Effects of Shiatsu Stimulation on Spinal Mobility and Muscle Stiffness

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I. Introduction

In last year's study, we reported on research into changes in muscle stiffness in the erector spinae at the L_4-L_5 level and changes in standing forward flexion and spinal range of motion after application of shiatsu stimulation consisting of basic Namikoshi shiatsu treatment to the back and lumbar regions in the prone position[1-3].

It is common to experience pain in the hamstrings and gastrocnemius muscles during standing forward flexion.

Therefore, for this year's study, we selected test subjects who have difficulty touching their hands to the floor during standing forward flexion-so-called 'stiff bodied' people-and measured changes in muscle stiffness in their hamstrings and gastrocnemius, along with changes in standing forward flexion and spinal range of motion, after application of shiatsu stimulation to the gluteal region and posterior lower limb.

II. Methods

1. Subjects

Research was conducted on 27 healthy, stiff-bodied males (aged 18–57 years; average age: 32.2 years old) with standing forward flexion values ranging from –2.3 cm to –24.5 cm (average: –10 cm).

2. Test location and test period

Testing was conducted in the shiatsu research lab at the Japan Shiatsu College between April 17 and June 26, 2004, on Saturday afternoons from 1:30PM to 5:00PM.

3. Items measured

Standing forward flexion was measured using a standing forward flexion gauge (Yagami Co., Ltd) and spinal range of motion was measured using a Spinal Mouse® (Index Co., Ltd.) spinal measurement device, with measurements carried out in three postures: erect, forward flexion, and posterior flexion. Muscle stiffness was measured using a Venustron (Axiom Co., Ltd.) muscle stiffness sensor, with measurements carried out bilaterally at the midpoints of the biceps femoris and the gastrocnemius.

Figures 1 and 2 show the testing equipment and examples of its use.

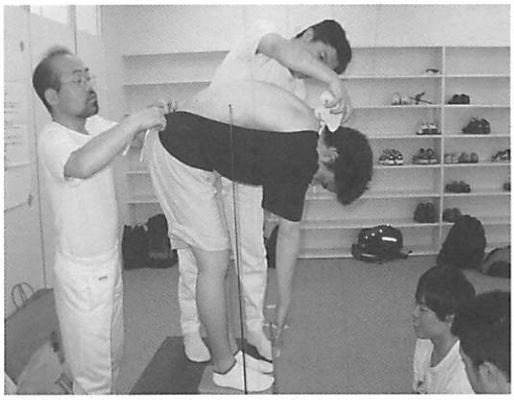

Fig. 1. Measurement using standing forward flexion and the Spinal Mouse®

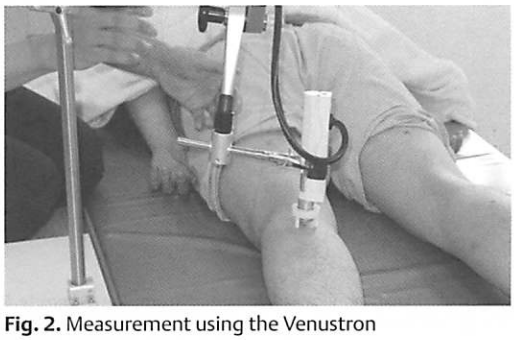

Fig. 2. Measurement using the Venustron

4. Data storage

Data was stored on a personal computer via the Spinal Mouse® and Venustron systems.

5. Stimulation (Fig. 3)

Full-body treatment is standard for Namikoshi shiatsu[4], a portion of which was carried out on the gluteal region and posterior limb in the prone position, as indicated below:

(1) 3 points, sacral region; 4 points, gluteal region; Namikoshi Point

(2) 10 points, posterior femoral region; 3 points, popliteal fossa

(3) 8 points, posterior crural region; 6 points, gastrocnemius muscle

(4) 3 points, calcaneal tubercle; 3 points, lateral and medial calcaneal region

(5) 4 points, plantar region; 1 point, arch of foot

Pressure was applied for 3 seconds per point, repeated 3 times per operation; for the Namikoshi Point, Point 1 inferior to the ischium, and the final application to Point 3 of the plantar region, continuous pressure was maintained for 5 seconds on the individual point, repeated 3 times. Standard pressure application methods were employed throughout (pressure gradually increased, sustained, and gradually decreased). Approximately 5–15 kg pressure was applied, depending on the comfort level of the test recipient.

