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Research Paper: Effects of Muscle Energy Technique on Daily Activities and Lumbar Stiffness in Women With Sacroiliac Joint Dysfunction: A Randomized Controlled Clinical Trial Study

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ABSTRACT

Introduction: Lumbar stiffness is a common complaint of patients with low back pain. The Muscle Energy Technique (MET) is a common intervention to treat the spine and sacroiliac joint dysfunctions and their resulting disability in daily activities. This research aimed to evaluate the effects of MET on pain, functional disability, and lumbar stiffness of patients with sacroiliac joint dysfunctions by considering the type of dysfunction and the orientation of the correcting maneuver.

Materials and Methods: Fifty women with ant innominate or post innominate dysfunctions were recruited for the research and randomly divided into two groups (n=25). One group received one session of MET, and the other group received the sham position. Visual Analogue Scale (VAS), lumbar Stiffness Disability Index (SDI) and Oswestry Disability Index (ODI) were used for the evaluation of the participants before, 24 hours after and one week after the intervention.

Results: According to the results, MET significantly decreased the mean range of VAS and ODI, 24 hours, and a week after the intervention (P<0.01). We did not see any significant difference in SDI values before, 24 hours, and one week after MET in the patients (P>0.01).

Conclusion: Applying MET regarding the kind of dysfunction may reduce the patient's pain and disability.

1. Introduction

One of the prevalent complaints is low-back pain that up to 80% of people experience it at least once in their life time [1]. Researchers believe that the prevalence of sacroiliac pain would be at least 13% and at most 30% in patients with low back and

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buttock pain [2]. The high prevalence of functional disorders of this joint deserves its evaluation and research.

Sacroiliac joint dysfunction can be caused by sudden or repetitive trauma or imbalance between the muscles around the joint. A variety of methods have been used to treat sacroiliac joint dysfunctions, but most treatments have not been successful so far, and standard therapy for sacroiliac joint dysfunction has not been presented yet [3]. The Muscle Energy Technique (MET) is a common intervention to treat the spine and sacroiliac joint dysfunctions and return those joints to the correct position (realignment) [4, 5].

MET is a non-invasive, safe, and inexpensive treatment that is carried out by physical therapists for the last two decades. MET is considered a moderate and active manual therapy to correct the limited joint movements [6, 7]. In this technique, physiotherapist asks the patient to do voluntary isometric muscle contractions in the right direction with 70% intensity while the therapist exerts the counterforce to block the joint movement [8].

Disability in daily activities and lumbar stiffness are common complaints of patients with low back pain [9, 10]. One of the most common ways to determine patients' self-reported disability and stiffness expressions is the Oswestry Disability Index (ODI) and Stiffness Disability Index (SDI) [10, 11].

In previous studies, MET has been examined alone or compared with other treatments; generally, this technique is applied in patients with non-specific low back pain or sacroiliac joint dysfunctions. The researchers studied these interventions without considering the kind of dysfunctions; also, the majority of studies used a common technique to treat all sacroiliac joint dysfunctions. They have also paid less attention to restoring normal activity as a key outcome of treatment [5, 12, 13].

Therefore, we aimed to investigate the therapeutic effects of MET on the level of pain, daily activities, and stiffness of patients with sacroiliac joint dysfunction (anterior and posterior iliac innominate) by considering the type of dysfunction and direction of the corrective maneuver. The main advantage of this study is to select a group of patients with certain sacroiliac joint disorders and the implication of a specific technique for each dysfunction.

2. Materials and Methods

This study was a double-blind, randomized clinical trial. It was performed at the Physiotherapy Clinic of Rehabilitation School, the Tehran University of Medical Sciences, Tehran, Iran, in 2017. A total of 93 patients with sacroiliac joint dysfunction (anterior innominate or posterior innominate) were selected by convenience sampling method. Of them, 30 patients failed the inclusion criteria, and eight patients were excluded from the study for other reasons. In the next step, 55 patients were recruited for the study, but five patients did not continue the study one week later (because of the personal problem). Finally, 50 patients participated in the study (age ranging from 18 to 40 years with a mean age of 29.6 years). Their problem was diagnosed and confirmed by orthopedic specialist, and the researcher assessed them by the relevant tests in orthopedic clinics.

