E) inflare ilium correction, (F) outflare ilium correction. Arrows indicate the direction of the thrust

Detailed description of MET technique

The patients were instructed to apply 30% force against the therapist's force and hold that contraction for 10 seconds. After this, 5 seconds of rest were given while the patient exhaled [23].

MET for anterior ilium correction

The patient was in crook lying position, with the therapist standing at the involved side. The therapist placed the forearm posterior to the distal thigh. The patient was instructed to press the forearm of the therapist down (Figure 3A).

MET for posterior ilium correction

The patient was in supine lying, with the therapist standing on the ipsilateral side of the involvement. The hip was kept in 40–50° flexion, supported on a pillow. The therapist placed a hand above the knee joint and instructed the patient to flex the hip against resistance (Figure 3B).

MET for upslip ilium correction

The patient was in side lying, with the therapist standing at a side of the couch, facing the posterior aspect of the patient. The therapist placed a palm over the iliac crest with reinforcement of the other hand and pulled the ilium down till a barrier was attained. At the barrier, the patient was instructed to pull the ilium upwards against resistance (Figure 3C).

MET for inflare ilium correction

The patient was in supine lying, with the therapist standing ipsilateral to the involved side. The patient's hip was taken for abduction and external rotation until a barrier was reached. The patient was then instructed to bring the hip for adduction and internal rotation against resistance [23] (Figure 3D).

MET for outflare ilium correction

The patient was in supine lying, with the therapist standing ipsilateral to the involved side. The lower limb was taken into adduction and internal rotation until a barrier was reached. The patient was instructed to take the lower limb for abduction and external rotation against resistance [23] (Figure 3E).

Outcome measures

Modified Oswestry Disability Index

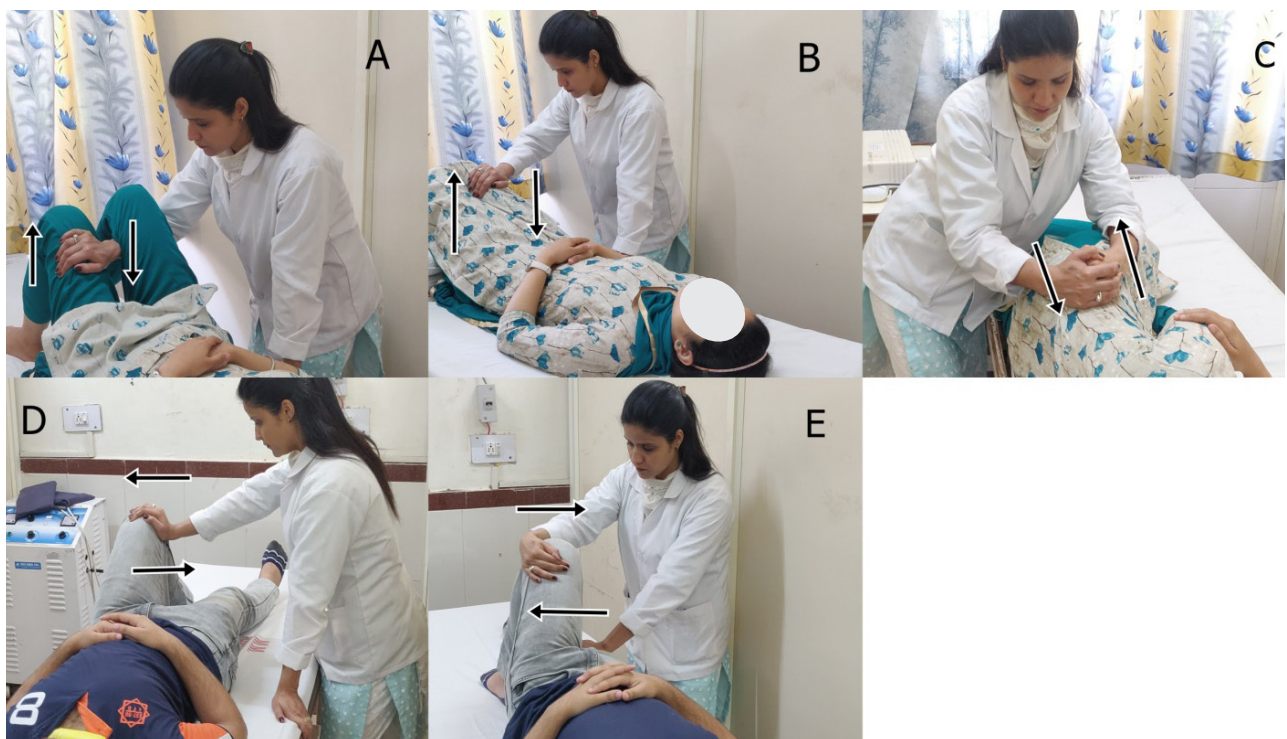
MODI has been found as a valid and reliable tool for determining disability improvement associated with manual therapy. It is widely used as an outcome in patients with non-specific LBP. MODI has been observed to be a reliable ($r: 0.94-0.99$) and valid tool for evaluating adequate responsiveness to change [20, 24]. The minimal clinically important difference (MCID) in MODI score for patients with non-specific LBP ranges from 5 to 10 points [25, 26].

