Collected Reports of the Shiatsu Therapy Research Lab

2013-2017

Japan Shiatsu College

Foreword

On Publication of the Collected Reports of the Shiatsu Therapy Research Lab Volume III

This year marks the 20th anniversary of the establishment of the Shiatsu Therapy Research Lab. In each year, we have presented the results of one or two studies at the medical conference held by the Japan College Association of Oriental Medicine, and published reports on those findings in the association's journal. Some of our studies have earned awards. This remarkable accomplishment is due entirely to efforts of the successive generations of researchers and their teaching advisors. In particular, I would like to thank professor Hidetoshi Mori and associate professor Hideo Ohsawa of the Tsukuba College of Technology for their supervision and guidance.

Many of our researchers carry on in the spirit of scientific inquiry even after graduation, applying their skills in clinical settings and in continuing research activities with the Shiatsu Society of Japan, delivering oral and written presentations and teaching practical skills.

In recent years, the imperative of evidence-based medicine (EBM) has extended its influence to Oriental medicine as well. It is our goal to develop shiatsu as a therapeutic modality with a firm basis in medical science. The reports published herein, along with the previous collections, together represent a succession of steps toward this goal.

In two years time, it will become possible in Japan for institutions to register as specialized vocational universities, and it is my understanding that several schools intend to apply. This will likely result in a large volume of specialized research papers being published. In this vital period when one can anticipate an increase in the number of anma, massage, and shiatsu vocational colleges, I encourage everyone to return to their roots and continue to conduct solid, high-quality research.

March 2018

Hiroshi Ishizuka
Principal, Japan Shiatsu College

In 1946, Tokujiro Namikoshi constructed a building in Dentsuin-mae, Tokyo, to serve as a shiatsu college and began disseminating his techniques in earnest. Since that time, the effectiveness of shiatsu therapy has come to be recognized by a great many people.

However, amassing scientific evidence to support this widely recognized effectiveness is a daunting task. One factor is that the shiatsu therapy we normally practice involves treating the entire body while adapting the treatment in response to changes detected in the subject's body. In order to verify shiatsu's effectiveness, though, it is necessary to measure the response to a fixed amount of shiatsu stimulation to a specific area. This process diverges from shiatsu therapy in actual practice. In an effort to demonstrate the cumulative significance of the individual studies, we have conducted our research on an ongoing basis, with each report building on the results of those previous.

Since 1998 when we confirmed that shiatsu reduces the heart rate, we have continued to verify shiatsu's effectiveness on various areas of the body using different indicators. Ongoing studies have reported on shiatsu's effectiveness in lowering blood pressure, increasing muscle blood volume, increasing muscle pliability, improving spinal mobility, stimulating stomach motility, and eliciting the pupil constriction response. These research results alone provide a firm basis for a theoretical understanding of shiatsu's therapeutic effects.

In closing, I would like to thank the many students whose tireless efforts have made the various studies reported here possible. Their hard work and understanding of the importance of sharing knowledge of shiatsu's effectiveness with those unfamiliar with shiatsu have been paramount.

March 2018

Kazuo Watanabe
Advisor, Shiatsu Therapy Research Lab

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2013-2017

Japan Shiatsu College

Contents

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

Japan Shiatsu College
Students: Shinpei Oki, Ryosuke Sasaki, Takako Takeuchi, Mizuki Torii, Akiko Nagata, Masaki Uehara
Supervisors: Kazuo Watanabe, Tomoko Tanaka, Takeshi Honda, Kazuhiro Kurosawa, Hiroshi Ishizuka
Hideo Ohsawa (Tsukuba University of Technology), Hidetoshi Mori (Tsukuba University of Technology)

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 pressure[2)], 3) increased muscle blood flow[3)], and 4) increased electrogastrography dominant power[4)-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 diameter[7)-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 ± 2.0°C, humidity was 79 ± 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

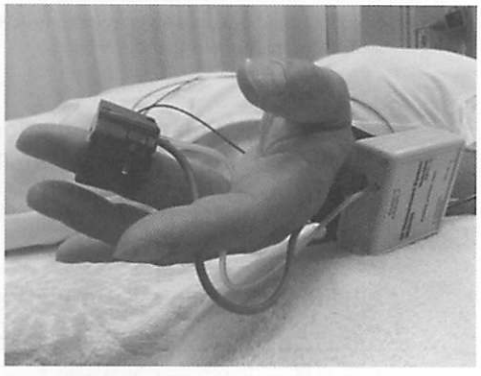

Fig. 2. Measurement using continuous blood pressure manometer

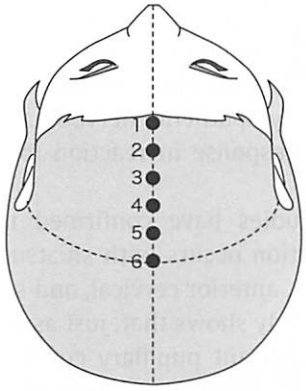

Fig. 3. Six points on median line of head region

Fig. 5. Measurement using pupillometer

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.

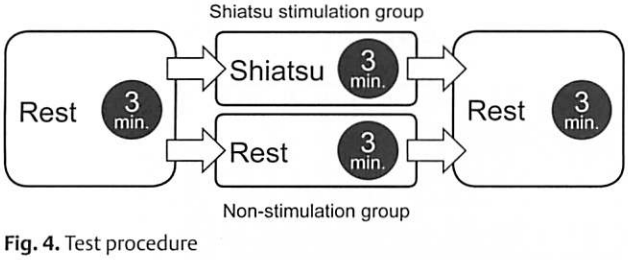

Fig. 4. Test procedure

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 stimulation[10]. 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 al[13)] and Shimura et al[14)] 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 regions[7)-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.

