Effects of Abdominal Shiatsu Stimulation on Spinal Mobility

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I. Introduction

In previous studies up until last year, we have reported on changes to standing forward flexion and spinal mobility due to shiatsu stimulation using basic Namikoshi shiatsu procedures on the dorsal surface of the body[1,3,4].

Building on these past results, this year we report on the effects of shiatsu stimulation to the ventral surface of the trunk by performing shiatsu stimulation to the abdominal region and investigating changes to standing forward flexion and spinal mobility.

II. Methods

1. Subjects

Research was conducted on 47 healthy males, aged 18–64 years (average age: 35.5 years old).

Test procedures were fully explained to each test subject and their consent obtained. They were also asked to refrain from receiving shiatsu or other stimulation on the day of testing.

2. Test period

May 7 to September 17, 2005

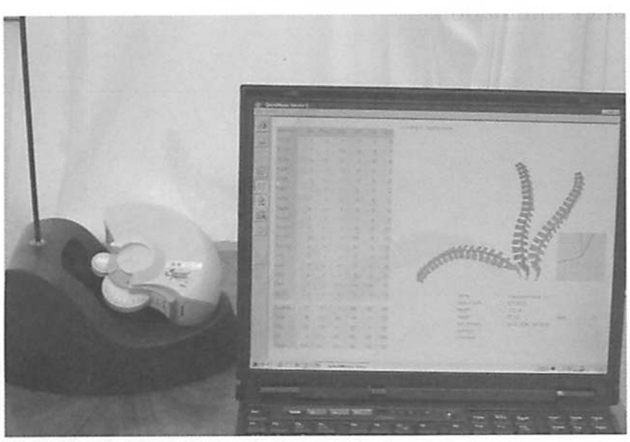

Fig. 1. Spinal Mouse®

3. Test location

Testing was conducted in the shiatsu research lab at the Japan Shiatsu College. Room temperature was 25 ± 1°C.

4. Measurement devices (Fig. 1)

Standing forward flexion was measured using a standing forward flexion gauge (Yagami Co., Ltd), muscle pliability was measured using a Venustron muscle stiffness sensor (Axiom Co., Ltd.), and spinal range of motion was measured using a Spinal Mouse® spinal measurement device (Index Co., Ltd.).

5. Data storage

Data from the muscle stiffness sensor was transferred via the control unit and stored on a personal computer (IBM 2611-456). Data from the Spinal Mouse® was transferred via the base station and stored on a personal computer (IBM 2655-P3J).

6. Stimulation (Fig. 2)

Full-body treatment is standard for Namikoshi shiatsu, a portion of which was carried out on the inguinal and abdominal regions in the supine position, as indicated below:

(1) 1 point, palm pressure, inguinal region; applied bilaterally
(2) 9 points, palm pressure, abdominal region
(3) 20 points, 2-thumb pressure, abdominal region

Pressure was applied for 3 seconds per point, repeated 3 times per operation, except for the inguinal region, where pressure was applied for 5 seconds per point, repeated 3 times.

Treatment was carried out by 2 therapists after measures were taken to ensure that they applied similar amounts of pressure. Approximately 5–15 kg pressure was applied, depending on the comfort level of the test recipient. Standard pressure application methods were employed throughout (pressure gradually increased, sustained, and gradually decreased).

7. Test procedure

Test procedures were fully explained to each test subject and their consent obtained. They also filled out a questionnaire listing back pain and other everyday symptoms.

Markings for measurements using the Spinal Mouse® were applied over the right erector spinae muscles at the heights of C_7 and S_3; markings for measurements of muscle pliability were applied bilaterally at the following acupoints: *Zhishi* (BL52), *Shenshu* (BL23), *Dachangshu* (BL25), and *Geguan* (BL46). Muscle stiffness was measured at the location indicated in Figure 3.

Measurements for standing forward flexion and spinal range of motion were carried out on a 45 cm platform. Relaxation, measurement of muscle stiffness, and shiatsu treatment were carried out on a futon mattress laid out on a thin mat laid out on the floor.

