J. Phys. Ther. Sci.
26: 845–848, 2014

Original Article

The effect of sacroiliac joint mobilization on pelvic deformation and the static balance ability of female university students with sacroiliac joint dysfunction

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Abstract. [Purpose] The present study aimed to determine the effect of an 8-week program of joint mobilization on changes in pelvic obliquity and pain level in seventeen female university students aged in their 20's with sacroiliac joint dysfunction by dividing them into two groups: a joint mobilization group (MWM) and a control group. [Subjects] Seventeen subjects were selected from female university students aged in their 20's attending N University in Cheon-An City, Korea, The subjects had sacroiliac joint syndrome, but experienced no problems with daily living and had no previous experience of joint mobilization exercise. The subjects were randomly assigned to a joint mobilization group of eight and a control group of nine who performed joint mobilization exercise. [Methods] Body fat and lean body mass were measured using InBody 7.0 (Biospace, Korea). The Direct Segmental Multi-frequency Bioelectrical Impedance Analysis Method (DSM-BIA) was used for body composition measurement. A pressure footstool (Pedoscan, DIERS, Germany) and a trunk measurement system (Formetric 4D, DIERS, Germany), a 3D image processing apparatus with high resolution for vertebrae, were used to measure 3D trunk images of the vertebrae and pelvis obliquity, as well as static balance ability. [Result] The MWM group showed a significantly better Balance than the control group. In addition, the results of the left/right and the front/rear balance abilities were significantly better than those of the control group. [Conclusion] This study proved that a combination of mobilization with movement and functional training was effective in reducing pelvis malposition and pain, and improving static stability control.

Key words: Joint mobilization, Sacroiliac joint dysfunction, MWM (Mobilization with Movement)

(This article was submitted Nov. 11, 2013, and was accepted Jan. 7, 2014)

INTRODUCTION

Due to industrial development and the consequent increase in daily comfort, physical activities have gradually decreased, leading to increased body weight with reduced physical strength, as well as more sedentary lifestyles and significantly decreased amounts of exercise. Due to incorrect exercise habits, even among those who exercise regularly, bad posture over extended periods, and inappropriate daily life and work habits, excessive load and tension are exerted on the back. The resulting continuous back tension has increased the number of patients with low back pain[1)].

Mennell[2)] presented the term joint dysfunction for arthrokinematic dysfunction in the absence of pathological changes in the joints, including capsules and ligaments. He also attributed muscular pain and muscle spasm to difficulties with normal arthrokinematic mobilization in joint capsules, which limit joint movement when patients attempted to move joints suffering from the symptoms of joint dysfunction. Joint mobilization can be performed to achieve a neurophysiological effect to reduce muscle pain and guarding, and a mechanical effect such as stretch or burst of contracted tissues. One study reported increased active exercise by patients as a result of joint mobilization[3)].

The physiological effects of joint mobilization, which is aimed at increasing the range of joint motion and pain reduction, can be explained by the gate control theory proposed by Melzack and Wall[4)]. The vicious cycle of muscle pain and spasm can be broken by closing the gate where the pain stimulus is largely transmitted through thin filaments, which have slow stimulus conduction velocity, while proprioceptive neurons of thick filaments are stimulated.

The present study aimed to determine the effect of an 8-week program of joint mobilization on changes in pelvic obliquity and pain level in seventeen female university students aged in their 20's with sacroiliac joint dysfunction by

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Fig. 1. Posterior innominate of MWM

Fig. 2. Anterior innominate of MWM

dividing them into two groups: a joint mobilization group, and a control group.

SUBJECTS AND METHODS

Seventeen subjects were selected from female university students aged in their 20's attending N University in Cheon-An City, Korea. The subjects had sacroiliac joint syndrome, but experienced no problems with daily living and had no previous experience of joint mobilization exercise. The subjects were randomly assigned to a joint mobilization group of eight, and a control group of nine who performed joint mobilization exercise.

The Mobilization with Movement (MWM) group was 21.13±1.46 years old, 158.59±6.91 cm tall, and 59.59±12.93 kg in weight. The control group was 23.20±2.15 years old, 161.23±5.28 cm tall, and 51.82±5.45 kg in weight.

Inbody 720 (Biospace, Korea) was used to measure the subjects' body composition while 4D-Formetric (Germany) was used for pelvic analysis.

Body fat and lean body mass were measured using In-Body 7.0 (Biospace, Korea). The Direct Segmental Multi-frequency Bioelectrical Impedance Analysis Method (DSM-BIA) was used for body composition measurement.

A pressure footstool (Pedoscan, DIERS, Germany) and a trunk measurement system (Formetric 4D, DIERS, Germany), a 3D image processing apparatus with high resolution for the vertebrae used in the studies of Lippold and colleagues[5] and Schroder[6], were used to measure 3D trunk images of vertebrae and pelvis obliquity, as well as static balance ability.

The posterior innominate and anterior innominate methods were used for joint mobilization (Mobilization with Movement). These two methods have been well described in the literature by Mulligan[7], Both procedures were repeated 10 times for one set, and for three sets (Figs 1 and 2).

SPSS PC for Windows (version 18.0) was used for data processing. In order to analyze the inter-group effect, two-way ANOVA with repeated measures was conducted. If a main effect was found, the paired t-test was conducted to test the difference between the groups, and one-way ANOVA was conducted to determine the difference of each parameter between the groups. LDS was used for post-hoc analysis. All statistical significance levels (α) were 0.05.