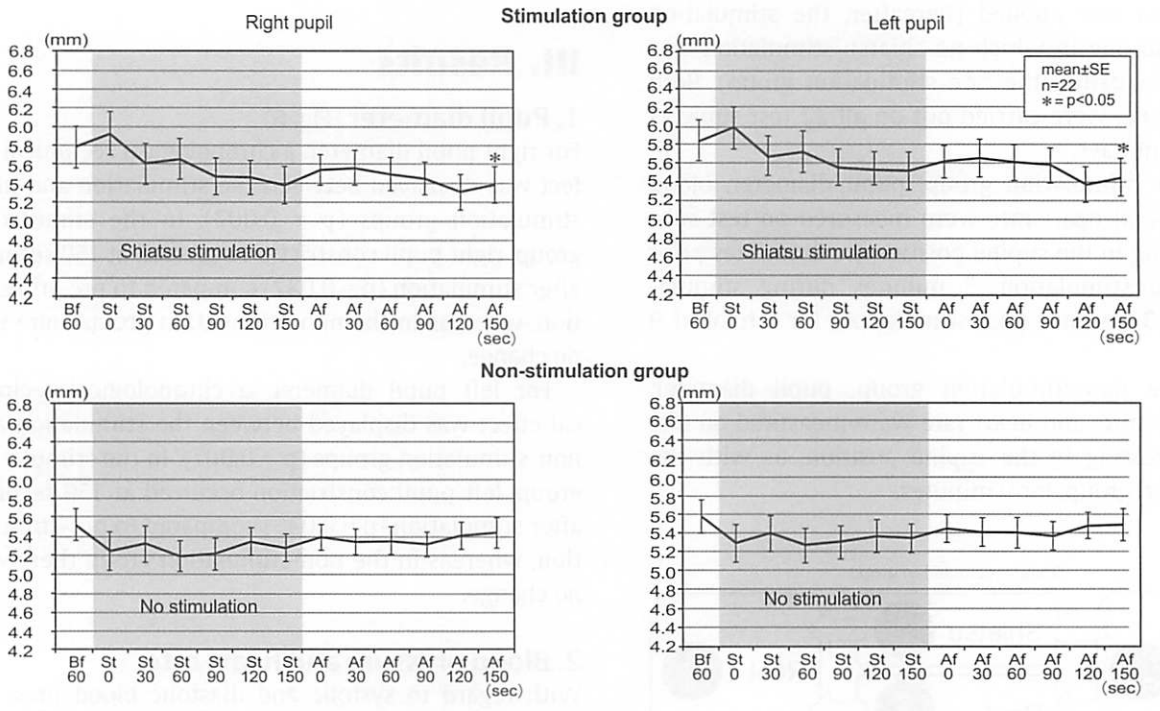

Fig. 6. Changes to pupil diameter due to shiatsu stimulation of head region
Upper graphs show the stimulation group and lower graphs show the non-stimulation group. On each graph, the vertical axis represents pupil diameter (mm) and horizontal axis represents elapsed time (sec), with mean ± SE displayed.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

