Volume: 3 **Issue:** 1
Year: 2022
DOI: 10.53811/ijtcmr.1023789

International Journal of Traditional and Complementary Medicine Research

Publisher
Duzce University

ORIGINAL RESEARCH

Comparing the Effectiveness of Chiropractic Manipulation and Muscle Energy Technique in Sacroiliac Joint Dysfunction Treatment

Sefa Haktan Hatik[1*], Demet Tekin[2], Korhan Baris Bayram[3]

[1]Graduate Education Institute, Bahçeşehir University, İstanbul,Türkiye
[2]Physiotherapy and Rehabilitation Department, Health Sciences Faculty, Fenerbahçe University, İstanbul, Türkiye
[3]Physical Therapy Clinic, İzmir Katip Çelebi University Atatürk Training and Research Hospital, İzmir, Türkiye

* Corresponding Author: Sefa Haktan Hatik, e-mail: haktanhtk@gmail.com

Received: 17.11.2021 Accepted: 21.02.2022

Abstract

Objective: The effects of chiropractic manipulation, muscle energy technique and home exercise program on pain, depression and functional level were compared in patients diagnosed with sacroiliac joint dysfunction (SIJD) in this study.

Material-Method: Forty-five volunteer patients aged 20-65 years who were diagnosed with SIJD participated in this study. The patients were tested through chiropractic and orthopedic examination methods, and aspects of dysfunction were detected. Patients were randomized into 3 groups: Chiropractic Manipulation Group (CM), Muscle Energy Technique Group (MET), Control Group. All groups were assigned a home exercise program. All treatment groups were evaluated with numerical pain scale (NPS), Oswestry low back pain disability questionnaire (OLBPDQ), Beck depression inventory (BDI) and algometer before and after treatment. Descriptive statistics were used in data analysis, Kruskal-Wallis tests in intergroup comparisons, Mann-Whitney U tests in pairwise comparisons, and Friedman, post-hoc Wilcoxon Rank tests were used for intragroup comparisons. The statistical significance value was set at $p<0.05$ in the study.

Results: Of the 45 volunteers who continued the study, 27 were female and 18 were male, and their mean age was 39.47±9.92 years. According to the results of intragroup analyses, a significant difference was found in all examination methods, and as a result of the intergroup analyses, there was a significant difference in all examination parameters except BDI. In the paired comparisons, positive results were obtained in all examinations in the CM and MET groups compared to the control group, in all parameters except for BDI in the analyses between CM and MET, and in examinations performed after the 4-week implementation in favor of CM ($p<0.05$).

Conclusion: In patients with SIJD, CM performed in addition to exercises was found to be more effective than MET and exercise alone.

Keywords: Chiropractic, Muscle Energy Technique, Exercise, Sacroiliac, Dysfunction

INTRODUCTION

Sacroiliac joint dysfunction (SIJD) can be seen in 15-25% of patients with low back pain and in 75% of individuals with lumbar disc herniation. The prevalence of SIJD ranges from 13.8% to 47.9% in the general population [1,2,3]. A dysfunction occurs due to the absence of any pathology in the sacroiliac joint and a biomechanical disorder in the load distribution transferred by the joint to the lower extremity. As a result of this dysfunction, low back and hip pain is frequently observed [4].

According to the guide published by the World Health Organization, chiropractic is an area of specialization that provides the diagnosis, treatment and prevention of diseases of the neuromusculoskeletal system, adjusts the pathological joint biomechanics on the normal joint that is not dislocated or fractured, and applies manual techniques that fall under this field. There are approximately 200 techniques and methods in chiropractic that are similar to or slightly different from each other. Commonly used methods: Methods such as diversified technique, activator method, Cox flexion/extension method, Thompson Drop table method are used [5].

In the study Zelle et al. conducted, chiropractic manipulation (CM) was applied 3 times a week for

2 weeks in volunteers with SIJD. Improvement was observed in most of the patients in the joint movement, pain and Oswestry rating scale [6].

Muscle energy techniques (METs) evolved in osteopathic medicine based on a variety of sources, including the pioneering work of TJ Ruddy (1961). Ruddy's approach (rapid resistive duction) was described as a "muscular energy technique". The core concepts of MET involve using the intrinsic strength of the muscles to achieve a variety of effects that include isometric and isotonic contraction variations. Reducing the tone of the agonist muscle after isometric contraction can also be defined as a form of mobilization of the soft tissue or joint. This technique is accepted as a manual therapy technique [7,8,9]. Kanchan et al. concluded that METs are moderately effective in the treatment of SIJD compared to the Maitland mobilization technique [10].

In general, the treatment of SIJD includes such treatment methods as CM, MET, exercise programs, mobilization methods and conventional therapies. However, the number of studies comparing the efficacy of these treatment methods and the level of evidence are limited. In addition, CM and MET methods have not been compared before in the literature. Therefore, the aim of our study is to compare the effects of CM and MET applied in addition to home exercise program on pain, depression and functional level in patients diagnosed with SIJD.