Then, the patients were randomly divided into two groups; the treatment (MET) group (n=25) received one session of MET, and the control (sham) group (n=25) was placed in sham position.

Inclusion and exclusion criteria

The included patients suffered from unilateral sacroiliac joint dysfunction (anterior innominate or posterior innominate) without radiation to the buttocks and lower extremities for more than one year (map pain is between the Posterior Superior Iliac Spine (PSIS) and gluteal fold) [14]. The patients also should have pain degree at least three by the Visual Analogue Scale (VAS) and were not under any manipulative or MET treatment within the past month.

Patients with any pathology of the back, paresthesia and numbness, motor weakness, spondylolisthesis, previous back and lower extremities surgery or fracture, rheumatoid arthritis, osteoporosis, metabolic bone disease, malignancy of lower extremities, cardiovascular or other medical disorder, and pregnancy were excluded from the study. Also, the women were asked about their monthly period times, and in those days, the intervention was not done for them.

For final inclusion of the patients in the study, these tests were carried out: Measuring the distance between the umbilicus and the Anterior Superior Iliac Spine (ASIS), iliac crest height, levelness of the Posterior Superior Iliac Spines (PSISs), levelness of the ASISs, standing flex test, Gillet test, long-sitting test, and provocation test. The researcher measured the distance between umbilicus to ASIS to exclude the patients with inflare and outflare of ilium dysfunction [15]. Because of the high reliability and validity of the provocation and long-sitting tests of ant innominate or post innomi-

nate dysfunction, the results of these two tests for diagnosis of ant innominate or post innominate dysfunction had to be positive and three tests out of five tests of iliac crest height, levelness of the PSISs, levelness of the ASISs, standing flex test, and Gillet test should be positive, too [16-18].

The participants entered the study after giving their signed consent form. All outcome measures were collected and recorded by the same examiner (Examiner 1), who was blinded to the treatment group. Examiner 2 administered the intervention to each group. Subjects were also unaware of to which group they had been allocated. The patients were randomly assigned to the control or MET group by a third person who was unknown to the Examiner 1 and 2.

We assessed the level of pain, stiffness of the back with SDI, and the patient's functional disabilities with ODI questionnaires, which have high reliability and validity [10, 11]. The patients before the intervention, 24 hours after, and one week after the intervention, answered the questions of questionnaires and their data were collected.

Muscle Energy Technique (MET)

In this research, the participating patients in group 1 received one session of MET. To correct anterior innominate rotation, we used the gluteus maximus muscle. The patient was asked to lay on her back while dangling the healthy lower extremity over the bed's edge and flexing the hip and the knee of the dysfunctional side. The examiner placed herself in front of the patient and fixed her flexed knee with her shoulder and moved the limb to the end of the range. For more stability, she held the edge of the bed on both sides and told the patient to push her knee against her shoulder with the sub-maximal isometric contraction so that the force should be 70% of the maximum force and hold it for seven to ten seconds. After the contraction, the patient relaxed, and then immediately flexed the hip again until examiner got a new barrier [8].

To correct posterior innominate rotation, the examiner used the rectus femoris muscle. The patient laid supine, and her lower extremity of the dysfunctional side dangled over the edge of the bed in such a way that the hip was extended and the knee was flexed, while the healthy hip and the knee were flexed. The examiner stood in front of the patient and put one of her hands on the anterior of the healthy knee and the other hand on the anterior supracondylar region of the dysfunctional side. The examiner pushed the supracondylar region down until she felt a barrier, and then asked the patient to push the knee upwards opposing the force of her hand with the sub-maximal isometric contraction so that the force should be 70% of the maximum strength and hold it for seven to ten seconds. After the contraction, the patient relaxed and immediately extended the hip more upwards to get a new barrier [8].