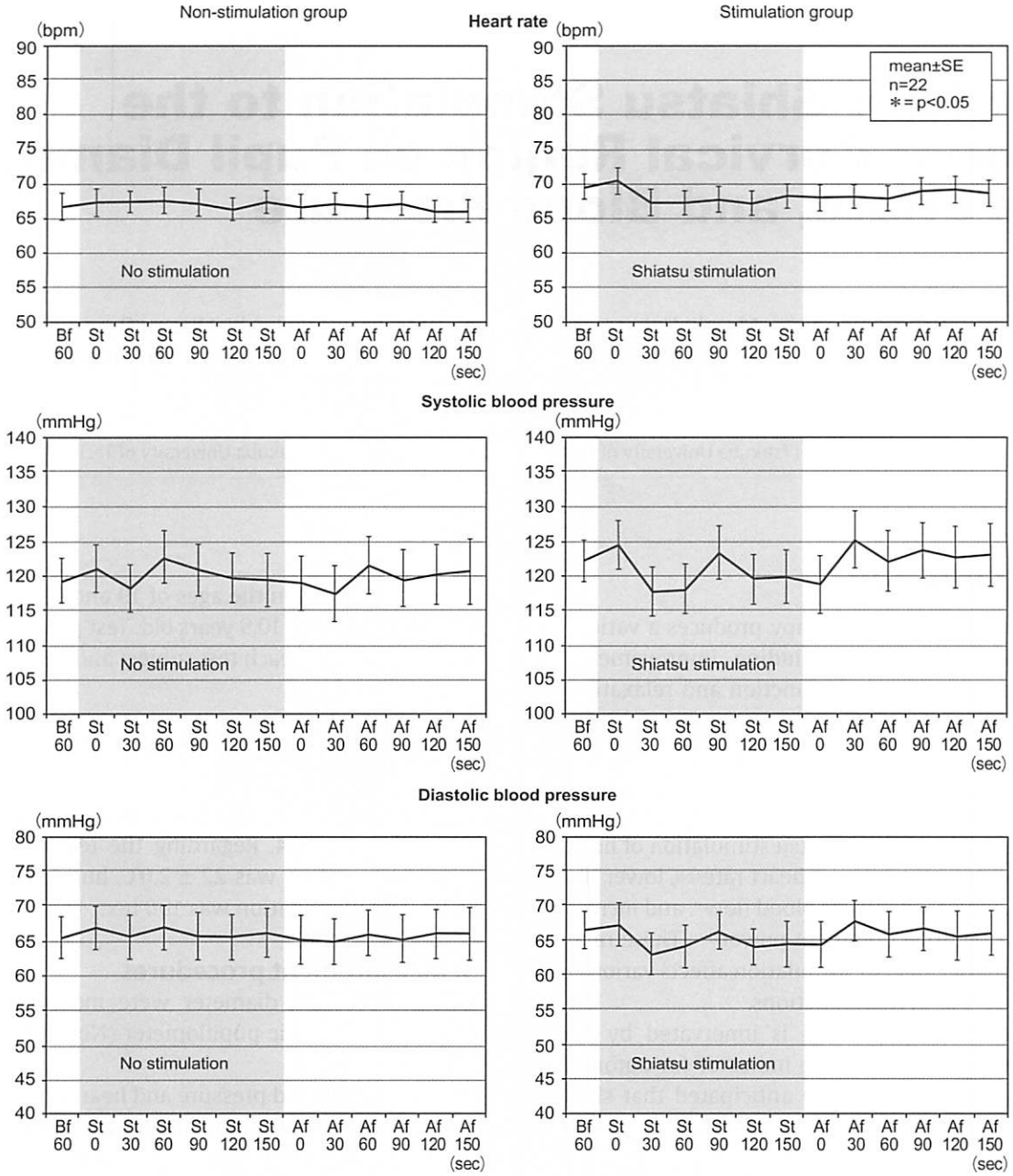

Fig. 7. Changes to heart rate and blood pressure due to shiatsu stimulation of head region

References

1 Koyata S et al: Shiatsu shigeki ni yoru shinjunkankei ni oyobosu koka ni tsuite. Toyo ryoho gakko kyokai gakkaishi 22: 40-45, 1998 (in Japanese)

2 Ide Y et al: Ketsuatsu ni oyobosu shiatsu shigeki no koka. Toyo ryoho gakko kyokai gakkaishi 23: 77-82, 1999 (in Japanese)

3 Kamohara H et al: Massho junkan ni oyobosu shiatsu shigeki no koka. Toyo ryoho gakko kyokai gakkaishi 24: 51-56, 2000 (in Japanese)

4 Sato K et al: Katai shiatsu shigeki ni yoru idenzu no henka. Toyo ryoho gakko kyokai gakkaishi 30: 34-38, 2006 (in Japanese)

5 Kurosawa K et al: Fukubushiatsu shigeki ni yoru idenzu no henka. Toyo ryoho gakko kyokai gakkaishi 31: 55-58, 2007 (in Japanese)

6 Kato R et al: Zenkeibu shiatsu shigeki ga jiritsu shinkei kino ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 32: 75-79, 2008 (in Japanese)

7 Kurihara K et al: Fukubu shaitsu shigeki ga dokochokkei ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 34: 129-132, 2010 (in Japanese)

8 Yokota M et al: Zenkeibu katai gaisokubu no shiatsu shigeki ga dokochokkei ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 35: 77-80, 2011 (in Japanese)

9 Watanabe T et al: Senkotsubu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 36: 15-19, 2012 (in Japanese)

10 Oono S: Pharmacological studies on pupillary reflex dilation. J Pharmacol 15: 91-112, 1965

11 Ward AAJ, Reed HL: Mechanism of pupillary dilation elicited by cortical stimulation. J Neurophysiol 9: 329-335, 1946

12 Lowenstein O, Loewenfeld IE: Role of sympathetic and parasympathetic systems in reflex dilation of the pupil: pupillographic studies. Arch Neurol Psych 64 (3): 313-340, 1950

13 Ohsawa H, Yamaguchi S, Ishimaru H et al: Neural mechanism of pupillary dilation elicited by electro-acupuncture stimulation in anesthetized rats. J Auton Nerv Syst 64 (2-3): 101-6, 1997

14 Shimura M, Ohsawa H, Tomita A, Sato A: Hifu shingai shigeki ni yoru hanshasei dokohanno. Jiritsushinkei 37 (5): 584-590, 2000 (in Japanese)

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

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Supervisors: Kazuo Watanabe, Tomoko Tanaka, Takeshi Honda, Kazuhiro Kurosawa, Hiroshi Ishizuka
Hideo Ohsawa (Tsukuba University of Technology), Hidetoshi Mori (Tsukuba University of Technology)

I. Introduction

It is known that shiatsu therapy produces a variety of physiological responses, including improvement of autonomic nervous system function and relaxation of muscle tone[1].

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 that shiatsu stimulation of healthy test subjects results in lower heart rate[2, 3], lower blood pressure[2], increased muscle blood flow[3], and increased electrogastrography dominant power[5-7]. These reports have shown that shiatsu stimulation affects various autonomic nervous system functions.

Because the pupil, which is innervated by autonomic nerves, is used as one 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, sacral region, and head region significantly reduces pupil diameter. On the other hand, shiatsu stimulation to the lateral crural region did not result in significant reduction in pupil diameter[8-11].

Based on previous research, in this report we measure changes to pupil diameter due to shiatsu stimulation of the antebrachial region, an area that has not been studied before. We also measure blood pressure and heart rate.