MATERIALS AND METHODS

This study is a randomized controlled study with three parallel groups. Diagnosed with SIJD, 45 volunteer patients aged between 20-65 who applied to İzmir Katip Çelebi University (İKÇU) Atatürk Training and Research Hospital Physical Therapy Outpatient Clinic participated in the study. Inclusion criteria for the study: Being between the ages of 20-65; having acute pain; having a score of 4 and above on the numerical pain scale (NPS); having a diagnosis of SIJD; volunteering to participate in the study. Non-inclusion criteria: Pregnancy; chronic progressive systemic diseases; malignancy and infectious diseases; history of spinal surgery; severe physical and psychological disorders; congenital hip dislocation; orthopedic and neurological deficits of the lower extremity; inflammatory rheumatological diseases; inflammatory sacroiliitis; surgery, injection, and other similar treatments on the sacroiliac joint in the last 3 months. Exclusion criteria: Unwillingness to continue the study, application of a treatment outside the study protocol, acute fractures of the spine and lower extremity, and becoming pregnant during the study.

Research procedure

In the literature, there are many studies on the effectiveness of CM, which have been performed bidirectionally as well as unidirectionally. In our study, a bidirectional study protocol was adopted and equality in the numbers of patients diagnosed with right or left SIJD was achieved in all groups. Patients diagnosed with SIJD were tested with chiropractic and orthopedic examination methods, and aspects of dysfunction were detected. Then, the volunteer patients were randomly divided into 3 groups as Chiropractic Manipulation group (CM, n: 15; 9 females, 6 males), Muscle Energy Technique group (MET, n: 15; 9 females, 6 males) and Control group (CG, n:15; 9 females, 6 males). After the groups were assigned, the hours and schedules of the procedures related to the treatment and examination of the patients were determined. Homogeneity was evaluated by analyzing the demographic data of the individuals participating in this study. The study, which had initially been designed with 51 people, was completed with 45 people after 6 people were excluded because they did not meet the specified criteria. Applications and examinations were performed by a physiotherapist with 2 years of experience and a master's degree, and a specialist physician who attended the courses.

In order to determine the sample size of the study, power analysis was performed using the G*Power (v3.1.9.2) program. The power of the study was found to be 1-β (β = probability of type II error). In the calculation performed to obtain 95% power at the α=0.05 level based on the pain (VAS), mean, and standard deviation values in Kamali and Shokri's (2012) study (initial value in patients with SIJD in whom high-velocity low-amplitude manipulation technique was applied: 41.56±21.03 / that after 1 month: 9.00±12.27), the effect size (d) was found to be 1.779. In the same study, the effect size (d) was found to be 1.866 in the calculation made to obtain 95% power at the α=0.05 level based on the changes in the scores of the Oswestry Low Back Pain Disability Questionnaire (OLBPDQ) (initial score: 24.58±8.83 / that after 1 month: 8.62±8.24) in the patient group with SIJD [29.] Accordingly, it was determined that there should be at least 6 people in each group. The study was planned on a total of 45 patients, 15 participants for

each group. In the home exercise program, it was aimed to provide mobility in the sacroiliac joint, pelvic stabilization, strengthening of the low back and hip muscles, and stretching of the shortened muscles. The exercises were explained to the patient in detail, and they were asked to perform at least 10 repetitions, 3 times a day every day [30].

CM was performed with the diversified technique in the side lying position. By evaluating the patient's leg length, high-velocity low-amplitude CM was applied to the sacroiliac joint in the anterior superior or posterior inferior direction [31].

MET, on the other hand, was performed with 10 repetitions in the supine and prone positions using long and short lever arms [32].

Only ergonomic adjustments and home exercise program were assigned to the control group. In the CM group, in addition to ergonomic adjustments and home exercise program, CM was applied twice for 4 weeks. In the MET group, in addition to ergonomic adjustments and home exercise program, MET was applied twice for 4 weeks. Examinations were performed using NPS, Beck Depression Inventory (BDI), OLBPDQ and Baseline 30 algometer (dolorimeter) device before the treatment and at the second and fourth weeks after the treatment.

Chiropractic manipulation

Diverse field chiropractic technique was used in our study. CM was performed 2 times a week for 4 weeks.

After evaluating the patient with the Derifield Leg Check test, the chiropractic manipulation direction and contact point were selected according to the position of the sacroiliac joint. The patient was asked to tie his arms while he was in the side lying position. Pushing maneuver was performed with HVLA from posterior to anterior and from medial to lateral with pelvic rotation. The contact point of the sacroiliac joint was PSIS.

Muscular energy technique

In muscle energy technique, it was used in combination with 4 different techniques: long and short leverage, distraction, and combined isometric method. MET was performed 2 times a week for 4 weeks. During each application, the patient's isometric contraction of 3-5 seconds was provided and repeated 10 times. In the long and short lever, distraction technique, the patient is in the supine position and the practitioner is on the dysfunction side. In the combined isometric technique, the patient is in the prone position and the practitioner is on the dysfunction side.

Ergonomic arrangements and home exercise program

Ergonomic arrangements were given to all patient groups in the form of a form and explained in detail. It was aimed to reduce such problems to a great extent by giving training on the correct use of movements that are repeated many times in daily life.

All exercises were requested to be performed for both lower extremities. Theraband in green color was recommended for exercises performed with resistance. A program that combined lumbar region muscle strengthening, back extensors stretching, hip flexors and extensors stretching, hip flexors and extensors strengthening, bridge exercise was applied. It was requested that the exercise program be performed every day, 3 times a day, at least 10 repetitions.

