Effect on Spinal Mobility of Shiatsu Stimulation to the Inguinal Region

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I. Introduction

The Japan Shiatsu College has previously conducted research into the effects of shiatsu stimulation on heart rate, peripheral circulation (pulse wave height, skin temperature, muscle blood volume), blood pressure, and spinal mobility. We reported responses including reduction in heart rate post-stimulation and reduced pulse wave height values in fingertip pulse wave during stimulation[1]; reduction in blood pressure during and after stimulation[2]; increase in heel pad skin temperature immediately post-stimulation[3]; and increased skin temperature accompanied by decreased muscle blood volume and decreased skin temperature accompanied by increased muscle blood volume immediately post-stimulation[4]. Concerning spinal flexibility, finger-floor distance (FFD) improved due to shiatsu stimulation of the dorsal region[5], as did standing forward flexion due to shiatsu stimulation of the abdominal and inguinal regions[6]. We were thus able to confirm shiatsu stimulation's action on the circulatory system and its effect on standing forward flexion.

The spine is freely mobile, capable of anteflexion, dorsiflexion, left and right lateral flexion, and left and right rotation. It is understood that, while individual intervertebral range of motion (ROM) is slight, the articulation of the spine's interrelated joints creates significant range of motion overall[6]. We have shown that, by using shiatsu stimulation to reduce muscular tension in the muscles that support and reinforce those joints in the dorsal and ventral regions, spinal range of motion is increased[5,6,8,9].

In this study, to further investigate spinal mobility, we applied shiatsu stimulation to the inguinal region, through which pass the iliacus and psoas major muscles, referred to collectively as the iliopsoas, a postural support muscle. The objective of this research was to study the effect of stimulation of the inguinal region on spinal mobility relating to spinal ROM in anteflexion and dorsiflexion.

II. Methods

1. Subjects

Research was conducted on 30 healthy adult students of the Japan Shiatsu College (18 males, 12 females) aged 18–67 years old (average age: 39.5 ± 14.1 years old).

2. Test period

April 1 to September 20, 2008, on Saturdays between 1:30PM and 6PM

3. Test location

Testing was conducted in the 5th-floor shiatsu training hall at the Japan Shiatsu College. Room temperature was 25.0 ± 2°C and humidity was 63.0 ± 12.0%.

4. Measurement procedures and devices used

Spinal mobility was measured using a Spinal Mouse® (Index Co., Ltd.). This device enabled measurement of angle and range of motion of each intervertebral space on both the sagittal and coronal planes from the body surface (Fig. 1).

In this test, to assess spinal ROM on the sagittal plane, we investigated anteflexion ROM and dorsiflexion ROM using angles at various locations (spinal inclination angle, thoracic kyphotic angle, lumbar lordotic angle, sacral/pelvic inclination angle), as measured in standing neutral (posture while standing), maximum anteflexion (posture of maximum anteflexion from standing), and maximum dorsiflexion (posture of maximum dorsiflexion from standing) positions. Anteflexion ROM is the difference between measurement values in the standing neutral and maximum anteflexion positions, and dorsiflexion ROM is the difference between measurement values in the standing