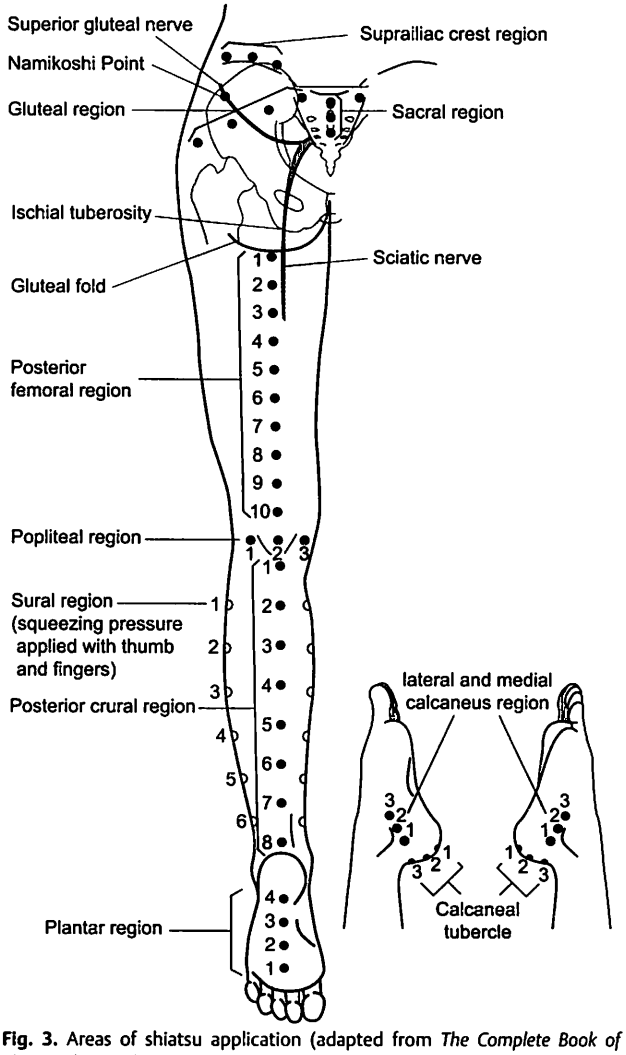

Fig. 3. Areas of shiatsu application (adapted from *The Complete Book of Shiatsu Therapy*, by Toru Namikoshi)

6. Test procedure

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 stiffness were applied bilaterally at the midpoints of the biceps femoris and the gastrocnemius.

Measurements for standing forward flexion and spinal range of motion were carried out on a 45 cm platform. Measurement of muscle stiffness and shiatsu treatment were carried out on a futon mattress laid out on a tatami-matted floor.

Stimulation was carried out in the following order, after test subjects filled out a questionnaire listing back pain and other everyday symptoms:

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

(2) Pre-treatment muscle stiffness measurements

(3) Treatment of sacral region, posterior leg, and plantar region according to basic Namikoshi shiatsu procedures

(4) Post-treatment muscle stiffness measurements

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

Test subjects were re-interviewed post-treatment to determine comfort or discomfort during treatment, subjective changes, and other information, and therapists recorded observations on changes in muscle tension, indurations, and other information.

7. Data processing

(1) Spinal range of motion (Figs. 4, 5)

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

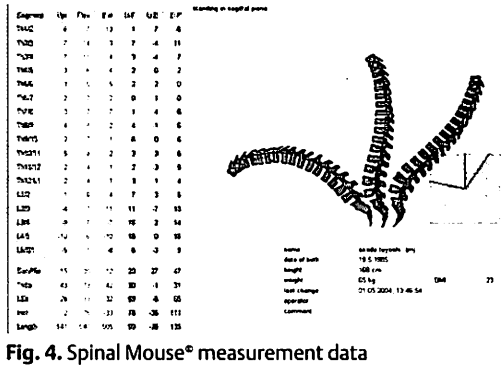

Fig. 4. Spinal Mouse® measurement data

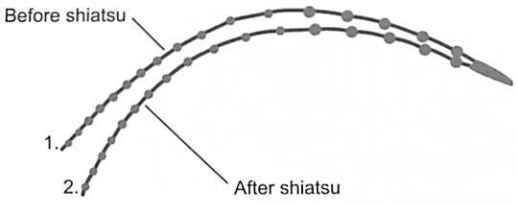

Fig. 5. Comparison of standing forward flexion before and after shiatsu

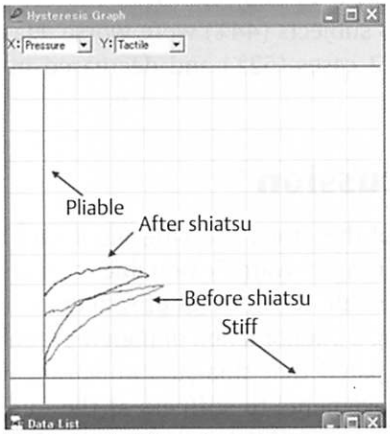

Fig. 6. Graph of Venustron measurements

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.