II. Methods

1. Subjects

Research was conducted on 26 healthy adult students and instructors of the Japan Shiatsu College (16 male, 10 female) between the ages of 19 and 61, with an average age of 35.6 ± 10.9 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 19 and September 8, 2014. Regarding the test environment, room temperature was 22 ± 2.0°C, humidity was 79 ± 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

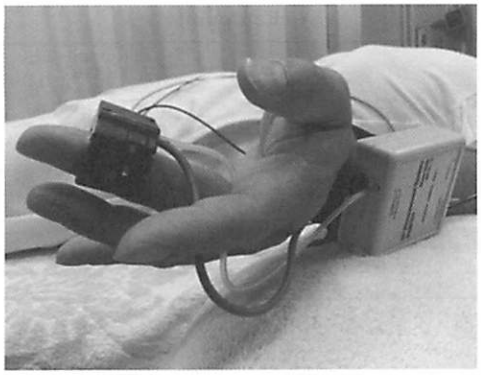

Fig. 2. Measurement using continuous blood pressure manometer

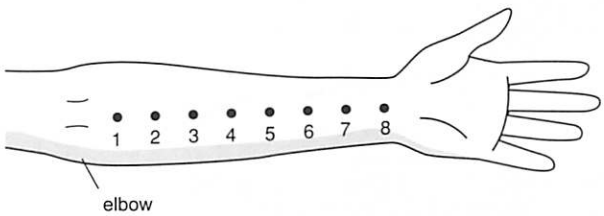

Fig. 3. Eight points on median line of medial antebrachial region

4. Stimulation

Area of stimulation (Fig. 3)

With the test subject in the supine position, stimulation was applied using two-thumb pressure to the eight points of the median line of the right medial antebrachial region, 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 subjects were 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 26 test subjects on different days.

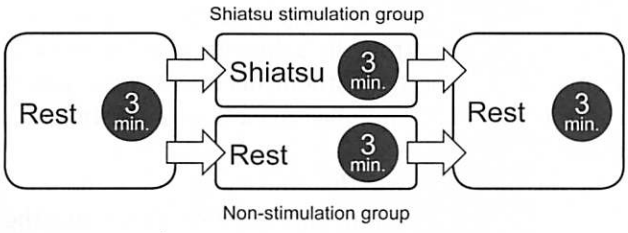

Fig. 4. Test procedure

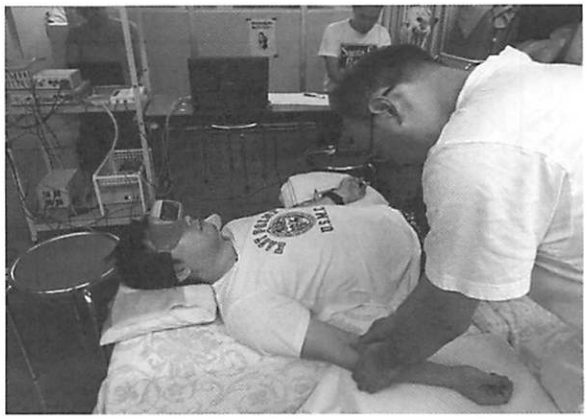

Fig. 5. Measurement using pupillometer

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. 5).

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

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.) Analysis was performed using IBM SPSS Statistics (ver. 22).

7. Statistical processing

Chronological changes to pupil diameter, heart rate, and blood pressure for each group were subject to linear analysis using a mixed-model, Bonferroni multiple comparison, and reciprocal effect was subject to linear analysis using a mixed model. A significance level of <5% was determined to be significant.

III. Results

1. Pupil diameter (Fig. 6)

For right pupil diameter, no chronological reciprocal effect was displayed between the stimulation and non-stimulation groups. In the stimulation group, transient right pupil dilation was observed immediately after commencement of stimulation, followed by a trend toward constriction, with significant constriction measured at 150 seconds during stimulation ($p = 0.03$) and at 60 seconds post-stimulation ($p = 0.046$), compared