Numeric Pain Rating Scale

NPRS was used as a tool for pain quantification. The patients were instructed to rate the intensity of pain on an 11-point scale (0–10), with 0 indicating no pain and 10 standing for the worst imaginable pain. Three ratings of pain were taken: current pain, best pain in 24 hours, and worst pain in 24 hours. The average value of the 3 ratings was assumed as pain intensity as determined with NPRS. According to the results of the scientific literature, a change of 1.25 points on the NPRS scale is established as MCID for patients with LBP [26, 27].

Statistical analysis

Statistical analysis was performed with the Statistical Package for the Social Sciences (SPSS), version 16 (SPSS Inc., Chicago, USA). A significance level of 0.05 was set. The



52 | Figure 3. Muscle energy technique for (A) anterior ilium correction, (B) posterior ilium correction, (C) upslip ilium correction, (D) inflare ilium correction, (E) outflare ilium correction. Arrows indicate the direction of the force applied by the therapist and by the patient

normality of data was determined by the Shapiro-Wilk test. As the data were normally distributed, parametric tests were used for data analysis. Demographic and baseline data were compared with the chi-square test and paired *t*-test for categorical and continuous variables, respectively. Categorical variables are presented as numbers and percentage, and continuous variables as mean and standard deviation. The paired *t*-test was used to compare within-group pre- and post-intervention MODI and NPRS values. Two-way analysis of covariance (ANCOVA) was applied for between-group analysis of MODI and NPRS, with pre-intervention MODI and pre-intervention NPRS as covariates.

Ethical approval

The research related to human use has complied with the National Ethical Guidelines for Biomedical and Health Research Involving Human Participants laid out by the Indian Council of Medical Research (2017), has followed the tenets of the Declaration of Helsinki, and has been approved by the authors’ Institutional Ethical Committee (Ref. No. IEC-131-G).

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

Among the patients recruited, 40% were males and 60% were females, with mean age of 30.47 ± 8.16 years and 31.93 ± 6.83 years in group A (receiving HVTM) and group B (receiving MET), respectively. The groups did not differ in baseline demographics (Table 1). A statistically significant difference was observed between baseline and post-treatment MODI and NPRS scores within both groups (*p* < 0.001) (Table 2).

For the primary outcome measure, the mean change in MODI was 17.33 in group A and 14.93 in group B; these val-

Table 3. Between-group MODI and NPRS comparison

Outcomes		Mean ± SD (95% CI)	df	F	<i>p</i> *	η _p ²
MODI	Group A	11.73 ± 3.51 (9.71–12.41)	1	0.03	0.86	0.01
	Group B	10.27 ± 3.57 (9.53–12.30)				
NPRS	Group A	2.33 ± 1.29 (1.72–2.94)	1	0.63	0.43	0.02
	Group B	2.00 ± 1.00 (1.39–2.61)				

MODI – Modified Oswestry Disability Index
NPRS – Numeric Pain Rating Scale
η_p² – partial eta squared, * *p* obtained with ANCOVA

ues are beyond MCID (8.2) in both groups [26]. When between-group analysis was performed, the result was not statistically significant for MODI (*p* = 0.86; η_p² = 0.01). For the secondary outcome measure, the mean change in NPRS was 5.60 in group A and 5.93 in group B; these values are beyond MCID (1.2) in both groups [26]. When between-group analysis was performed, the result was not statistically significant for NPRS (*p* = 0.43; η_p² = 0.02). The partial eta squared values for MODI and NPRS signified a small effect size (Table 3).

Discussion

The purpose of the present study was to compare the effects of HVTM and MET in SIJD. The study reported that both HVTM and MET were effective and resulted in a significant improvement of disability and pain perception (*p* < 0.05). No statistically significant difference was observed in the readings of NPRS and MODI between group A and group B,

Table 1. Baseline demographic characteristics of participants

Characteristics		Group A (n = 15)	Group B (n = 15)	<i>p</i> *
Age ^a		30.47 ± 8.16	31.93 ± 6.83	0.598 ^c
Gender ^b	Male	6 (40%)	6 (40%)	1.000 ^d
	Female	9 (60%)	9 (60%)	
Height ^a (m)		1.63 ± 0.11	1.66 ± 0.07	0.493 ^c
Weight ^a (kg)		62.91 ± 6.25	65.85 ± 6.951	0.968 ^c
Body mass index ^a (kg/m ²)		24.02 ± 4.41	24.075 ± 2.45	0.968 ^c

* *p* ≤ 0.05 considered as significant, ^a mean ± standard deviation, ^b n (%), ^c continuous variable (independent *t*-test), ^d categorical variable (chi-square test)