Primary outcome measures

The diagnosis and differentiation of SIJD as the primary outcome measure was evaluated with 7 orthopedic tests consisting of Gillet [33], Standing Flexion [33], Prone Extension [34], Compression [35], Gaenslen [35], Yeoman's [33] and Faber [35]. Diversified leg check was used to determine the method of CM [36].

Numerical pain scale (NPS)

The NPS is an 11-point rating scale ranging between 0-10, with the phrase “no pain” on the far left and “worst pain imaginable” on the far right. The current, best and worst pain levels of the patients in the last 24 hours are evaluated [37].

Oswestry low back pain disability questionnaire (OLBPDQ)

The OLBPDQ has become one of the condition-specific outcome measures used in the treatment of spinal disorders [40]. It is a self-administered questionnaire divided into ten sections designed to assess the limitations of various activities of daily living. Each section is scored between 0-5 and a score greater than 5 represents a disability. The questionnaire is calculated by dividing the total score by the total possible score, which is then multiplied by 100 and expressed as a percentage. Thus, the denominator is reduced by 5 for each unanswered question. If a patient ticks more than one statement in a question, the one with the highest score is recorded as a true disability indicator [41].

Pressure pain threshold measurement (PPT)

Pressure pain threshold measurement is an objective tool used to measure pain sensitivity. The

Volume: 3 **Issue:** 1
Year: 2022
DOI: 10.53811/ijtcmr.1023789

International Journal of Traditional and Complementary Medicine Research

Publisher
Duzce University

instrument designed for this purpose is called the algometer. While the patient is in the prone position, the therapist applies an axial force to assess the tenderness of the Posterior Superior Iliac Spine (PSIS) as a whole, placing the probe of the algometer 1 cm below the PSIS. Patients are asked to report the first pain they perceive when force is applied to them. This procedure was repeated three times with 1-minute intervals between each trial, and the mean was considered the final score. Force measurements were recorded in kilograms [38].

Secondary outcome measures

Beck depression inventory (BDI)

The BDI is a 21-item self-report questionnaire aiming to assess the severity of depression in normal and psychiatric populations. It was developed by Beck et al. in 1961. It is based on the theory of negative cognitive distortions that are central to depression [39.] Simple random sampling method was used for patients. To this end, the sampling module on the computers was used. In addition, attention was paid to the distribution of patients into the groups based on their gender.

Permissions

The study was designed in accordance with the Declaration of Helsinki, and approval was obtained from the Izmir Katip Çelebi University Faculty of Medicine Clinical Research Ethics Committee on 17.05.2018. Photos were shot following the approval of the participants, and permissions were obtained for the photos to be shared.

Statistical analysis

BDI, NPS, OLBPDQ and algometer measurements were performed before the treatment, 2 weeks and 4 weeks after the treatment of the groups, which were divided into CM group, MET group and control group. It was examined whether these examinations differed both by time within the group and at different times between the groups.

Kruskal-Wallis test was used for intergroup comparisons, Mann-Whitney U test for pairwise comparisons, Friedman test for intragroup comparisons, and Wilcoxon Rank test was used for paired comparisons. SPSS 25.0 package program (SPSS Inc., Chicago, IL) was used to evaluate the data within the scope of the study. The statistical significance value was set at $p<0.05$ in the study.

RESULTS

There was no statistically significant difference between the groups in terms of age (p=0.108), height (p=0.117), body weight (p=0.147), body mass index (p=0.646) (p>0.05) (Table 1).

Table 1. Demographic characteristics of patients

Parametreler	Mean ± SD (Min-Max)			Kruskal Wallis H value	df	P value
	CM (n:15)	MET (n:15)	CG (n:15)			
Age (years)	39.47±9.92 (23-56)	35.07±10.06 (19-51)	43.4±10.76 (22-57)	4.46	2	0.108
Height (cm)	168.73±7.61 (158-182)	169.07±10.24 (155-191)	174.33±7.35 (157-187)	4.30	2	0.117
Body weight (kg)	68.4±15.62 (47-96)	69.73±12.59 (49-92)	76±7.48 (59-85)	3.84	2	0.147
Body mass index (kg/m^2)	23.77±3.94 (17.9-29.3)	24.2±2.72 (19.6-29.8)	25.09±3.14 (20.9-31.6)	0.87	2	0.646
Gender (Female/Male) (n)	9/6	9/6	9/6			

*p<0.05; **p<0.01; ***p<0.001* CM: Chiropractic Manipulation, MET: Muscle energy techniques, CG: Control Group

In order to understand whether the treatment results differed according to the measurements carried out at different times within the groups, comparisons were performed within the 3 groups.

There were statistically significant differences between NPS and OLBPDQ in the CM group according to different times (p<0.001). In terms of both parameters, there are statistically significant differences in the combinations between the first measurements, the second measurements performed after the treatment, and the third measurements. NPS scores decreased significantly while OLBPDQ scores increased significantly (Table 2). When the BDI scores of the CM group were examined at different times, there was a statistically significant difference (p<0.001). Statistically significant differences were observed in the scale scores between the combinations of the first measurements, the second measurements performed after the treatment, and the third measurements (p<0.01). The scale scores decreased significantly (Table 2).