(1) Pre-treatment spinal range of motion and standing forward flexion measurements

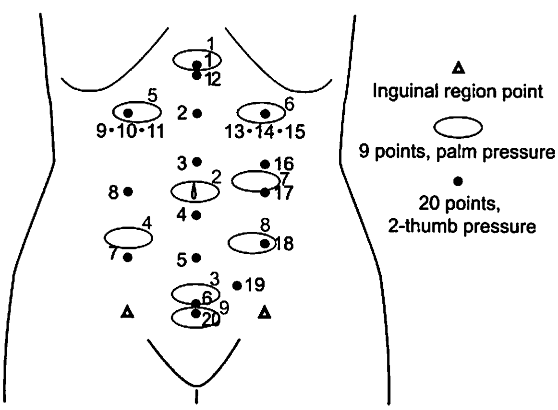

Fig. 2. Treatment area (excerpt from reference 5)

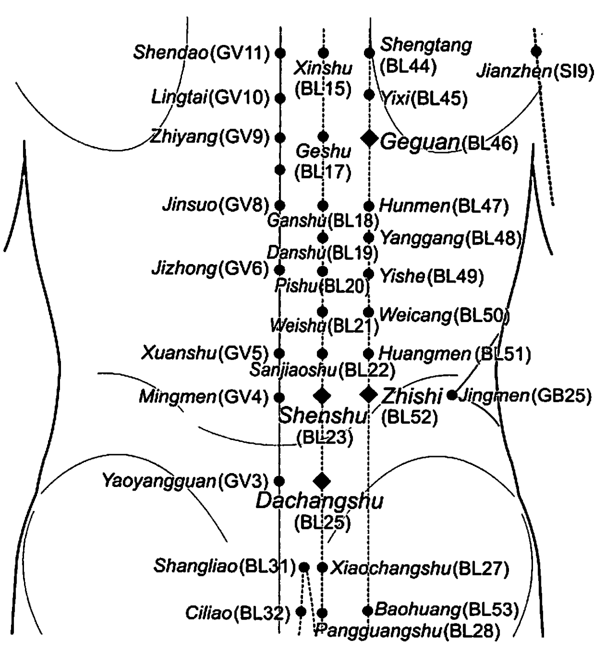

Fig. 3. Muscle stiffness measurement locations (excerpt from reference 6)

(2) 5 minutes rest (prone position) *During this period, pre-treatment muscle stiffness measurements (prone) were carried out on 9 randomly selected test subjects

(3) Treatment of inguinal region and abdominal region according to basic Namikoshi shiatsu procedures (supine position)

(4) 5 minutes rest (supine) *After this period, post-treatment muscle stiffness measurements (prone) were carried out on 9 randomly selected test subjects

(5) Post-treatment spinal range of motion and standing forward flexion measurements

After completion of the above test procedures, therapists recorded observations on changes in muscle tension, indurations, and other information.

In addition, non-stimulation testing was performed on 15 of the test subjects, in which no shiatsu stimulation applied during the above procedures.

8. Data processing

Changes in before and after measurements for standing forward flexion and spinal range of motion were subject to statistical processing using a t-test.

(1) Spinal mobility (Fig. 4)

Measurements were made using a Spinal Mouse® in erect, forward flexion, and posterior flexion postures. Spinal angle of inclination was calculated based on a straight, vertical line projected from the base point at S_3, with the incline angle of a straight line connecting C_7 to S_3 shown as positive to indicate forward flexion and negative to indicate posterior flexion. Spinal angle of inclination is the angle of inclination, based on a horizontal line, between each vertebra including the sacrum, shown as positive to indicate forward flexion and negative to indicate posterior flexion.

For purposes of this study, changes of less than 1° were treated as within the margin of error, indicating no change.

(2) Muscle stiffness (Fig. 5)

The round-trip changes in load and vibration frequency when the tactile sensor was depressed with a maximum force of 100 g were compared before and after stimulation.