Table 2. Baseline and post-intervention MODI and NPRS scores (mean ± SD) in both groups

Groups	Outcomes	Before intervention	After intervention	Mean difference ± SD (95% CI)	<i>p</i>
A	MODI	29.07 ± 7.22	11.73 ± 3.51	17.33 ± 5.50 (14.23–20.44)	< 0.001
	NPRS	7.93 ± 1.03	2.33 ± 1.13	5.60 ± 1.45 (6.40–4.79)	< 0.001
B	MODI	25.20 ± 7.73	10.27 ± 3.57	14.93 ± 5.55	< 0.001
	NPRS	7.93 ± 1.16	2.00 ± 1.00	5.93 ± 1.39 (6.70–5.16)	< 0.001

MODI – Modified Oswestry Disability Index, NPRS – Numeric Pain Rating Scale

which indicates that none of the groups was better than the other in the improvement of functional disability and pain. The results support the null hypothesis as the effectiveness of HVTM and MET was the same in treating the patients with SIJD.

The findings of this study are similar to those obtained by Vaseghnia et al. [22], who concluded that manually assisted mechanical forces or HVTM of low amplitude and instrument delivered thrust in SIJD patients was associated with beneficial effects in reduction of pain perception and improvement of functional disability. The within-group analysis demonstrated a statistically significant improvement ($p < 0.001$) in mean NPRS and MODI in both treatment groups but no statistically significant difference was observed when comparing the manually assisted thrust manipulation. However, Patel et al. [9] suggested that manipulation in patients with ilium dysfunction resulted in a significant improvement in functional disability and pain perception, with greater changes in MODI and visual analogue scale scores when compared with MET.

The results of this study are somewhat similar to those presented in a study performed among athletes with SIJD, comparing MET and osteopathic manipulation [28]. It was concluded that MET and manipulation both demonstrated significant results in athletes with SIJD but the improvement in the MET group was seen after the initial intervention only. However, those authors indicated that osteopathic manipulation was better than MET in an athletic population, which is different from the non-athletic population of the present study. Here, the within-group analysis has shown a significant improvement in functional disability in group A and pain perception in group B. The results found in this study are supported by those of a study conducted by Childs et al. [26], in which patients with chronic LBP who received manipulation intervention experienced an immediate improvement in the symmetry of iliac crest and weight bearing. Improvements in weight bearing symmetry were related to improvements of functional disability in patients with chronic LBP. Selkow et al. [29] also observed that MET was efficient in reducing pain in patients suffering from acute LBP. The improvement can be assumed on the basis of beneficial effects of manipulation. A sudden movement following manipulation leads to mechanoreceptor desensitization, which helps remove the reflexive protective spasm of muscles and permits the joint to move again. Manipulation also allows the entrapped menisci to exit the facet joint along with an exit of a formerly lodged capsule between the 2 articular surfaces [20].

The decrease in pain can be assumed on the basis of MET neurophysiology as described by Chaitow: post-isometric relaxation results in a decrease in the tone of the agonist muscle after isometric contraction [30]. This decrease in tone occurs owing to stretch receptors (Golgi tendon organs), which react to muscle overstretching by repressing further contraction of the muscle. The (afferent) nerve impulses from Golgi tendon organs enter the spinal cord via the dorsal root and meet inhibitory motor neurons, which results in pain relief. No statistically significant difference was observed between the groups but there was a greater improvement in functional disability in group A than in group B, with a mean change in MODI of 17.33 ± 5.50 and 14.93 ± 5.55 , respectively. Also, a greater improvement in pain perception was noted in group B than in group A, with a mean change in NPRS of 5.93 ± 1.39 and 5.60 ± 1.45 , respectively.

The study was free from errors, as the threats of internal validity were eliminated: the allocation of the participants into both groups was random, and a blind observer recorded both the baseline and post-intervention data. The threats of exter-

nal validity were also reduced: strict inclusion criteria were set, and all the participants in both groups had similar baseline demographic characteristics.

Clinical implication

The results obtained in the study will enlighten the clinicians about considering the utility of diagnostic tests and use of manual therapy approaches to combat SIJD in patients presenting pain and stiffness in the sacroiliac joint region. Also, careful thorough assessment of patients with LBP could reveal mechanical SIJD, which is not often regarded as a major area of interest. This study will help practising clinicians determine specific diagnosis-based manual therapy in such patients.

Limitations

The major limitations of this study were the small sample size, lack of the patients' division into gender-based groups, and the fact that immediate effects could be due to a carry-over of the benefits from the interventions. Another limitation was that long-term follow-up was not applied after the intervention. Moreover, HVTM and MET are not necessarily limited to the impact on the sacroiliac joint but could also influence the lumbar spine, so a response to care is no guarantee of ensuring diagnostic accuracy.

Conclusions

The results of the present study evidenced that both HVTM and MET led to an improvement in SIJD patients. Hence, it is concluded that both treatments give favourable outcomes with respect to functional disability and pain.

Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

The authors state no conflict of interest.

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