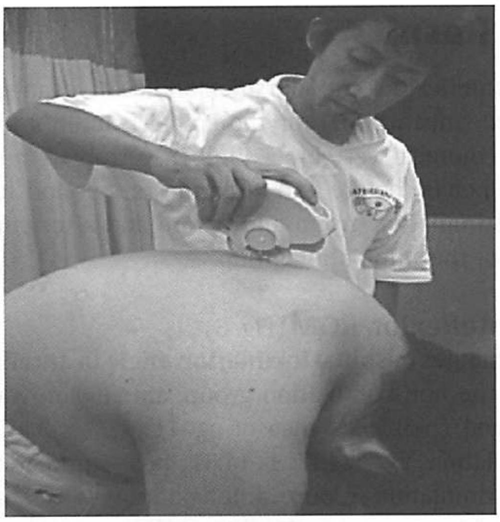

Fig. 1. Measurement using Spinal Mouse®

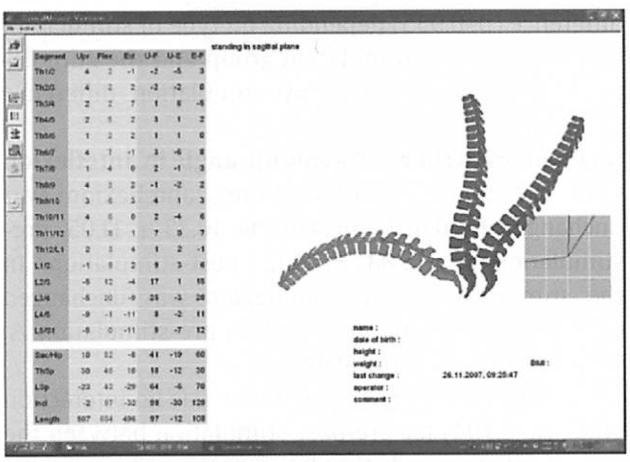

Fig. 2. Spinal ROM measurement screen

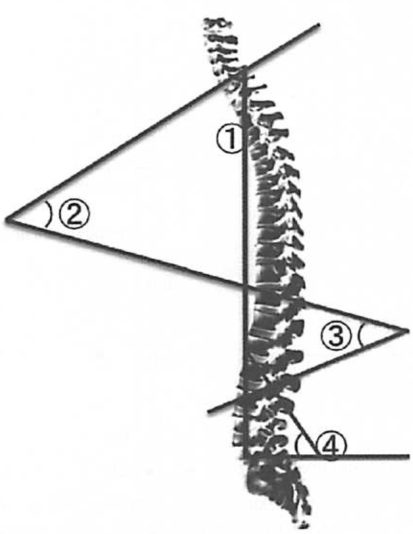

Fig. 3. Measurement items: angle of curvature of spine and individual locations.

neutral and maximum dorsiflexion positions (Fig. 2).

Measurement involved taking the segmental angle, consisting of the angle between a line joining the superior and inferior spinous processes and a vertical line, inputting the data recorded using the Spinal Mouse® into a computer, and abstracting the anteflexion and dorsiflexion of the sagittal curve.

Measurement items are shown below (Fig. 3).

① Spinal inclination angle (SIA): Indicates the measure of overall ROM using a straight line between the 1st thoracic vertebra and the 1st sacral vertebra. Expressed as the angle between that line and a vertical line.

② Thoracic kyphotic angle (TKA): Indicates the curvature from the 1st to the 12th thoracic vertebrae, or the overall thoracic curve.

③ Lumbar lordotic angle (LLA): Indicates the curvature from the 1st to the 5th lumbar vertebrae, or the overall lumbar curve.

④ Sacral/pelvic inclination angle (SIA): The sacral inclination angle is the angle measured, but because the sacrum is joined to the pelvis via the sacroiliac joints, it corresponds to the pelvic inclination angle.

5. Shiatsu stimulation (Fig. 4)

Palm pressure was applied for 5 seconds per point to each of the 3 basic Namikoshi shiatsu points in the inguinal region (following the inguinal ligament, Point 1: medioinferior to the anterior superior iliac spine; Point 2: over the arterial pulse; Point 3: superolateral to the pubic bone), bilaterally for 5 minutes per side, for a total of 10 minutes. All shiatsu stimulation was applied using standard pressure application methods (pressure gradually increased, sustained, and gradually decreased), and the amount of pressure used in stimulation was classified as standard pressure (pressure regulated so as to be pleasurable for the test subject)[10].

Because the use of palm pressure is a basic procedure in shiatsu, it was categorized as shiatsu ("finger pressure") for the purpose of this study.

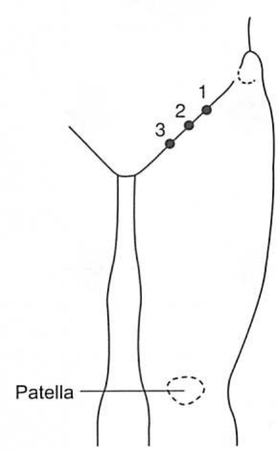

Fig. 4. Area of stimulation

6. Test procedure (Fig. 5)

Test procedures were fully explained to each test subject and their consent obtained. They were also questioned on subjective symptoms such as lumbar pain as well as regular exercise habits.

Two tests were performed, one in which shiatsu stimulation was not applied (hereafter, the non-stimulation group) and one on which shiatsu stimulation was applied (hereafter, the stimulation group). Both tests were applied to all 30 test subjects on different days.

(1) Non-stimulation group

15 minutes rest → measurement → 10 minutes rest → measurement

(2) Stimulation group

15 minutes rest → measurement → 10 minutes shiatsu stimulation → measurement

Rest and stimulation were carried out in the supine position; measurement was carried out in the standing position.