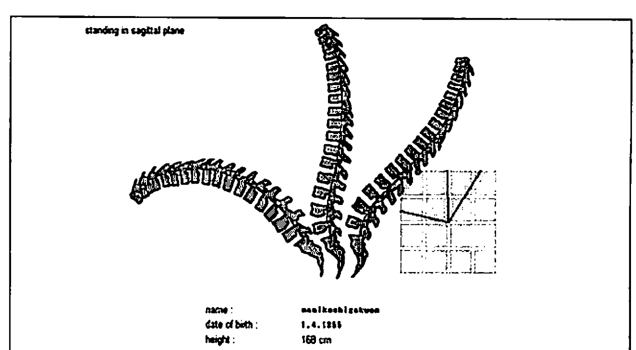

Fig. 4. Screen image of spinal range of motion measurement

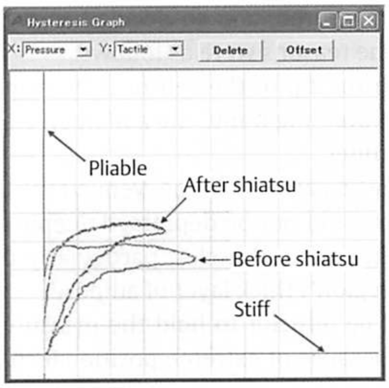

Fig. 5. Screen image of muscle stiffness measurements

The graph's x-axis indicates the depression pressure and the y-axis the sympathetic vibration frequency. The slope of the graph line indicates greater muscle stiffness as it approaches the x-axis, and greater muscle pliability as it approaches the y-axis. Muscle elasticity is indicated by the difference in vibration frequency between depression and retraction pressure, with elasticity being greater the less the difference.

III. Results

1. Standing forward flexion (Fig. 6)

Pre-stimulation values were 2.7 ± 1.3 cm (mean ± SE) and post-stimulation values were 4.9 ± 1.2 cm, indicating a significant improvement ($p<0.01$). Improvement occurred in 36 of 47 cases, with 1 case showing no change, and 10 cases showing a change for the worse. The average before-after change, calculated by subtracting the post-stimulation measurement value from the pre-stimulation measurement value, was 2.15 ± 0.54 cm.

In the 15 non-stimulation cases, there was not a significant before-after change in measurements.

2. Spinal range of motion during forward flexion

(1) Spinal angle of inclination (Fig. 7)

After eliminating data tainted by equipment malfunction, pre-stimulation values were +109.2 ± 1.6° and post-stimulation values were +110 ± 1.7°, which did not indicate a significant improvement. Of a total of 39 cases, 16 cases showed an improvement, 14 cases showed no change, and 9 cases showed no improvement. The average before-after change was 1.8 ± 0.92°.

(2) Sacral angle of inclination (Fig. 8)

Pre-stimulation values were 61.9 ± 1.8° and post-stimulation values were 65.4 ± 1.9°, indicating a significant improvement ($p<0.01$). Of a total of 39 cases, 24 cases showed an improvement, 8 cases showed no change, and 7 cases showed no improvement. The average before-after change was 3.5 ± 0.9°.

3. Muscle pliability

Results for muscle stiffness measurements taken bilaterally at 8 points are as follows. Improvement rates are shown separately for muscle stiffness (change in pressure) and muscle elasticity (change in frequency). Left *Zhishi* (BL52): stiffness improved in 3 cases (33%) and elasticity in 3 cases (33%); right *Zhishi* (BL52): stiffness improved in 5 cases (56%) and elasticity in 6 cases (67%). Left *Shenshu* (BL23): stiffness improved in 3 cases (33%) and elasticity in 6 cases (67%); right *Shenshu* (BL23): stiffness improved in 7 cases (78%) and elasticity in 5 cases (56%). Left *Dachangshu* (BL25): stiffness improved in 6 cases (67%) and elasticity in 3 cases (33%); right *Dachangshu* (BL25): stiffness improved in 5 cases (56%) and elasticity in 5 cases (56%). Left *Geguan* (BL46): stiffness improved in 3 cases (33%) and elasticity in 4 cases (44%); right *Geguan* (BL46) (excluding 1 case due to data error): stiffness improved in