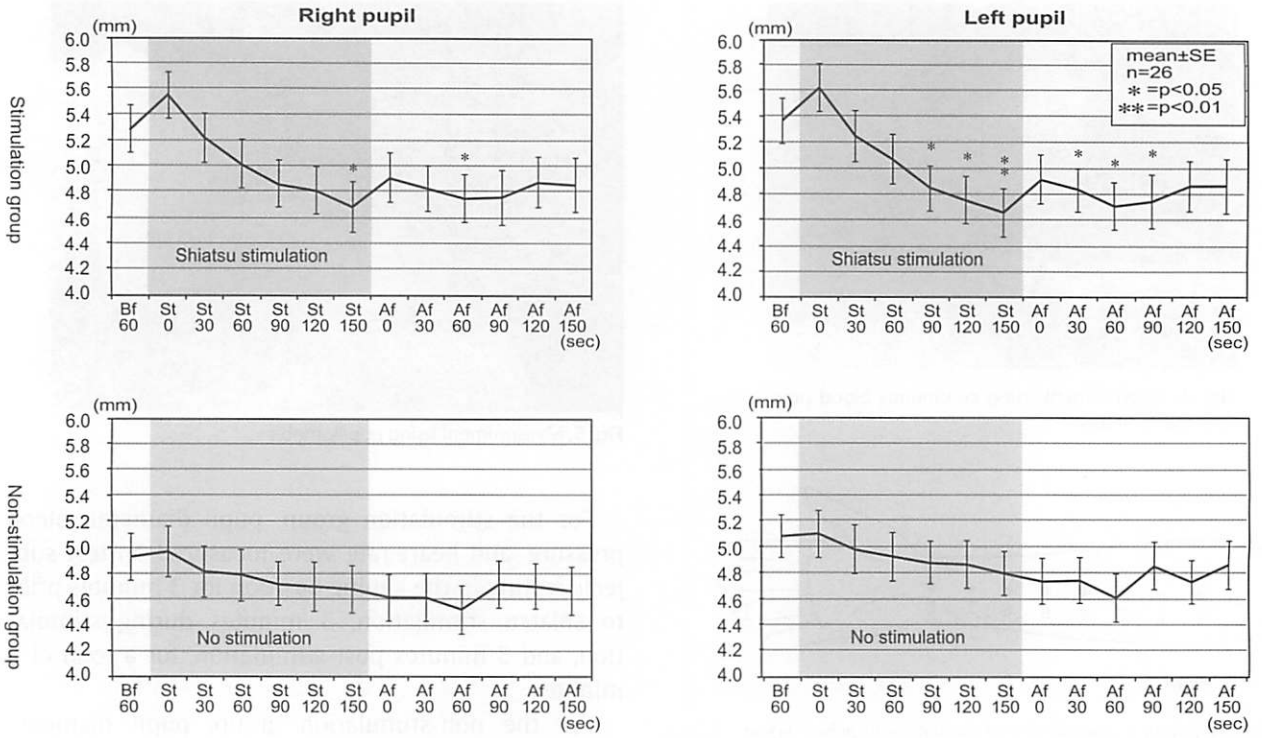

Fig. 6. Changes to pupil diameter due to shiatsu stimulation of antebrachial region
Upper graphs show the stimulation group and lower graphs show the non-stimulation group. On each graph, the vertical axis represents pupil diameter (mm) and horizontal axis represents elapsed time (sec), with mean ± SE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

to pre-stimulation (control). In the non-stimulation group, right pupil diameter showed a gradual trend toward constriction, but there was no significant change compared to pre-stimulation.

For left pupil diameter, no chronological reciprocal effect was displayed between the stimulation and non-stimulation groups. In the stimulation group, transient left pupil dilation was observed immediately after commencement of stimulation, followed by a trend toward constriction, with significant constriction measured at 90 seconds ($p = 0.043$), 120 seconds ($p = 0.022$), and 150 seconds ($p = 0.009$) during stimulation, and at 30 seconds ($p = 0.035$), 60 seconds ($p = 0.012$), and 90 seconds ($p = 0.028$) post-stimulation, compared to pre-stimulation. In the non-stimulation group, right pupil diameter showed a gradual trend toward constriction, but there was no significant change compared to pre-stimulation (control).

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 (Fig. 7).

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 antebrachial region, significant constriction of the pupil occurred.

With regard to systolic and diastolic blood pressure and heart rate, no significant difference was observed when comparing the stimulation and non-stimulation groups.

It has been reported that pupil dilation occurs in response to pain stimulation[12]. 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[13),14)], but Ohsawa et al[15)] and Shimura