7. Analysis

In analysis of inter-group pre/post-stimulation data between the non-stimulation and stimulation groups, each angle measured (spinal inclination angle, thoracic kyphotic angle, lumbar lordotic angle, and sacral/pelvic inclination angle) was analyzed using Bonferroni multiple comparison and two-way analysis of variance using a general linear model. In analysis of pre/post-stimulation data for the non-stimulation and stimulation groups, each angle measured was analyzed using Bonferroni multiple comparison and one-way analysis of variance. Analytical software used was SPSS Ver.15, with a significance level of ≤5% taken as significant.

III. Results

For anteflexion and dorsiflexion ROM, changes are shown (mean ± SD) for the spinal column and each area (thoracic vertebrae, lumbar vertebrae, and sacrum/pelvis) before and after the rest period for the non-stimulation group and before and after stimulation for the stimulation group.

1. Anteflexion ROM (Fig. 6)

(1) Changes to spinal inclination angle in anteflexion

In the non-stimulation group, anteflexion was unchanged (p=0.592), measuring 113.97 ± 13.87° pre-stimulation vs. 114.17 ± 14.61° post-stimulation. In the stimulation group, anteflexion was unchanged (p=0.439), measuring 113.83 ± 13.14° pre-stimulation vs. 114.70 ± 13.85° post-stimulation.

For the spinal column, there was no interaction effect (p=0.57) for pre/post-stimulation between the non-stimulation and stimulation groups. There was no difference (p=0.955) depending on type of stimulation between the non-stimulation group and the stimulation group, and no pre/post-stimulation difference (p=0.364).

(2) Changes to thoracic kyphotic angle in anteflexion

In the non-stimulation group, anteflexion was unchanged (p=0.697), measuring 16.33 ± 11.05° pre-stimulation vs. 15.83 ± 11.12° post-stimulation. In the stimulation group, anteflexion was unchanged (p=0.445), measuring 15.93 ± 12.26° pre-stimulation vs. 14.97 ± 11.23° post-stimulation.

For the thoracic vertebrae, there was no interaction effect (p=0.794) for pre/post-stimulation between the non-stimulation and stimulation groups. There was no

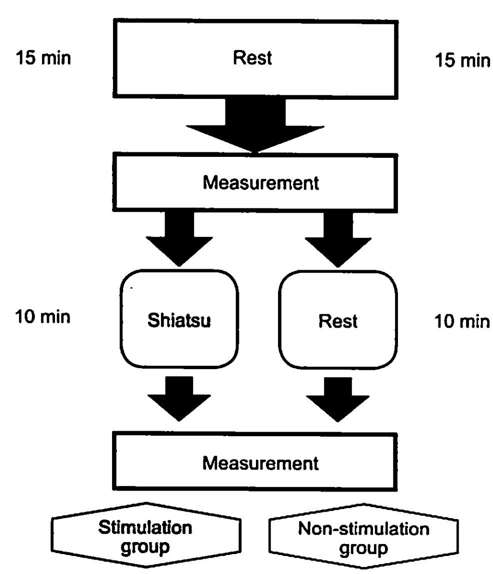

Fig. 5. Test procedure

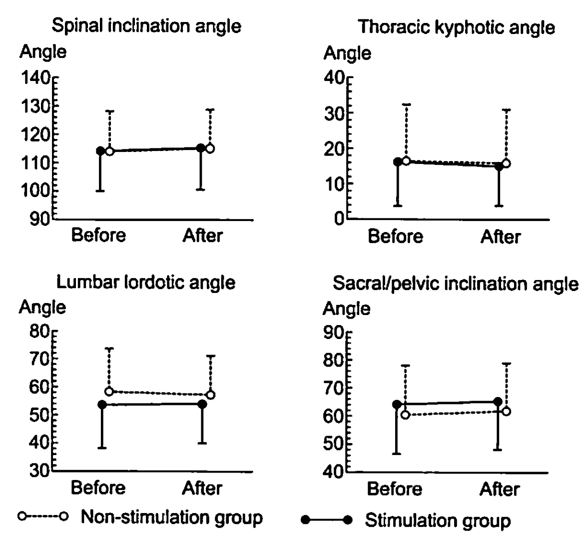

Fig. 6. Changes to anteflexion ROM as measured by spinal inclination angle, thoracic kyphotic angle, lumbar lordotic angle, and sacral/pelvic inclination angle, resulting from non-stimulation and shiatsu stimulation

difference (p=0.823) depending on type of stimulation between the non-stimulation group and the stimulation group, and no pre/post-stimulation difference (p=0.413).