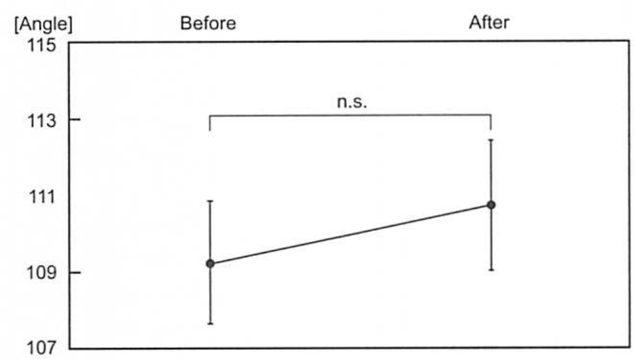

Fig. 7. Change in spinal range of motion during forward flexion

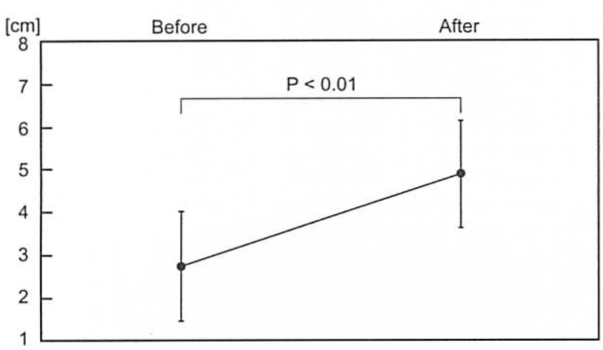

Fig. 6. Change in standing forward flexion before and after shiatsu

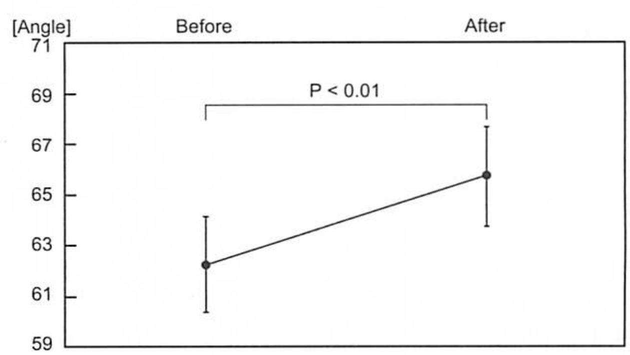

Fig. 8. Change in sacral range of motion during forward flexion

4 cases (50%) and elasticity in 4 cases (50%). Right-side measurement points showed a comparatively higher rate of improvement, but overall a definite trend was not confirmed.

IV. Discussion

In this study, standing forward flexion improved significantly due to shiatsu stimulation of the abdominal region.

Eto et al[3] demonstrated that shiatsu stimulation of the back and lumbar regions improved standing forward flexion and muscle pliability of the same region and concluded that the mechanism for this was due to an increase in muscle blood volume[2] from increased blood flow caused by either axonal reflex[8] or sympathetic nerve suppression, resulting in increased muscle pliability. Tazuke et al[4] performed shiatsu on the posterior lower limb, including the hamstrings, which are a limiting factor in standing forward flexion, and reported improvements to standing forward flexion and spinal range of motion.

Therefore, standing forward flexion values were improved by shiatsu stimulation to all areas, including the back and lumbar region, posterior lower limb, and abdominal region.

As in this study, unlike previous studies, stimulation was applied to the abdominal region on the ventral surface of the trunk, the following factors may be considered as causes for improvement in standing forward flexion.

The rectus abdominis connects "the anterior surfaces of the 5th to 7th costal cartilages and the xiphoid process" with the "pubic crest"[7]. The appropriate amount of tension in the rectus abdominis causes the pelvis to tilt posteriorly, allowing the hip joints to flex effectively. However, excessive tension in the rectus abdominis causes the pelvis to tilt excessively posteriorly, forcing the hip joints to extend. Thus, alleviating excessive tension in the rectus abdominis may improve the sacral angle of inclination, thereby increasing range of motion in the hip joints resulting in improved standing forward flexion. In addition, it is also possible that the rectus abdominis also exerts an influence via its upper attachments to the costal cartilages, causing changes to elevation of the thorax and mobility of the thoracic vertebrae; this is being considered as a topic for future study.

In reports by Eto et al[3] and Tazuke et al[4], muscle stiffness was measured in the areas subject to shiatsu stimulation; in this study, we initially planned to measure muscle stiffness both in the stimulated area and the remote area of the back and lumbar region, but determined that it would be difficult to obtain proper measurements due to the relationship between Venustron's measurement sensor and the nature of the area to be measured, and so decided to measure the back only. The reasons were as follows:

(1) Although the tip of the sensor is hemispherical, it is likely that pressing it into the abdomen would cause muscle guarding.

(2) It was anticipated that the Venustron's measurement sensor could not be depressed deeply enough to reach the abdominal muscles, particularly due to the abdominal region's thick layer of adipose.

(3) It would be difficult to hold the measurement device stable because of extreme positional changes due to respiration.

We hope that in the future, we will be able to reexamine our measurement procedures and accurately measure abdominal muscle stiffness, providing evidence to support the test findings of this study.

The results obtained in this study indicate that shiatsu stimulation to the abdominal region can be effective in cases of lumbar pain accompanied by muscle tension, especially when it is difficult to move the body from the supine position.

V. Conclusions

From this study involving 47 adult males, the following is evident:

Spinal range of motion, as indicated by standing forward flexion, showed significant improvement due to Namikoshi-style shiatsu stimulation of the abdominal and inguinal regions.

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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