Volume: 3 **Issue:** 1
Year: 2022
DOI: 10.53811/ijtcmr.1023789

International Journal of Traditional and Complementary Medicine Research

Publisher
Duzce University

Table 2. Within-group comparisons

Parameters		Mean ± SD (Min-Max) 1.Test	2.Test	3.Test	Chi-Square Value	df	P value	Differences Between Groups
CM	NPS	7.67±0.9 (6-9)	4.2±1.57 (2-8)	1.6±1.06 (0-4)	29.53	2	<0.001***	1.Test>2.Test*** 2.Test>3.Test*** 1.Test>3.Test***
	PPT	4.87±1.4 (3-7.5)	7.43±2.1 (4-14.5)	9.83±2.77 (7.5-18.5)	30.00	2	<0.001***	1.Test<2.Test*** 2.Test<3.Test*** 1.Test<3.Test***
	BDI	26.07±18.3 (4-51)	17.67±13.15 (1-37)	8.93±7.51 (0-26)	19.75	2	<0.001***	1.Test>2.Test** 2.Test>3.Test** 1.Test>3.Test**
	OLBPDQ	46.8±20.04 (22-82)	25.6±14.99 (6-50)	11.33±8.71 (0-28)	21.66	2	<0.001***	1.Test>2.Test** 2.Test>3.Test** 1.Test>3.Test***
MET	NPS	7.4±1.24 (5-10)	4.8±1.15 (3-7)	3±0.65 (2-4)	28.53	2	<0.001***	1.Test>2.Test*** 2.Test>3.Test** 1.Test>3.Test***
	PPT	5.6±2.21 (3.5-13)	7±1.98 (5-13.5)	8.4±2.05 (6.5-15)	29.53	2	<0.001***	1.Test<2.Test*** 2.Test<3.Test*** 1.Test<3. Test***
	BDI	27.87±17.11 (4-47)	21.13±13.82 (2-37)	15.27±10.97 (0-32	29.53	2	<0.001***	1.Test>2.Test*** 2.Test>3.Test*** 1.Test>3.Test***
	OLBPDQ	51.87±24.64 (16-86)	36.27±17.14 (14-68)	24.27±13.37 (4-46)	28.13	2	<0.001***	1.Test>2.Test*** 2.Test>3.Test*** 1.Test>3.Test***
CG	NPS	8±0.93 (7-9)	6.73±1.1 (5-9)	5.8±1.08 (4-8)	26.12	2	<0.001***	1.Test>2.Test** 2.Test>3.Test** 1.Test>3.Test***
	PPT	3.37±1.01 (2-5)	4.1±0.81 (2.5-5)	4.43±0.88 (3-5.5)	23.53	2	<0.001***	1.Test<2.Test** 2.Test<3.Test** 1.Test<3.Test***
	BDI	41.6±8.76 (23-54)	35.53±9.84 (18-53)	28.67±9.88 (11-42)	30.00	2	<0.001***	1.Test>2.Test*** 2.Test>3.Test*** 1.Test>3.Test***
	OLBPDQ	62.73±19.45 (32-88)	52.53±17.49 (24-80)	44.67±18.14 (14-76)	30.00	2	<0.001***	1.Test>2. Test*** 2.Test>3. Test*** 1.Test>3. Test***

*p<0.05; **p<0.01; ***p<0.001* CM: : Chiropractic Manipulation, MET: Muscle energy techniques, CG: Control Group, NPS: Numerical Pain Scale, PPT: Pressure Pain Threshold, BDI: Beck Depression Inventory, OLBPDQ: Oswestry Low Back Pain Disability Questionnaire

OLBPDQ scores displayed a statistically significant difference according to time (p<0.001). Statistically significant differences were observed in the scale scores between the combinations of the first measurements, the second measurements performed after the treatment, and the third measurements (p<0.01; p<0.001). The scale scores decreased significantly (Table 2).

Statistically significant differences were found between the NPS and OLBPDQ scores in the MET group according to different times (p<0.001). Statistically significant differences were observed in both parameters between the combinations of the first measurements, the second measurements performed after the treatment, and the third measurements (p<0.01; p<0.001). NPS scores decreased significantly while OLBPDQ scores increased significantly (Table 2).

The BDI scores of the MET group showed a statistically significant difference according to different times (p<0.001). Statistically significant differences were observed in the scale scores between the combinations of the first measurements, the second measurements performed after the treatment, and the third measurements (p<0.001). The scale scores decreased significantly (Table 2).

The OLBPDQ scores of the MET group displayed a statistically significant difference according to time (p<0.001). Statistically significant differences were

observed in the scale scores between the combinations of the first measurements, the second measurements performed after the treatment, and the third measurements ($p<0.01$). The scale scores decreased significantly (Table 2).

Statistically significant differences were found between the NPS and OLBPDQ scores of CG according to different times ($p<0.001$). In terms of both parameters, there were statistically significant differences in the combinations between the first measurements, the second measurements following the treatment, and the third measurements ($p<0.01$; $p<0.001$). The NPS scores decreased significantly, while OLBPDQ parameters increased significantly (Table 2).