(3) Changes to lumbar lordotic angle in anteflexion

In the non-stimulation group, anteflexion was unchanged (p=0.207), measuring 58.57 ± 15.25° pre-stimulation vs. 57.10 ± 13.94° post-stimulation. In the stimulation group, anteflexion was unchanged (p=0.798), measuring 53.70 ± 14.01° pre-stimulation vs. 54.03 ± 15.03° post-stimulation.

For the lumbar vertebrae, there was no interaction effect (p=0.299) for pre/post-stimulation between the non-stimulation and stimulation groups. There was no difference (p=0.283) depending on type of stimulation between the non-stimulation group and the stimulation group, and no pre/post-stimulation difference (p=0.512).

(4) Changes to sacral/pelvic inclination angle in anteflexion

In the non-stimulation group, anteflexion was unchanged (p=0.209), measuring 60.33 ± 17.68° pre-stimulation vs. 61.43 ± 17.26° post-stimulation. In the stimulation group, anteflexion was unchanged (p=0.585), measuring 64.00 ± 16.31° pre-stimulation vs. 64.90 ± 17.57° post-stimulation.

For the sacrum and pelvis, there was no interaction effect (p=0.914) for pre/post-stimulation between the non-stimulation and stimulation groups. There was no difference (p=0.415) depending on type of stimulation between the non-stimulation group and the stimulation group, and no pre/post-stimulation difference (p=0.282).

2. Dorsiflexion ROM (Fig. 7)

(1) Changes to spinal inclination angle in dorsiflexion

In the non-stimulation group, spinal ROM decreased significantly (p=0.046), measuring −34.47 ± 8.66° pre-stimulation vs. −32.53 ± 9.87° post-stimulation. In the stimulation group, spinal ROM increased significantly (p=0.008), measuring −32.87 ± 8.60° pre-stimulation vs. −35.37 ± 9.73° post-stimulation.

For the spinal column, interaction effect was shown (p=0.001) for pre/post-stimulation between the non-stimulation and stimulation groups. There was no difference (p=0.789) depending on type of stimulation between the non-stimulation group and the stimulation group, and no pre/post stimulation difference (p=0.659).

(2) Changes to thoracic kyphotic angle in dorsiflexion

In the non-stimulation group, dorsiflexion was unchanged (p=0.844), measuring 3.63 ± 11.48° pre-stimulation vs. 3.97 ± 12.69° post-stimulation. In the stimulation group, dorsiflexion was unchanged (p=0.947), measuring 2.10 ± 13.50° pre-stimulation vs. 2.20 ± 15.23° post-stimulation.

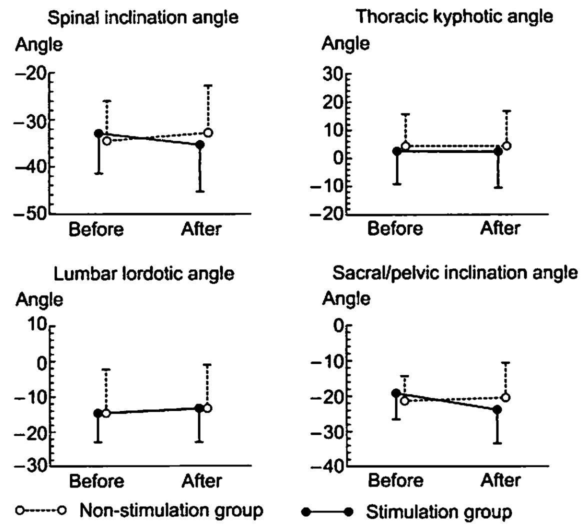

Fig. 7. Changes to dorsiflexion ROM as measured by spinal inclination angle, thoracic kyphotic angle, lumbar lordotic angle, and sacral/pelvic inclination angle, resulting from non-stimulation and shiatsu stimulation

For the thoracic vertebrae, there was no interaction effect (p=0.917) for pre/post-stimulation between the non-stimulation and stimulation groups. There was no difference (p=0.613) depending on type of stimulation between the non-stimulation group and the stimulation group, and no pre/post-stimulation difference (p=0.847).

(3) Changes to lumbar lordotic angle in dorsiflexion

In the non-stimulation group, dorsiflexion was unchanged (p=0.461), measuring −14.40 ± 6.99° pre-stimulation vs. −13.27 ± 12.11° post-stimulation. In the stimulation group, dorsiflexion was unchanged (p=0.292), measuring −14.67 ± 8.30° pre-stimulation vs. −13.17 ± 9.52° post-stimulation.