These techniques were repeated three to four times until no barrier was felt. In the end, we returned the limb to the baseline position passively [8]. It should be noted that while performing these techniques, the patient's breathing should be relaxed [8]. The control group were asked to take the sham position by lying supine on a treatment table for one minute. It is necessary to mention that the techniques were performed by a physiotherapist with ten years' experience of manual therapy, and approved and supervised by the study's supervisor.

The functional sacroiliac tests were re-checked immediately after the techniques, and if the test results were positive, the techniques would be performed on the patient again. If the tests were positive still after the re-check, the patient would be excluded from the study.

All patients received the same physical conditions during the performances such as room temperature, lighting, time, and place. The plan and the aims of the study were fully described to all the participants, and the tests began after they agreed and signed the consent form. At every level, the tests would be suspended if patients did not want to continue treatment. All the patients were confident that their data would remain strictly private and we also made the participants informed of the possible side effects of the intervention. Also, in case of any problem, we would take responsibility and compensate them as much as feasible.

All outcome measures were collected by the same examiner (Examiner 1), who was blinded to the treatment group division. The outcome evaluation tools were VAS, SDI, and ODI.

Study tools

We used Visual Analogue Scale (VAS) to measure the level of the patient's pain. The scale is a 10 cm (100 mm) line that its left end defines no pain (0), and right end indicates the worst pain or very severe pain [10]. We asked the patients to draw a vertical mark on each line indicating the level of their current pain [17].

Lumbar Stiffness Disability Index (SDI) questionnaire has ten questions, and each question assesses the stiffness of back in daily activities. Each question is scored between 0 and 4. Score 0 means the patient can do that activity with no problem. Score 1 was given when the patient does that activity with little stiffness. Score 2 was given when the patient does that activity with more stiffness. Score 3 was given when the stiffness of the patient was so intense that she does the activity with help and score 4 was given when the stiffness of patient was so much that she cannot do that activity. The resulting scores were added, and the total would be between 0 to 40 and these results multiplied by 100. This questionnaire has high validity and reliability [10].

Oswestry Low Back Pain and Disability Index (ODI) questionnaire contains ten sections, and each section asks the patient's problems in activities such as lifting objects, walking, sitting, sleeping, and so on. Each section has 6 questions that are scored from 0 to 5. Zero represents no limit to carry out the activity of the section, and five represents the maximum limit of carrying out the activity of this section. The resulting sum is multiplied by 2 to obtain the percentage of disability. The disability index of zero indicates that person is healthy and able to perform everyday activities without pain. Scores of 1 to 20 in disability index indicate minimum disability, 21 to 40 indicates moderate disability, 41 to 60 indicates high disability, 61 to 80 indicates severe disability, and 81 to 100 disability index indicates complete disability. ODI has high validity and reliability [18]. We used the Persian version of that questionnaire in our study [19].

We used SPSS V. 21 to analyze the obtained data. Repeated measurement test was used to analyze the data, and this analysis would determine any significant change in our outcomes between the groups before, 24 hours after, and one week after the treatment. The significance level was set at $P<0.05$.

3. Results

Table 1 demonstrates no significant differences in anthropometric data between the two groups (n=50). Table 2 presents the results of the repeated measurement tests to outcome measurements for two groups before, 24 hours after and one week after the intervention (from day zero to day seven after the intervention). This table indicates that some variables before the intervention, 24 hours, and a week after the intervention had a significant difference ($P<0.05$) with corresponding 95% confidence interval.

As per Figure 1, the mean change of VAS before the intervention, 24 hours, and one week after the intervention decreased significantly ($P<0.05$), and this decline continued up to one week after the intervention ($P<0.05$). However, no significant difference was seen in the control group at pretest, 24 hours, and one week after the test (Table 2).

The mean changes of SDI decreased, but this reduction was not significant 24 hours after or one week after the intervention in both groups. The within-groups P values were 0.28 and 0.76, respectively 24 hours and one week after the intervention and between-groups P value was 0.78 for both time points. This means that the lumbar stiffness felt by the patients did not change significantly at 24 hours after and one week after the intervention (Table 2).

The mean range of ODI 24 hours after and one week after MET decreased and the mean difference was significant. The within-group P value was 0.03, and between-groups P value was <0.001 (Table 2). But the mean range of ODI in the control group did not significantly change 24 hours after and one week after the intervention ($P=0.68$) (Table 2).