The BDI scores of CG showed a statistically significant difference according to different times ($p<0.001$). Statistically significant differences were observed in the scale scores between the combinations of the first measurements, the second measurements performed after the treatment, and the third measurements ($p<0.01$). The scale scores decreased significantly (Table 2).

In CG, the OLBPDQ scores indicated a statistically significant difference according to time ($p<0.001$). Statistically significant differences were observed in the scale scores between the combinations of the first measurements, the second measurements performed after the treatment, and the third measurements ($p<0.01$). The scale scores decreased significantly (Table 2).

In order to understand whether the measurement parameters differed according to the groups, tests in which the 3 groups were compared together were performed.

There was no statistically significant difference between the groups in terms of the first NPS measurement ($p>0.05$). However, significant differences were observed in terms of the second and third measurements ($p<0.001$). In the second measurement, the NPS scores in CG were statistically significantly higher than those in the CM and MET groups ($p<0.001$). In the third measurement, the NPS score in CG was statistically significantly higher than those in the CM and MET groups, and the NPS score in the MET group was statistically significantly higher than that in the CM group ($p<0.001$) (Table 3).

There were statistically significant differences between the groups in terms of the first, second and third measurements of the OLBPDQ parameter ($p<0.001$). The treatment groups were statistically significantly higher than the CG in the first and second measurements, ($p<0.01$; $p<0.001$). In the third measurement, the treatment groups were statistically significantly higher than CG ($p<0.001$), and the score of the CM group was statistically significantly higher than that of the MET group ($p<0.05$) (Table 3).

There were statistically significant differences between the groups in terms of the first, second and third measurements of the BDI score ($p<0.05$; $p<0.001$). In all measurements, the scores of CG were statistically significantly higher than the scores of CM and MET groups ($p<0.05$; $p<0.01$; $p<0.001$) (Table 3).

There was no statistically significant difference between the groups in terms of the first measurement of OLBPDQ score ($p>0.05$). There were significant differences in terms of the 2nd and 3rd measurements ($p<0.001$). In the second measurement, the OLBPDQ score of the CG was statistically significantly higher than the CM and MET groups ($p<0.05$; $p<0.001$). In the third measurement, both the OLBPDQ score of the CG was statistically significantly higher than the CM and MET groups, and the OLBPDQ score of the MET group was statistically significantly higher than the CM group ($p<0.01$) (Table 3).

DISCUSSION

In this study, the effectiveness of CM and MET methods applied for 4 weeks in patients diagnosed with SIJD were compared. The diagnosed patients were randomly selected and divided into three groups, namely CM, MET and CG. Ergonomic arrangements and home exercise program were assigned to all groups.

In a case study conducted by Boyle et al., an acceptable improvement was observed in the NPS and OLBPDQ scores when an exercise program was applied to a 65-year-old female patient diagnosed with SIJD [11]. The study Jeong-Hyun et al. conducted showed that functional training and mobilization increased static stability and reduced pain in 20-year-old university students with SIJD [12]. In our study, similar treatment and test methods were used, and the age range was similar, which was determined to be 20 to 65 years.

Volume: 3 **Issue:** 1
Year: 2022
DOI: 10.53811/ijtcmr.1023789

International Journal of Traditional and Complementary Medicine Research

Publisher
Duzce University

Tablo 3. Decoupling between groups

Parameters		Mean. ± SD (Min-Max)			Kruskal Wallis H value	df	P value	Differences Between Groups
		CM (n=15)	MET (n=15)	CG (n=15)				
NPS	1.TEST	7.67±0.9 (6-9)	7.4±1.24 (5-10)	8±0.93 (7-9)	2.25	2	0.325	
	2.TEST	4.2±1.57 (2-8)	4.8±1.15 (3-7)	6.73±1.1 (5-9)	19.81	2	<0.001***	CG>CM*** CG>MET***
	3.TEST	1.6±1.06 (0-4)	3±0.65 (2-4)	5.8±1.08 (4-8)	35.02	2	<0.001***	MET>CM*** CG>CM*** CG>MET***
PPT	1.TEST	4.87±1.34 (3-7.5)	5.6±2.21 (3.5-13)	3.37±1.01 (2-5)	16.49	2	<0.001***	CM>CG** MET>CG***
	2.TEST	7.43±2.51 (4-14.5)	7±1.98 (5-13.5)	4.1±0.81 (2.5-5)	25.97	2	<0.001***	CM>CG*** MET>CG***
	3.TEST	9.83±2.77 (7.5-18.5)	8.4±2.05 (6.5-15)	4.43±0.88 (3-5.5)	31.54	2	<0.001***	CM> MET* CM>CG*** MET>CG***
BDI	1.TEST	26.07±18.3 (4-51)	27.87±17.11 (4-47)	41.6±8.76 (23-54)	6.10	2	<0.001***	CG>CM* CG>MET*
	2.TEST	17.67±13.15 (1-37)	21.13±13.82 (2-37)	35.53±9.84 (18-53)	13.95	2	<0.001***	CG>CM*** CG>CET**
	3.TEST	8.93±7.51 (0-26)	15.27±10.97 (0-32)	28.67±9.88 (11-42)	18.57	2	<0.001***	CG>CM*** CG>MET**
OLBPDQ	1.TEST	46.8±20.04 (22-82)	51.87±24.64 (16-86)	62.73±19.45 (32-88)	4.35	2	0.113	
	2.TEST	25.6±14.99 (6-50)	36.27±17.14 (14-68)	52.53±17.49 (24-80)	14.6	2	<0.001***	CG>CM*** CG>MET*
	3.TEST	11.33±8.71 (0-28)	24.27±13.37 (4-46)	44.67±18.14 (14-76)	22.01	2	<0.001***	MET>CM** CG>CM*** CG>MET**