Figure 5 shows superimposed graphs of standing forward flexion before and after shiatsu, indicating increased spinal mobility after shiatsu.

(2) Muscle stiffness (Fig. 6)

The round-trip change in vibration frequency when the tactile sensor was depressed with a force of 30 g was compared before and after stimulation.

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. 7)

Pre-stimulation values were −9.9 ± 1.2 cm (mean ± SE) and post-stimulation values were −6.6 ± 1.4 cm, indicating a significant improvement ($p<0.01$). Of the total, 23 cases showed an improvement of 1 cm or greater, 2 cases showed no change, and 2 cases showed 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 3.3 cm.

2. Spinal range of motion

(1) Spinal angle of inclination (Fig. 8)

Pre-stimulation values were +105.1 ± 1.5° and post-stimulation values were +108 ± 1.9°, indicating a significant improvement ($p<0.01$). Of the total, 19 cases showed an improvement, 2 cases showed no change, and 6 cases showed a change for the worse. The average before-after change was 2.8°.

(2) Sacral angle of inclination (Fig. 9)

Pre-stimulation values were +56.5 ± 1.9° and post-stimulation values were +61.6 ± 2.3°. Of the total, 24 cases showed an improvement, 0 cases showed no change, and 3 cases showed a change for the worse. The average before-after change was 4.8°, which was recognized as a significant difference ($p<0.01$).

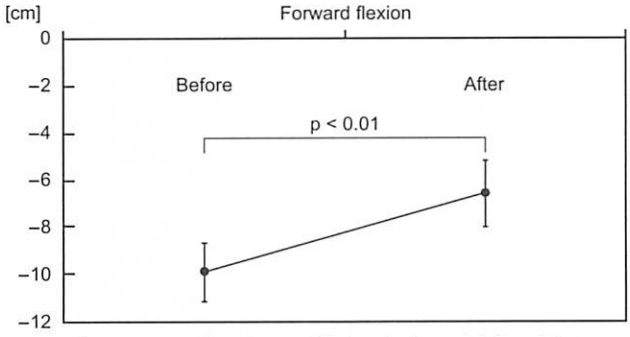

Fig. 7. Change in standing forward flexion before and after shiatsu

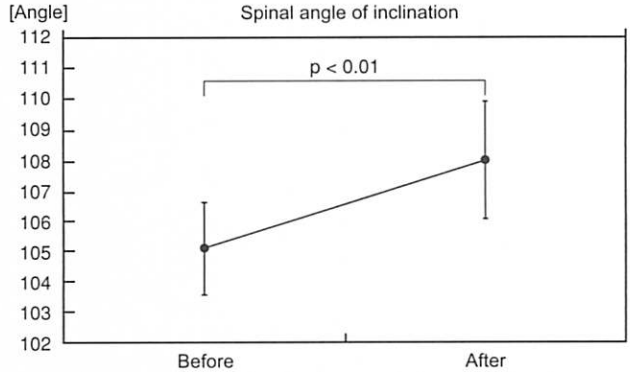

Fig. 8. Change in spinal angle of inclination before and after shiatsu

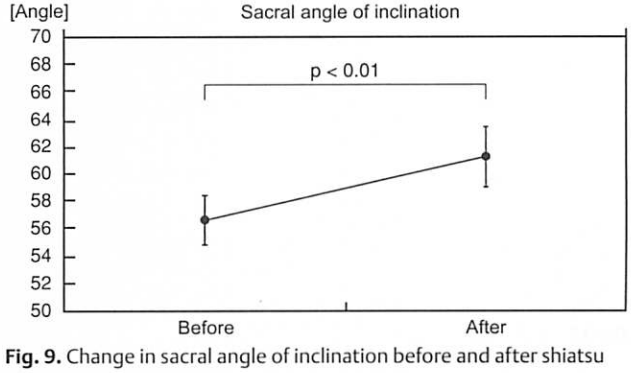

Fig. 9. Change in sacral angle of inclination before and after shiatsu

3. Correlation between standing forward flexion and spinal range of motion

(1) The changes in standing forward flexion and spinal angle of inclination before and after shiatsu had a correlation coefficient of r=0.817, confirming a significant correlation. (Fig. 10)

(2) The changes in standing forward flexion and sacral angle of inclination before and after shiatsu had a correlation coefficient of r=0.598, confirming a significant correlation. (Fig. 11)

4. Muscle stiffness

Of 23 test subjects, not counting 4 eliminated due to data errors:

(1) At the midpoint of the left biceps femoris, for muscle stiffness, 9 subjects (40%) showed improvement, 13 subjects (57%) were worse, and 1 subject (4%) showed no change. Elasticity increased in 12 cases (52%) and decreased in 11 cases (48%).