Figure 2 shows the mean change of the ODI range 24 hours after and one week after the intervention. This means that disability decreased and remained one week after the intervention in the MET group and the maximum decrease occurred after 24 hours.

Table 1. Anthropometric characteristic of the study participants (n=50)

Variables	Mean±SD	Range
Age (y)	29.6±5.30	18-40
Weight (kg)	61.63±13.12	42.0-91.0
Height (m)	1.64±0.05	1.56-1.78
BMI (kg/m^2)	23.68±3.73	17.41-29.63

Table 2. The alteration of all variables in the MET and sham groups

Variable	Group	Mean±SD			P	
		Before the Intervention	24 h After the Intervention	A Week After the Intervention	Within	Between
Visual analog scale	MET	7.33±1.41	5.05±1.70	3.85±1.38	0.00	0.000
	Sham	6.85±1.68	7.05±1.59	6.89±1.42	0.91	
Lumbar stiffness disability index	MET	6.33±4.61	6.43±5.25	6.51±4.50	0.28	0.78
	Sham	6.51±3.49	6.36±3.15	6.48±3.5	0.76	
Oswestry low back pain and disability index	MET	24.16±6.78	11.70±5.78	12.83±6.25	0.03	<0.001
	Sham	23.93±7.59	23.03±7.62	22.25±7.46	0.68	

MET: Muscle Energy Technique

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4. Discussion

We measured the degree of the pain, lumbar stiffness, and disability in patients with ant innominate or post innominate dysfunctions in daily activities 24 hours and one week after MET and sham position for the first time in this study. According to the results, MET could not alleviate lumbar stiffness, but this technique had assisted in relieving the level of pain and disability in daily activities.

Koch and others claimed that following any skin touch and manual therapy, the mechanical receptors of the facet joints capsule, muscle spindles, and skin would induce thick afferent fibers of Aβ due to the closure of the pain gate and preventing the central transmission of pain messages [18]. On the other hand, Zhang et al. asserted that neurophysiological mechanisms like gate control theory and supraspinal mechanisms could reduce the level of pain followed by manual therapy [20]. These theories could support the results of this study about the reduction of the level of pain by MET.

Lewit confirmed this observation too. He said that the increased tension of the affected muscles and the resulting pain and dysfunction were both relieved by restoring the full stretch length of the muscle [15, 21]. One study done by Selkow and others supports the findings of our research by concluding that manual therapy is effective in decreasing pain in patients with acute low back pain [12]. Another study by Dale et al. describes that the soft tissue manipulation and neuromuscular technique can reduce pain, muscle rigidity, and lengthen muscle fibers [22]. These could be reasons for decreasing an individual's disability in daily activities and improve function after MET.

Based on the findings of Chaitow L and DeStefano LA et al. aplying MET with emphasis on segmental muscle contraction and limited joint motion, relaxes the affected muscles by inhibition of motor activity

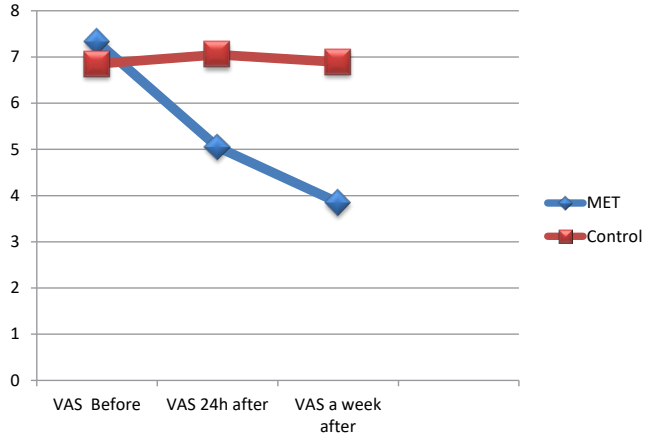

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Figure 1. Visual analog scale values before, 24 hours and one week after the intervention in the MET and sham position groups