*p<0.05; **p<0.01; ***p<0.001* CM: : Chiropractic Manipulation, MET: Muscle energy techniques, CG: Control Group, NPS: Numerical Pain Scale, PPT: Pressure Pain Threshold, BDI: Beck Depression Inventory, OLBPDQ: Oswestry Low Back Pain Disability Questionnaire

The study by Walker et al. showed that CM is effective in pain and dysfunction in the lower back and hip [13]. In their study conducted with 30 volunteers, Childs et al. reported significant changes in NPS and OLBPDQ scores as a result of CM in patients with acute and chronic low back pain and asymmetry in the pelvis region [14]. Zelle et al. applied CM 3 times a week for 2 weeks in 11 volunteers with SIJD in their study. Most patients showed improvement in joint motion, pain, and the Oswestry rating scale [6]. Suter et al. revealed that sacroiliac joint manipulation led to a decrease in lower extremity muscle inhibition in patients with SIJD and knee complaints [15]. Similarly, positive effects were obtained in our study in terms of NPS, PPT, OLBPDQ and BDI scores in the study group, where CM was performed twice a week for 4 weeks in addition to ergonomic arrangements and home exercise program. These results are in accordance with the literature.

Heinzman concluded that MET could be an effective treatment for acute injuries and sports injuries, chronic pain, hypertonicity and muscle spasms [16]. Kanchan et al. concluded that METs are moderately effective in the treatment of SIJD compared to the Maitland mobilization technique. The results of the study showed that MET combined with active exercises was moderately significant in improving functional ability compared to Maitland mobilization technique [10]. A moderate improvement was observed in our study in the NPS, PPT, OLBPDQ and BDI scores in the group in which MET was applied twice for 4 weeks in addition to ergonomic adjustments and home exercise program, compared to CM. This result is similar to the results of Kanchan et al.

Sai Kumar et al. concluded that the exercise applied to the adductor muscle groups together with traditional exercise for 2 weeks had a positive effect on the improvement of pain and functional status in patients with SIJD [17]. In the study by Added et al., an exercise program aimed at the gluteus maximus

muscle was applied in patients with SIJD. There was a decrease in pain, and all subjects were discharged from physical therapy and were able to return to their normal daily activities [18]. Michael et al. carried out a study examining the effects of postural exercises on sacroiliac joint pain and found a significant improvement in pain [19]. In our study, exercises aimed at stretching and strengthening the muscles especially in the low back and hip regions were applied to patients with SIJD. In the analyzes performed at the end of four weeks, positive results in terms of NPS, PPT, OLBPDQ and BDI scores were revealed in CG, which is consistent with the literature.

The review Al Subahi et al. conducted revealed that manipulation is the most effective and common approach in reducing pain and problems associated with SIJD, and it is used in physical therapy clinics. They showed that manipulation is more effective than other treatment approaches in the treatment of pain and pelvic asymmetry in SIJD [20]. In the literature review we conducted, we observed that CM and MET had not been compared before. When we compared CM and MET in our study, our results were in favor of CM in terms of NPS, OLBPDQ and PPT scores. In the study Barbosa et al. conducted, pain reduction and functional improvement were reported in patients with SIJD when spinal manipulation and isotonic exercise program were used, and they found that spinal manipulation method was more successful than exercise program [21]. Similar to the study by Barbosa et al., positive results were obtained even in terms of NPS, PPT, OLBPDQ and BDI scores compared to the group in which only ergonomic adjustments and home exercise program of CM were applied. Fernandez et al. studied the effects on psychological, analgesic and segmental inhibitory mechanisms after spinal manipulation [22]. As in the study by Fernandez et al., better results were obtained compared to the other treatment groups.

Giles et al. concluded that there is a strong correlation between leg length disparity and low back pain lasting at least 3 months. The study revealed that this significant leg disparity could be corrected and it was improved nearly back to normal in people who underwent MET compared to those who received conventional therapy [23]. In the study by Mathew et al., MET and mobilization techniques were compared with the conventional therapy method. MET and mobilization techniques were shown to be more successful than conventional therapy in NPS and modified Oswestry low back pain disability scores [24]. It was found in our study that MET which was applied in addition to ergonomic regulations and home exercise program helped obtain better results in terms of NPS, PPT, OLBPDQ scores compared to the group that only did exercises, and this finding is in accordance with the literature.

In the study by Robertson et al., it was found that low back pain experienced by more than 50% of the subjects was significantly associated with both depression and somatization [25]. In the study Kennedy et al. conducted with 973 university students, it was shown that psychological factors are directly related to the prevalence of low back pain [26]. Similarly, in their study on 250 university students, Ünalan et al. revealed the relationship between back pain and depression [27]. On the other hand, Mitchell et al., in their study on 170 nursing students, found that there was no difference in the depression scores between the group with and without low back pain [28]. In light of this information, the level of depression in the patients diagnosed with SIJD was examined in our study, and BDI was used to test it. In addition, it was aimed to reveal how much the treatment could be effective if the patient has a high level of depression. When the treatment groups were compared, it was observed that the scores obtained in the CM and MET groups in the second and third measurements following the treatment revealed more significant results compared to the CG. When the scores of the CM and MET groups were compared, it was found that there was no significant difference between them.

