

Effects of Shiatsu Stimulation to the Head Region on Pupil Diameter, Heart Rate, and Blood Pressure

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I. Introduction

The Japan Shiatsu College has been conducting ongoing research to clarify the effects of shiatsu stimulation on autonomic nervous system functions, and has previously reported in the Journal of the Japan College Association of Oriental Medicine that shiatsu stimulation of healthy test subjects results in 1) lower heart rate^{1), 2)}, 2) lower blood pressure²⁾, 3) increased muscle blood flow³⁾, and 4) increased electrogastrography dominant power⁴⁾⁻⁶⁾. These reports have shown that shiatsu stimulation affects various autonomic nervous system functions.

Because the pupil, which is innervated by autonomic nerves, is frequently used as an indicator for autonomic nervous system function, we anticipated that shiatsu stimulation would affect pupil diameter via the autonomic nervous system. Starting in 2010, we began studying the effects of shiatsu stimulation on pupil diameter, and have shown that shiatsu stimulation to the abdomen, anterior cervical region, and sacral region significantly reduces pupil diameter⁷⁾⁻⁹⁾.

Based on previous research, in this report we study the effects on pupil diameter of shiatsu stimulation to the head region, as well as blood pressure and heart rate.

II. Methods

1. Subjects

Research was conducted on 22 healthy adult students and instructors of the Japan Shiatsu College (9 male, 13 female) between the ages of 20 and 46, with an average age of 34.7 ± 8.6 years old. Test procedures were fully explained to each test subject and their prior consent obtained.

2. Test period and location

Testing was conducted in the basic medicine research lab at the Japan Shiatsu College between April 27 and August 10, 2013. Regarding the test environment, room

temperature was $22 \pm 2.0^\circ\text{C}$, humidity was $79 \pm 15.0\%$, and illumination was 100 lux.

3. Measurement procedures

Changes in pupil diameter were measured using a binocular electronic pupillometer (Newopto Corp. ET-200) (Fig. 1).

Changes in blood pressure and heart rate were measured using a continuous blood pressure manometer (MediSense MUB101) (Fig. 2).



Fig. 1. Binocular electronic pupillometer



Fig. 2. Measurement using continuous blood pressure manometer

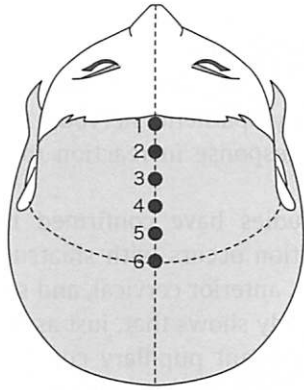


Fig. 3. Six points on median line of head region

4. Stimulation

Area of stimulation (Fig. 3)

With the test subject in the supine position, shiatsu stimulation was applied using two-thumb pressure to the six points of the median line of the head, as per basic Namikoshi shiatsu. Stimulation was applied for 3 seconds per point, repeated for 3 minutes using standard pressure (pressure gradually increased, sustained, and gradually decreased) with the amount of pressure applied classified as standard (pressure regulated so as to be pleasurable for the test subject).

5. Test procedure (Fig. 4)

Test procedures were fully explained to each subject and their prior consent obtained. They were also questioned on physical condition and history of eye disease.

Two tests were performed, one in which shiatsu stimulation was applied (hereafter, the stimulation group) and one in which no shiatsu stimulation was applied (hereafter, the non-stimulation group). Both interventions were carried out on all 22 test subjects on different days.

For the stimulation group, pupil diameter, blood pressure, and heart rate were measured on test subjects resting in the supine position for 3 minutes prior to shiatsu stimulation, 3 minutes during stimulation, and 3 minutes post-stimulation, for a total of 9 minutes.

For the non-stimulation group, pupil diameter, blood pressure, and heart rate were measured on test subjects resting in the supine position, as with the stimulation group, for 9 minutes.

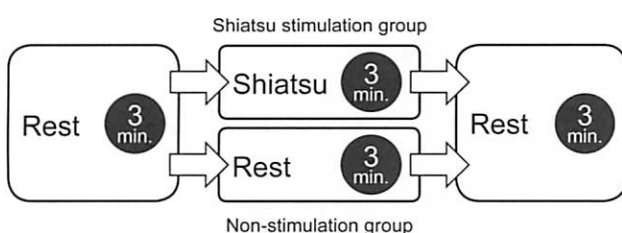


Fig. 4. Test procedure



Fig. 5. Measurement using pupillometer

For measurement of pupil diameter, test subjects were told to focus on a 1.5 cm mark affixed within their field of vision (Fig. 5).

6. Data analysis

The measurement taken 60 seconds prior to stimulation (Bf.60) was established as the control value, and calculations performed using data taken at 30-second intervals during stimulation (St.) and post-stimulation (Af.)

7. Statistical processing

Pupil diameter, blood pressure, and heart rate were analyzed with a mixed model using two-way analysis of variance, and a Bonferroni multiple comparison was carried out on each group. A significance level of <5% was determined to be significant.