(2) At the midpoint of the right biceps femoris, for muscle stiffness, 11 subjects (48%) showed improvement and 12 subjects (52%) were worse. Elasticity increased in 14 cases (60%) and decreased in 9 cases (40%).

(3) At the midpoint of the left gastrocnemius, for muscle stiffness, 12 subjects (52%) showed improvement, 10 subjects (44%) were worse, and 1 subject (4%) showed no change. Elasticity increased in 15 cases (65%) and decreased in 8 cases (35%).

(4) At the midpoint of the right gastrocnemius, for muscle stiffness, 13 subjects (57%) showed improvement and 10 subjects (44%) were worse. Elasticity increased in 12 cases (52%) and decreased in 11 cases (48%).

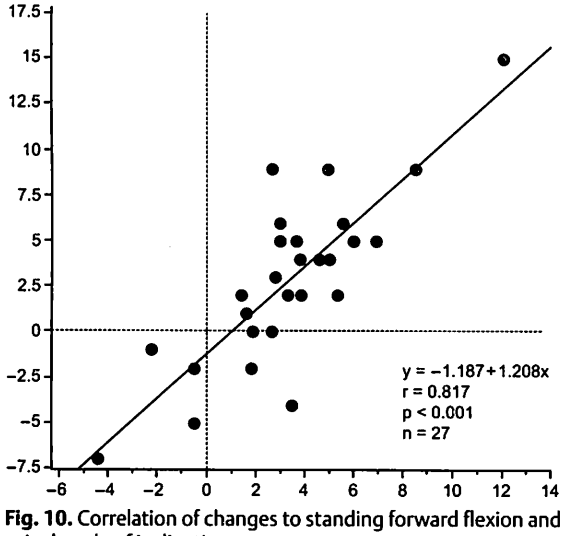

Fig. 10. Correlation of changes to standing forward flexion and spinal angle of inclination

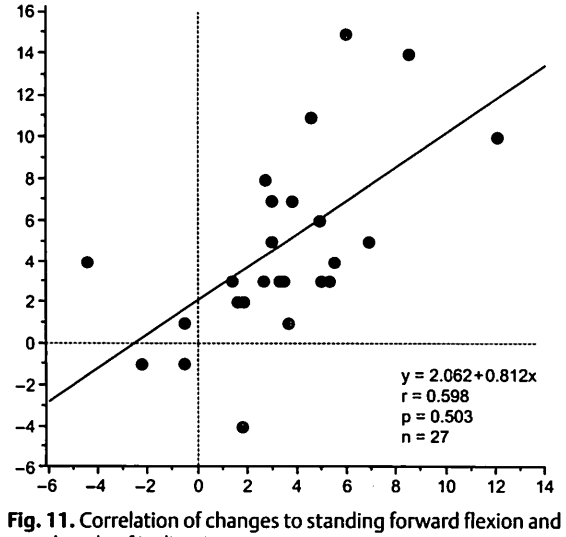

Fig. 11. Correlation of changes to standing forward flexion and sacral angle of inclination

IV. Discussion

The results of this study showing significant improvement in standing forward flexion due to shiatsu stimulation corroborate the findings of Asai et al[1] and Eto et al[3], indicating a phenomenon of high reproducibility.

We anticipated that shiatsu stimulation would result in improvements to stiffness at the midpoints of the biceps femoris and the gastrocnemius, but clear results could not be obtained from measurement values of the muscle stiffness sensor. Possible reasons for this are:

(1) The Venustron measurement sensor was depressed 10 mm, just as last year, but this depth may have been too shallow for large muscles such as the biceps femoris and the gastrocnemius.

(2) The locations where pain occurs in the hamstrings and gastrocnemius during forward flexion are near the tendons, not the muscle belly, so perhaps measurements should have been taken where the indurations occur. This is being considered as a topic for future study.

V. Conclusions

Spinal range of motion and standing forward flexion were improved by shiatsu stimulation to the posterior lower limb.

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

References

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2 Sugata N et al: Shiatsu shigeki ni yoru kin no junansei ni taisuru koka (dai 2 ho). Toyo ryohogakko kyokai gakkaishi 26: 35-39, 2002 (in Japanese)

3 Eto T et al: Shiatsu shigeki ni yoru kin no junansei ni taisuru koka (dai 3 ho). Toyo ryohogakko kyokai gakkaishi 27: 97-100, 2003 (in Japanese)

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