For the lumbar vertebrae, there was no interaction effect (p=0.859) for pre/post-stimulation between the non-stimulation and stimulation groups. There was no difference (p=0.974) depending on type of stimulation between the non-stimulation group and the stimulation group, and no pre/post-stimulation difference (p=0.207).

(4) Changes to sacral/pelvic inclination angle in dorsiflexion

In the non-stimulation group, dorsiflexion was unchanged (p=0.594), measuring −21.13 ± 6.99° pre-stimulation vs. −20.40 ± 9.62° post-stimulation. In the stimulation group, dorsiflexion increased (p=0.006), measuring −19.27 ± 7.66° pre-stimulation vs. −23.70 ± 11.55° post-stimulation.

For the sacral/pelvic angle, interaction effect was shown (p=0.014) for pre/post-stimulation between the non-stimulation and stimulation groups. There was no difference (p=0.737) depending on type of stimulation between the non-stimulation group and the stimulation group, and a trend toward pre/post stimulation difference ($p=0.074$).

IV. Discussion

The purpose of this study was to investigate changes to spinal range of motion due to shiatsu stimulation of the inguinal region. The results indicate that spinal range of motion in dorsiflexion showed a pre/post-stimulation difference (interaction effect) during stimulation: shiatsu stimulation resulted in an increase in spinal ROM, whereas no shiatsu stimulation resulted in a decrease in spinal ROM. In dorsiflexion, the pelvis (sacral inclination angle) also showed a pre/post-stimulation difference (interaction effect) during stimulation, with shiatsu stimulation resulting in increased pelvic ROM and no shiatsu stimulation resulting in no change to pelvic ROM.

Joints in the thoracic spine, lumbar spine, and pelvis are all involved in spinal ROM, and it has been shown that a flexible person can attain a maximum of 250° cumulative ROM in these joints between anteflexion and dorsiflexion[7].

Houki et al[11] analyzed the postures of 168 subjects between the ages of 19 and 65 using a Spinal Mouse®. In anteflexion, males achieved 89.9 ± 15.1° and females 85.3 ± 21.7°, and in dorsiflexion, males achieved -29.8 ± 11.3° and females -22.0 ± 11.1°.

Hakuta et al[12] analyzed the standing postures of 89 subjects between the ages of 18 and 28 using a Spinal Mouse®. In anteflexion, males achieved 97.1 ± 16.0° and females 96.1 ± 18.2°, and in dorsiflexion, males achieved -40.1 ± 12.8° and females -38.0 ± 9.0°.

In this study, pre-stimulation anteflexion figures were 113.97 ± 13.87° for the non-stimulation group and 113.83 ± 13.14° for the stimulation group, while pre-stimulation dorsiflexion figures were -34.47 ± 8.66° for the non-stimulation group and -32.87 ± 8.60° for the stimulation group. This indicates that spinal ROM was greater for subjects in this study than in previous studies by Houki et al and Hakuta et al. Spinal ROM in dorsiflexion was analogous to that seen in previous studies by Houki et al and Hakuta et al.

In the inguinal region, which was the area subject to shiatsu stimulation in this study, the psoas major originates on the lumbar transverse processes and the iliacus originates on the ilium, both inserting on the lesser trochanter of the femur. The action of the iliopsoas is to flex the hip joint (anteflexion), but it is likely that the relaxation of tonus in this pair of muscles can also affect dorsiflexion. From this, we surmise that shiatsu stimulation of the inguinal region caused increased pelvic ROM, which was accompanied by increased spinal dorsiflexion ROM.

We have previously reported that shiatsu stimulation of the lumbodorsal region, posterior lower limb, abdomen, and inguinal regions result in increased (improved) spinal ROM in anteflexion (FFD, or finger-floor distance)[5,6,8,9]. In this study involving shiatsu stimulation to the inguinal region, it was thought that not including shiatsu stimulation to the lumbodorsal region and posterior lower limb was a factor in the results obtained for ROM in anteflexion. It was also suggested that the relaxation of tonus in erector spinae and posterior lower limb muscles have an important effect on anteflexion ROM. One more factor to take into consideration was that spinal ROM in anteflexion was greater in this study (pre-stimulation) than ROM in anteflexion measured in previous studies.

V. Conclusions

In this study involving 30 healthy adults, the following results were obtained through measurement of anteflexion and dorsiflexion of the spine and its various segments using a Spinal Mouse®.

Shiatsu stimulation of the inguinal region caused increased pelvic ROM, which was accompanied by increased spinal dorsiflexion ROM.

In closing, we would like to express our appreciation to the instructors and students of the Japan Shiatsu College who participated in this research.

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