Limitations of the study

The fact that the exercises given in the treatment protocol we applied were not performed with a physiotherapist and that the treatment program was completed in a short period of time, i.e. 4 weeks, are among the limitations of our study.

CONCLUSION

As a result of our study, an improvement was observed in pain, pressure pain threshold, functional and depression levels in patients with SIJD when the home exercise program was compared with the pre- and post-treatment of CM and MET applied in addition to the home exercise program. It was concluded that CM applied in addition to the home exercise program was more successful in terms of pain, pressure pain threshold and functional levels

compared to the other treatment methods. It was found that MET applied in addition to the home exercise program was more successful in terms of pain, pressure pain threshold and functional levels compared to the home exercise program alone. It was found that the CM and MET applied in addition to the home exercise program led to a greater decrease in the depression level than the home exercise program alone. However, no difference was found between CM and MET applied in addition to the home exercise program in reducing the level of depression.

Disclosure statement: The authors have no conflicts of interest to declare.

Author contributions: Conceptualization: [SHH, DT, KBB]; Design: [SHH, DT, KBB]; Writing: [SHH, DT, KBB]; Investigation/Data collection: [SHH, KBB].

Conflict of interest: There is no potential conflict of interest relevant to this article.

REFERENCES

1. Bashir F. Diagnosis and manipulative therapy of sacroiliac joint disorder. *International Musculoskeletal Medicine* 2011; 33(3):115–119.
2. Keklicek H, Demirel A, Yalcin A ve ark. Investigating the effects of sacroiliac joint dysfunction on gait in individuals with lumbar herniation nucleus pulposus. *Gait & posture* 2018; 65:467.
3. Cho BY,Yoon JG. The effect of gait training with shoe inserts on the improvement of pain and gait in sacroiliac joint patients. *Journal of physical therapy science* 2015; 27(8): 2469-2471.
4. Sarı H, Mısıroğlu TÖ. Sakroiliak Eklem Disfonksiyonu. *Turkiye Klinikleri Physical Medicine Rehabilitation-Special Topics* 2011; 4(1):53-59.
5. Yıldız S, Ağaoğlu M. Dünya Sağlık Örgütü kılavuzları ışığı altında kayropraktik. *Integratif Tıp Dergisi* 2013; 1(2):73-76.
6. Zelle BA, Gruen GS, Brown S, George S. Sacroiliac joint dysfunction: evaluation and management. *The Clinical journal of pain* 2005; 21(5):446-455.
7. Mitchell FL. An Evaluation and Treatment Manual of Osteopathic Muscle Energy Procedures. First Edition, Valley Park: Mitchell; Moran and Pruzzo Associates, 1979:126-129.
8. DeStefano L. Greenman's Principles of Manual Medicine. Fourth Edition, Philadelphia: Wolters Kluwer, 2011:103-108.
9. Chaitow L. Mucle Energy Techniques. Second Edition, Edinburgh:Churchill Livingstone, 2001:9-122.
10. Kanchan R, Nitesh BS. Comparative analysis on the efficacy of the G.D Maitland's concept of mobilization & muscle energy technique in treating sacroiliac joint dysfunction. *Journal of Physiotherapy and Occupational Therapy* 2009; 3:18-22.
11. Boyle KL. Managing a female patient with left low back pain and sacroiliac joint pain with therapeutic exercise: a case report. *Physiother Can* 2011; 63:154-163.
12. Jeong-Hyun S, Gi DP, Hoo SP. The Effect of Sacroiliac Joint Mobilization on Pelvic Deformation and the Static Balance Ability of Female University Students with SI Joint Dysfunction. *Journal of Physical Therapy Science* 2014; 26(6):845–848.
13. Walker BF, French SD, Grant W, Green, S. A Cochrane review of combined chiropractic interventions for low-back pain. *Spine* 2011; 36: 230-242.
14. Childs JD, Piva SR, Erhard RE. Immediate improvements in side-to-side weight bearing and iliac crest symmetry after manipulation in patients with low back pain. *J Manipulative Physiol Ther* 2004; 27:06–313.
15. Suter E, McMorland G, Herzog W, Bray R. Decrease in quadriceps inhibition after sacroiliac joint manipulation in patients with anterior knee pain. *J Manipulative Physiol Ther* 1999; 22:l49-53.
16. Heinzman KJ. 'Muscle Energy Technique' presented at 2006 MN APTA spring conference, April 7-9,2006- Early Brown Heritage Center, Brooklyn Center,MN.
17. Kumar SN, Akalwadi A, Babu VK, Wani ZR. Efficacy of adductor pull back exercise on pain and functional disability for sacroiliac joint dysfunction. *Internatıonal Journal Of Physıotherapy* 2015; 2(4):667-675
18. Added MAN, de Freitas DG, Kasawara KT. Strengthenıng the gluteus maxımus ın subjects wıth sacroılıac dysfunctıon.. *International journal of sports physical therapy* 2018; 13(1):114.
19. Michel F, Decavel P, Toussirot E. Piriformis muscle syndrome: Diagnostic criteria and treatment of a monocentric series of 250 patients. *Ann Phys Rehabil Med* 2013; 56:371-383.
20. Al-Subahi M, Alayat M, Alshehri MA. The effectiveness of physiotherapy interventions for sacroiliac joint dysfunction: a systematic review. *Journal of physical therapy science* 2017; 29(9):1689-1694.
21. Barbosa AC, Martins FL, Barbosa MC. Manipulation and selective exercises decrease pelvic anteversion and low-back pain: a pilot study. *J Back Musculoskeletal Rehabil* 2013; 26:33–36.
22. Fernández-Carnero J, Cleland JA, Arbizu RLT. Examination of motor and hypoalgesic effects of cervical vs thoracic