III. Results

1. Pupil diameter (Fig. 6)

For right pupil diameter, a chronological reciprocal effect was displayed between the stimulation and non-stimulation groups ($p = 0.002$). In the stimulation group, right pupil constriction occurred at 150 seconds after stimulation ($p = 0.032$) compared to pre-stimulation, whereas in the non-stimulation group there was no change.

For left pupil diameter, a chronological reciprocal effect was displayed between the stimulation and non-stimulation groups ($p = 0.007$). In the stimulation group, left pupil constriction occurred at 150 seconds after stimulation ($p = 0.039$) compared to pre-stimulation, whereas in the non-stimulation group there was no change.

2. Blood pressure and heart rate

With regard to systolic and diastolic blood pressure and heart rate, no chronological change was observed in either the stimulation group or the non-stimulation group.

IV. Discussion

In this study, no significant change in pupil diameter was observed in the non-stimulation group, whereas in the group that received shiatsu stimulation to the head region, significant constriction of the pupil occurred.

It has been reported that pupil dilation occurs in response to pain stimulation¹⁰⁾. We may assume that a dilation response did not occur in this study because subjects received standard shiatsu stimulation unaccompanied by pain.

Pupil diameter is governed by sympathetic nerves (cervical sympathetic nerves), which control the dilator pupillae muscle, and parasympathetic nerves (oculomotor nerve), which control the sphincter pupillae muscle. The pupillary constriction response due to shiatsu stimulation observed in this study was probably due to an autonomic nervous system response involving either stimulation of the parasympathetic nervous system, which controls the sphincter pupillae muscle, suppression of the sympathetic nervous system, which controls the dilator pupillae muscle, or a combination of the two.

It has been shown that the sympathetic nervous system is involved in pupillary responses involving the higher brain centers^{11), 12)}, but Ohsawa et al¹³⁾ and Shimura et al¹⁴⁾ showed that reflexive pupil dilation occurs in anesthetized rats due to electro-acupuncture and pinch stimulation, and is unaffected by severing

cervical sympathetic nerves, confirming that dilation occurs due to suppression of the parasympathetic nervous system. They also reported on the important role the parasympathetic nervous system plays in the pupillary response in reaction to somatosensory stimulation.

Previous studies have confirmed that significant pupil constriction occurs with shiatsu stimulation to the abdominal, anterior cervical, and sacral regions⁷⁾⁻⁹⁾. The current study shows that, just as with these other regions, a significant pupillary constriction response also occurs due to shiatsu stimulation to the head region.

V. Conclusions

From this study performed on healthy adults, the following is evident:

1. Shiatsu stimulation of the head region displayed a compensation effect compared to no stimulation, and pupil diameter was significantly constricted after completion of stimulation.
2. No change was observed in systolic or diastolic blood pressure or heart rate.