All the subjects understood the purpose of this study and provided their written informed consent prior to their participation in the study in accordance with the ethical principles of the Declaration of Helsinki.

RESULTS

The pelvic obliquity DL-DR decreased by 3.25° from 4.88° before the intervention to 1.63° after the mobilization exercise in the control MWM group, but increased by 0.22° from 1.89° to 2.11° in the control group.

The pelvic torsion L-R decreased by 0.5° from 2.50° to 2.00° in the MWM group, but increased by 0.66° from 1.56° to 2.22° in the control group.

The trunk length increased by 8.38 mm from 440.25 mm to 448.63 mm in the MWM group, but decreased by 1.89 mm from 451.67 mm to 449.78 mm in the control group (Table 1).

The mean velocity decreased by 0.28 mm from 1.26 mm to 0.98 mm in the MWM group, but increased by 0.1 mm from 1.13 mm to 1.23 mm in the control group.

The sway area decreased by 0.14 cm^2 from 0.21 cm^2 to 0.07 cm^2 in the MWM group, but increased by 0.07 cm^2 from 009 cm^2 to 0.16 cm^2 in the control group.

The mean frequency decreased by 0.42 Hz from 0.97Hzto 0.55 Hz in the MWM group, but was unchanged at 0.66 Hz in the control group (Table 2).

DISCUSSION

The sacroiliac joint refers to the posterior joint of the bony pelvis between the sacrum and the ilium of the pelvis. With its extremely limited mobility and small joint mobilization, this joint rarely causes any pathological problem except for body imbalance due to sacroiliac joint obliquity and changes in iliac, ischium, and length of the ilium[8]. The analysis of the pelvis obliquity showed the intervention of this study provided the greatest statistically significant interaction effect on left and right pelvis obliquity ($p<0.001$). Furthermore, a group performing combined joint mobilization and functional exercise showed statistically significant differences between before and after the exercise whereas the control group performing simple joint mobilization did not ($p<0.001$). In a previous study, Yang[9] reported the measurement results of changes around the sacroiliac joint after 12 weeks of rolling massage for patients with chronic low back pain. He found that ilium deviation was reduced by

Table 1. Change of pelvis malposition

	Group	pre-test	post-test
Pelvic Obliquity DL-DR (°)	MWM	4.88±2.48	1.63±1.92**
	Control	1.89±1.69	2.11±1.76
Pelvic L-R torsion (°)	MWM	2.50±0.76	2.00±0.53*
	Control	1.56±1.01	2.22±1.20**
Trunk Length (mm)	MWM	440.25±17.62	448.63±15.62*
	Control	451.67±16.82	449.78±15.93**

*p<0.05, **p <0.01: paired t-test
##p<0.01: independent t-test

Table 2. Change of static stability

	Group	pre-test	post-test
Mean Velocity (cm/s)	MWM	1.26±0.27	0.98±0.12*
	Control	1.13±0.13	1.23±0.14
Sway Area (cm^2)	MWM	0.21±0.22	0.07±0.03
	Control	0.09±0.04	0.16±0.11
Mean Frequency (Hz)	MWM	0.97±0.52	0.55±0.28*
	Control	0.66±0.26	0.66±0.18

*p<0.05, **p <0.01: paired t-test
##p<0.05: independent t-test

about 2.37 mm, sacroiliac joint deviation by about 2.25 mm, and ischium deviation by about 2.5 mm, resulting in a significant difference overall in the sacroiliac joint-related areas ($p<0.001$). However, Lee[10] reported that changes in low back pain found in experimental and control groups after manipulative therapy administered to patients with sacroiliac joint dysfunction with muscle imbalance differed significantly between the two groups before and after the experiment ($p<0.001$), whereas changes in pelvis rotation between the experimental and control groups showed significant difference between before and after the experiment ($p>0.05$), in contrast to our study's results. We attribute difference in these study results to the difference between our joint mobilization and Lee's manipulative therapy, and to the lack of any functional exercise.

For pain control, it is advantageous to discover and treat specific lesions causing the pain (trigger point, over-loaded muscle, weakened or abnormal movement types, or joint dysfunction), not only to reduce the symptoms (pain) but also to induce functional recovery[11].

The results for the joint mobilization intervention used in this study show that two groups of showed statistically significant decreases of pain compared to the control group ($p<0.001$).

In a previous study, Lee[12] reported significant reductions of low back pain, functional disorder level, and low back instability in patients with chronic low back pain after lower extremity strengthening exercise along with low back stabilization exercise ($p<0.05$). He also claimed that a program of combined exercise performing low back stabilization exercise and lower extremity strengthening exercise was more effective at decreasing low back pain, functional disorder level, and low back instability than a stabilization exercise alone.

Han[13] reported that a combination of functional exercises resulted in significant pain relief from 4.61 to 1.94 on a subjective pain index (VAS), while simple exercise resulted in non-significant pain relief from 3.93 to 1.57. Furthermore, Im[14] reported that VAS showed a significant difference between before and after Chuna therapy and spinal stabilization exercises for 16 weeks. Significant differences were also found between two groups: a group of single treatment with Chuna therapy and a group of combined treatment of Chuna therapy and spinal stabilization exercise. This last result is consistent with our own study result.

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