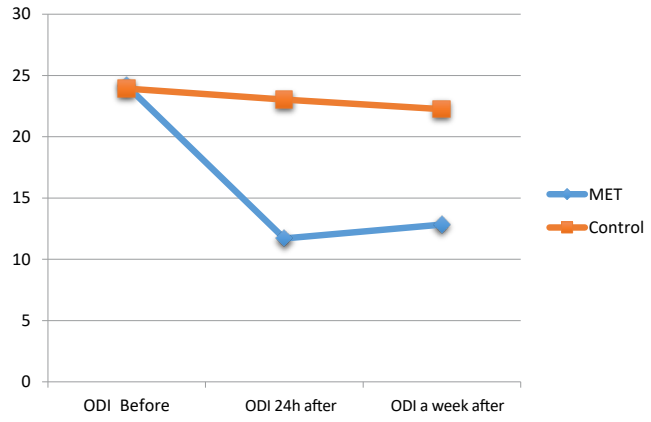

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Figure 2. Oswestry Disability Index values before, 24 hours and one week after the intervention

through the Golgi tendon organs. Following isometric contraction, Golgi tendon organs strain and stimulate the Ib afferents, which through a feedback circuit, inhibit the motor neurons of homonymous muscle and reduce muscle spasms. On the other hand, antagonist muscles are inhibited after the technique due to the phenomenon of reciprocal inhibition, and this allows an increase in the range of motion [15, 21].

Ruttenthe et al. claimed that the patient's physical functioning and level of pain improved by manual therapy in patients with low back pain. They did not consider the sub-grouping of patients and the mechanism and cause of the low back pain [23]. In our study, we tried to homogenize the patients by categorizing sacroiliac joint dysfunctions and used eight clinical tests to separate anterior innominate from posterior innominate dysfunctions. Although many studies have emphasized the increase in muscle length and range of motion after MET, we did not see any significant differences in lumbar stiffness disability after this intervention [22, 24, 25].

A possible physiologic mechanism for our finding is that MET may produce post inhibition, paraspinal muscles were inhibited and decreased the activity of α motor neurons after stimulating of inhibitory interneurons in stretching of the facet joints capsule. The shortening of muscle seems to be a self-perpetuating phenomenon that results from an over-reaction of the gamma-neuron system. It appears that the muscle is incapable of returning to a normal resting length as long as this condition exists. While the effective length of the muscle is shortened, it is still capable of reducing further [26].

One session of treatment seems to be not enough to increase muscle length, and range of motion or there are other causes for lumbar stiffness that have not been considered in this study. The heterogeneity of patients with sacroiliac joint dysfunctions has been a challenging issue, with the sub-grouping of patients declared to be one of the main objects of this research. Also, the pathokinesiological movement patterns in the sacroiliac joint have been investigated and described [8, 15, 25]. What differentiates this article from other articles is applying the MET with consideration of the kind of dysfunction (ant innominate or post innominate), and we concluded that this kind of intervention might be more efficient in improving patients' symptoms.

5. Conclusion

Muscle energy technique might be effective in decreasing the level of pain and disability index, but there are no significant differences in stiffness index after muscle energy technique 24 hours and one week after the intervention.

This study had some limitations. The low number of patients and the use of only one gender are considered as some limitations of this study. Therefore, we recommend that this study be repeated with a larger number of patients of both genders. Future studies should also assess the effects of MET and manipulation as well as other techniques on patients with other joints dysfunctions. Future studies should focus on comparing the effectiveness of treatment techniques on different dysfunctions of the sacroiliac joint and examining other functional outcomes in larger samples in both genders. Follow up of this study is short (one week after treatment). So it is suggested that future studies consider longer follow up period after the intervention.

Ethical Considerations

Compliance with ethical guidelines

The Ethics Committee of Tehran University of Medical Sciences approved. It was also registered in the Iranian Registry Clinical Trial (IRCT20171126037633N1).

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Authors contributions

All authors equally contributed in preparing this article.

Conflict of interest

The authors have no personal or financial relationships with other people or organizations that could present a potential conflict of interest in their works.

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