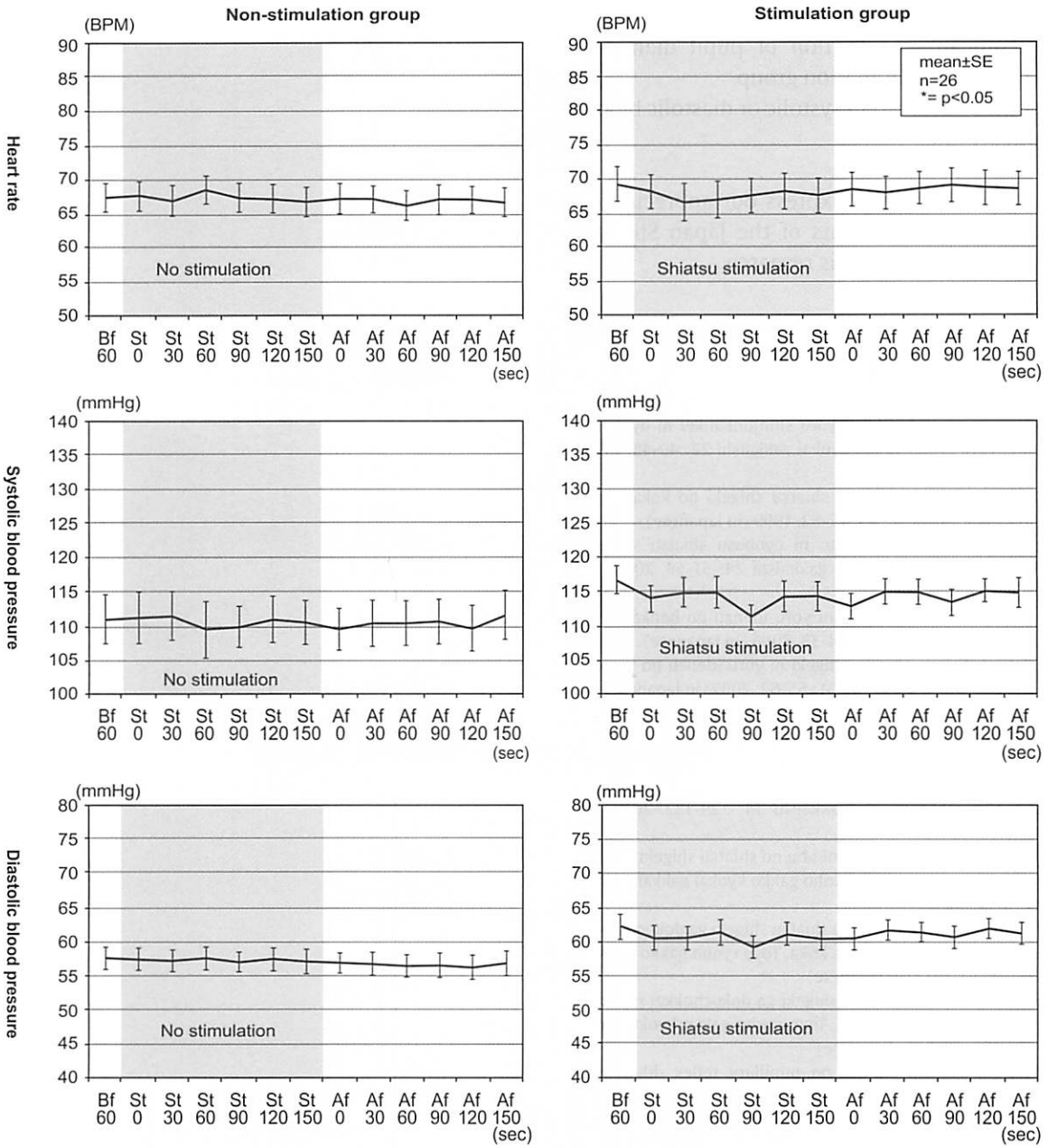

Fig. 7. Changes to heart rate and blood pressure due to shiatsu stimulation of antebrachial region

et al[16] 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 conducted up to last year have confirmed that significant pupil constriction occurs with shiatsu stimulation to the abdominal, anterior cervical, sacral, and head regions[8)-11)]. The current study shows that a significant pupillary constriction response also occurs due to shiatsu stimulation to the antebrachial region. This pupillary response suggests that shiatsu stimulation probably causes excitation of the parasympathetic nervous system.

In the report on the lateral crural region by Yokota et al[9], when comparing the stimulation and non-stimulation groups, no significant constriction in pupil diameter was observed. This suggests that the constriction response differs depending on which region is subject to shiatsu stimulation. Further study is necessary to determine the different effects of shiatsu stimulation depending on the region.

V. Conclusions

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

1. Shiatsu stimulation of the antebrachial region resulted in significant constriction of pupil diameter compared to the non-stimulation group.
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.

References

1 Mori H, editor: Zukai kihon jutushiki anma massaji shiatsu ni yoru zenshin chosei. Ishiyaku Publishers, Inc., Tokyo, 2006 (in Japanese)
2 Koyata S et al: Shiatsu shigeki ni yoru shinjunkankei ni oyobosu koka ni tsuite. Toyo ryoho gakko kyokai gakkaishi 22: 40-45, 1998 (in Japanese)
3 Ide Y et al: Ketsuatsu ni oyobosu shiatsu shigeki no koka. Toyo ryoho gakko kyokai gakkaishi 23: 77-82, 1999 (in Japanese)
4 Kamohara H et al: Massho junkan ni oyobosu shiatsu shigeki no koka. Toyo ryoho gakko kyokai gakkaishi 24: 51-56, 2000 (in Japanese)
5 Sato K et al: Katai shiatsu shigeki ni yoru idenzu no henka. Toyo ryoho gakko kyokai gakkaishi 30: 34-38, 2006 (in Japanese)
6 Kurosawa K et al: Fukubushiatsu shigeki ni yoru idenzu no henka. Toyo ryoho gakko kyokai gakkaishi 31: 55-62, 2007 (in Japanese)
7 Kato R et al: Zenkeibu shiatsu shigeki ga jiritsu shinkei kino ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 32: 75-79, 2008 (in Japanese)
8 Kurihara K et al: Fukubu shaitsu shigeki ga dokochokkei ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 34: 129-132, 2010 (in Japanese)
9 Yokota M et al: Zenkeibu katai gaisokubu no shiatsu shigeki ga dokochokkei ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 35: 77-80, 2011 (in Japanese)
10 Watanabe T et al: Senkotsubu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 36: 15-19, 2012 (in Japanese)
11 Tadaka J et al: Tobu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 37: 154-158, 2013 (in Japanese)
12 Oono S: Pharmacological studies on pupillary reflex dilation. J Pharmacol 15: 95-112, 1965
13 Ward AAJ, Reed HL: Mechanism of pupillary dilation elicited by cortical stimulation. J Neurophysiol 9: 329-335, 1946
14 Lowenstein O, Loewenfeld IE: Role of sympathetic and parasympathetic systems in reflex dilation of the pupil. Arch Neurol Psych 64: 313-340, 1950
15 Ohsawa H, Yamaguchi S, Ishimaru H et al: Neural mechanism of pupillary dilation elicited by electro-acupuncture stimulation in anesthetized rats. J Auton Nerv Syst 64: 101-106, 1997
16 Shimura M, Ohsawa H, Tomita A, Sato A: Hifu shingai shigeki ni yoru hanshasei dokohanno. Jiritsushinkei 37: 584-590, 2000 (in Japanese)

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

Japan Shiatsu College
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I. Introduction

It is known that shiatsu therapy produces a variety of physiological responses, including improvement of autonomic nervous system function and relaxation of muscle tone[1].

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 that shiatsu stimulation of healthy test subjects results in lower heart rate[2,3], lower blood pressure[2], increased muscle blood flow[4], and increased electrogastrography dominant power[5-7]. These reports have shown that shiatsu stimulation affects various autonomic nervous system functions.

Because the pupil, which is innervated by autonomic nerves, is used as one 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, sacral region, head region, and antebrachial region significantly reduce pupil diameter. On the other hand, shiatsu stimulation to the lateral crural region did not result in significant reduction in pupil diameter[8-12].

Based on previous research, in this report we measure changes to pupil diameter, blood pressure, and heart rate due to shiatsu stimulation of the interscapular region, an area that has not been studied before.

II. Methods

1. Subjects

Research was conducted on 19 healthy adult male students and instructors of the Japan Shiatsu College between the ages of 21 and 54, with an average age of 34.7 ± 9.3 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 10 and July 25, 2015. Regarding the test environment, room temperature was 22 ± 2.0°C, humidity was 79 ± 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).