spine manipulation in patients with lateral epicondylalgia: a clinical trial. *Journal of manipulative and physiological therapeutics* 2011; 34(7):432-440.
23. Giles LG, Taylor JR. Low back pain associated with leg length inequality. *Spine* 1981; 6:510-521.
24. Mathew R, Srivastava N, Joshi SA. Study to Compare the effectiveness of MET and Joint Mobilization along with Conventional Physiotherapy in the Management of SI Joint Dysfunction in Young Adults. *Indian Journal of Physiotherapy & Occupational Therapy* 2015; 9(3):203–208.
25. Robertson D, Kumbhare D, Nolet P, Srbely J, Newton G. Associations between low back pain and depression and somatization in a Canadian emerging adult population. *The Journal of the Canadian Chiropractic Association*, 2017; 61(2):96.
26. Kennedy C, Kassab O, Gilkey D, Linnel S, Morris D. Psychosocial factors and low back pain among college students. *Journal of American College Health* 2008; 57(2): 191-196.
27. Unalan D, Celikten M, Mazicioğlu M. Depressive symptom profile of Turkish students experiencing back pain. *Social Behavior and Personality: an international journal* 2009; 37(2):155-162.
28. Mitchell T, O'Sullivan PB, Smith A, Burnett AF, Straker L, Thornton J, Rudd CJ. Biopsychosocial factors are associated with low back pain in female nursing students: a cross-sectional study. *International journal of nursing studies* 2009; 46(5):678-688.
29. Kamali F, Shokri E. The effect of two manipulative therapy techniques and their outcome in patients with sacroiliac joint syndrome. *Journal of bodywork and movement therapies* 2012;16(1):29-35.
30. Javadov A, Ketenci A, Aksoy C. The Efficiency of Manual Therapy and Sacroiliac and Lumbar Exercises in Patients with Sacroiliac Joint Dysfunction Syndrome. *Pain Physician*, 2021;24:223-233.
31. Shearar KA, Colloca CJ,White, HL. A randomized clinical trial of manual versus mechanical force manipulation in the treatment of sacroiliac joint syndrome. *Journal of manipulative and physiological therapeutics* 2005;28(7):493-501.
32. Dhinkaran M, Sareen A, Arora T. Comparative analysis of muscle energy technique and conventional physiotherapy in treatment of sacroiliac joint dysfunction. *Indian Journal of Physiotherapy and Occupational Therapy* 2011;5(4): 127-130.
33. Nejati P, Sartaj E, Imani F, Moeineddin R, Nejati L, Safavi M. Accuracy of the diagnostic tests of sacroiliac joint dysfunction. *Journal of Chiropractic Medicine* 2020;19(1):28-37.
34. Choi JH, Oh JS, Kim MH. The Effect of Pelvic Compression Belt on the Strength of Hip Muscle and EMG Activity in Individuals with Sacroiliac Joint Pain during Prone Hip Extension. *Journal of Musculoskeletal Science and Technology* 2019;3(1):14-21.
35. Kokmeyer DJ, Van der Wurff P, Aufdemkampe G, Fickenscher TC. The reliability of multitest regimens with sacroiliac pain provocation tests. *Journal of Manipulative and Physiological Therapeutics* 2002;25(1):42-48.
36. Cooperstein R. Heuristic exploration of how leg checking procedures may lead to inappropriate sacroiliac clinical interventions. *Journal of chiropractic medicine* 2010;9(3):146-153.
37. Childs JD, Piva SR,Fritz JM. Responsiveness of the numeric pain rating scale in patients with low back pain. *Spine* 2005;30(11):1331-1334.
38. Srivastava S, KU DK, Mittal H, Dixit S, Nair A. Short-term effect of muscle energy technique and mechanical diagnosis and therapy in sacroiliac joint dysfunction: A pilot randomized clinical trial. *Journal of Bodywork and Movement Therapies* 2020;24(3):63-70.
39. Jackson-Koku G. Beck depression inventory. *Occupational Medicine* 2016;66(2):174-175.
40. Fairbank JC, Pynsent PB. The Oswestry disability index. *Spine* 2000;25(22):2940-2953.
41. Mehra A, Baker D, Disney S, Pynsent PB. Oswestry Disability Index scoring made easy. *The Annals of The Royal College of Surgeons of England* 2008;90(6):497-499.