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

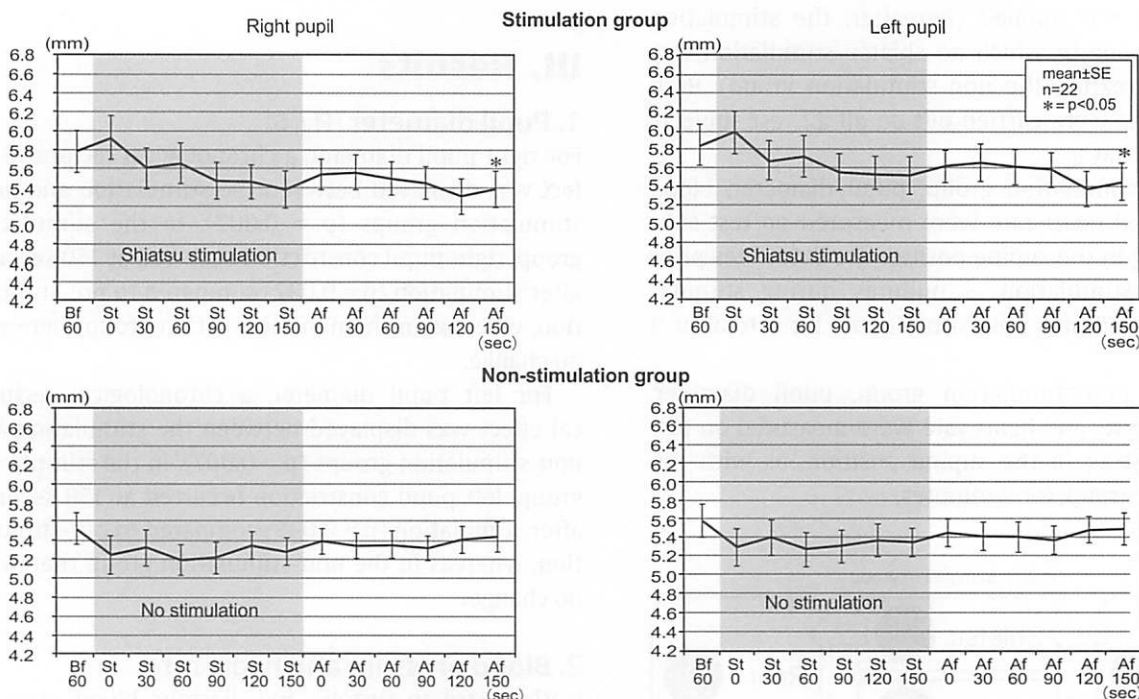


Fig. 6. Changes to pupil diameter due to shiatsu stimulation of head region
Upper graphs show the stimulation group and lower graphs show the non-stimulation group. On each graph, the vertical axis represents pupil diameter (mm) and horizontal axis represents elapsed time (sec), with mean ± SE displayed. Bf: pre-stimulation (control); St: during stimulation; Af: post-stimulation

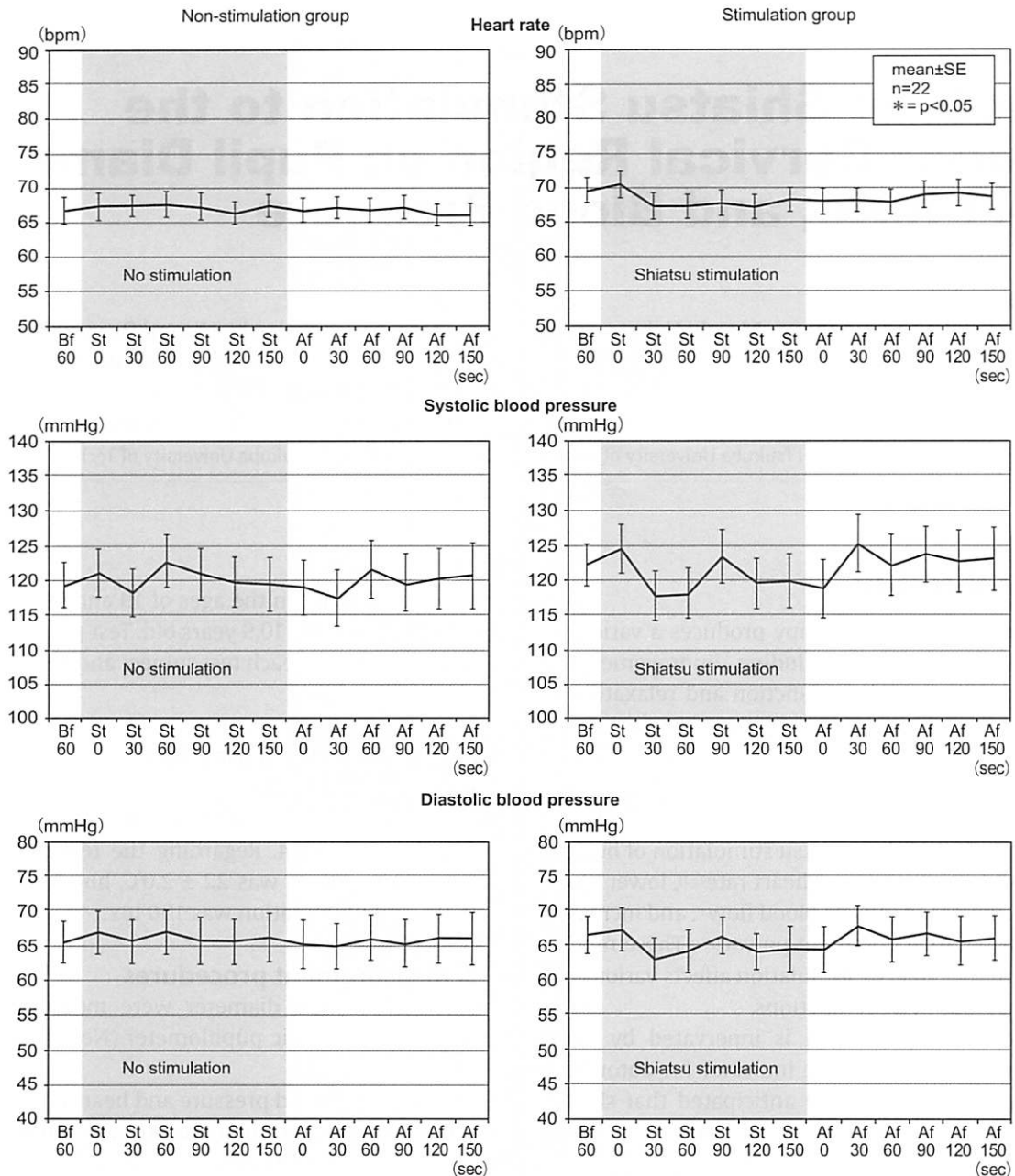


Fig. 7. Changes to heart rate and blood pressure due to shiatsu stimulation of head region

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