4. Stimulation

With the test subject in the right lateral position, stimulation was applied using two-thumb pressure to the five points of the right interscapular region, parallel

Fig. 1. Binocular electronic pupillometer

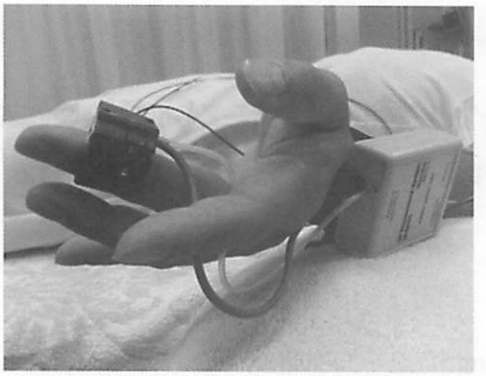

Fig. 2. Measurement using continuous blood pressure manometer

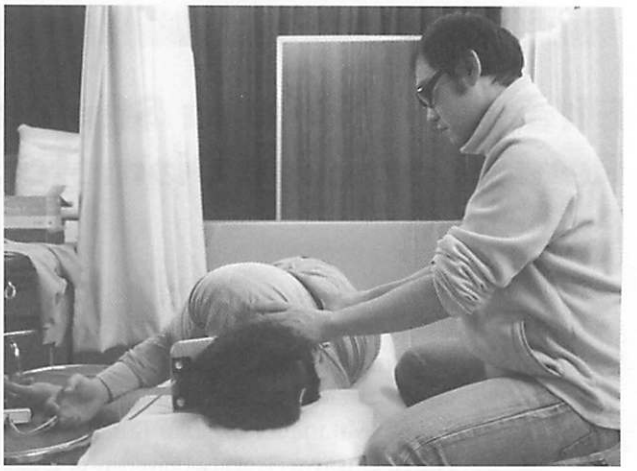

Fig. 5. Measurement of shiatsu stimulation group

to the spine, as per basic Namikoshi shiatsu (Fig. 3). 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 subjects were 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 19 test subjects on different days.

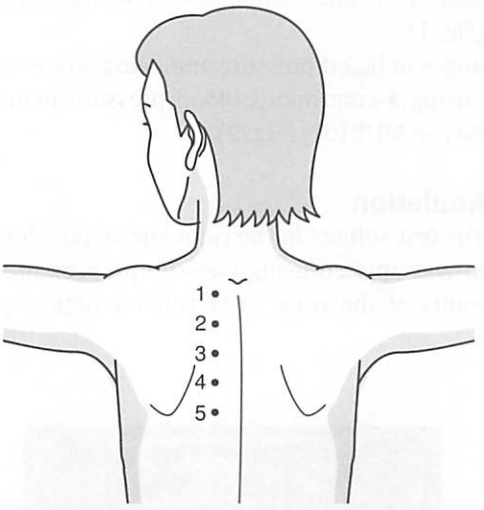

Fig. 3. Area of stimulation (5 points of interscapular region)

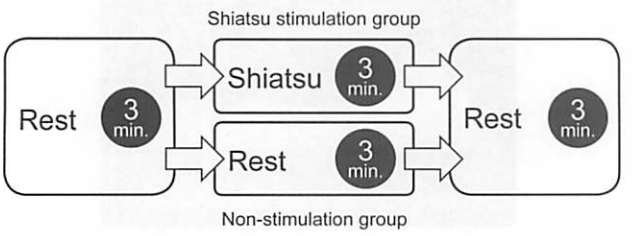

Fig. 4. Test procedure

For the stimulation group, pupil diameter, blood pressure, and heart rate were measured on test subjects resting in the lateral 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 lateral position, as with the stimulation group, for 9 minutes. (Fig. 5)

For measurement of pupil diameter, test subjects were told to focus on a mark affixed within their field of vision.

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.) Analysis was performed using IBM SPSS Statistics (ver. 22).

7. Statistical processing

Chronological changes to pupil diameter, heart rate, and blood pressure for each group were subject to linear analysis using a mixed-model, Bonferroni multiple comparison, and alternation effect was subject to linear analysis using a mixed model. A significance level of <5% was determined to be significant.

III. Results

1. Pupil diameter (Fig. 6)

Right pupil diameter: In the stimulation group,

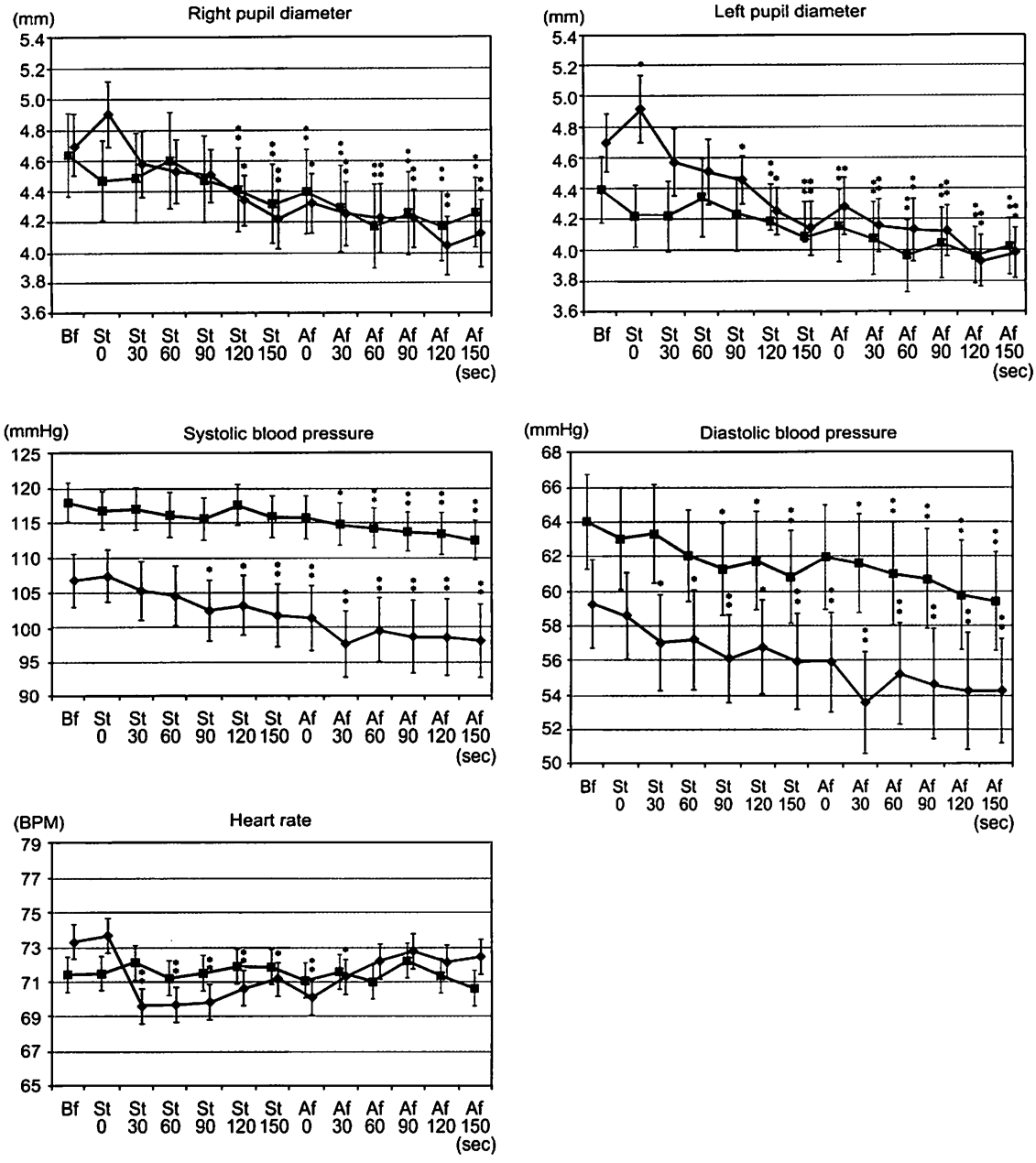

Fig. 6. Changes to pupil diameter, blood pressure, and heart rate due to shiatsu stimulation of the interscapular region
The vertical axis represents pupil diameter (mm) and the horizontal axis represents elapsed time (sec). On each graph, Bf: pre-stimulation (control); St: during stimulation; Af: post-stimulation.
Stimulation group: (◆), Non-stimulation group: (▩), * $p < 0.05$, ** $p < 0.01$

transient right pupil dilation was observed immediately after commencement of stimulation, followed by a trend toward constriction, with constriction measured at 120 seconds ($p = 0.003$) and 150 seconds ($p < 0.0001$) during stimulation and at 0 seconds ($p = 0.002$), 30 seconds ($p < 0.0001$), 60 seconds ($p < 0.0001$), 90 seconds ($p < 0.0001$), 120 seconds ($p < 0.0001$), and 150 seconds ($p < 0.0001$) post-stimulation, compared to pre-stimulation (Control). The non-stimulation group displayed significant constriction at 120 seconds ($p = 0.05$) and 150 seconds ($p = 0.005$) during the stimulation period and at 0 seconds ($p = 0.037$), 30 seconds ($p = 0.002$), 60 seconds ($p < 0.0001$), 90 seconds ($p = 0.001$), 120 seconds ($p < 0.0001$), and 150 seconds ($p = 0.001$) during the post-stimulation period, compared to the pre-stimulation period (Control). No chronological alternation effect was displayed between the two groups ($p = 0.067$).

Left pupil diameter: In the stimulation group, transient right pupil dilation was observed immediately after commencement of stimulation ($p = 0.044$), followed by a trend toward constriction, with constriction measured at 90 seconds ($p = 0.024$), 120 seconds ($p < 0.0001$), and 150 seconds ($p < 0.0001$) during stimulation and at 0 seconds ($p < 0.0001$)), 30 seconds ($p < 0.0001$), 60 seconds ($p < 0.0001$), 90 seconds (p

< 0.0001), 120 seconds (p < 0.0001), and 150 seconds (p < 0.0001) post-stimulation, compared to pre-stimulation (Control). The non-stimulation group displayed significant constriction at 120 seconds (p = 0.044) and 150 seconds (p = 0.003) during the stimulation period and at 0 seconds (p = 0.019), 30 seconds (p = 0.002), 60 seconds (p < 0.0001), 90 seconds (p = 0.001), 120 seconds (p < 0.0001), and 150 seconds (p < 0.0001) during the post-stimulation period, compared to the pre-stimulation period (Control). No chronological alternation effect was displayed between the two groups (p < 0.0001).

2. Heart rate and blood pressure (Fig. 6)

Heart rate: In the stimulation group, heart rate decreased at 30 seconds (p < 0.0001), 60 seconds (p < 0.0001), 90 seconds (p < 0.0001), 120 seconds (p < 0.001) and 150 seconds (p = 0.01) during stimulation and at 0 seconds (p < 0.0001) and 30 seconds (p = 0.015) post-stimulation, compared to pre-stimulation (Control). The non-stimulation group showed no change compared to pre-stimulation (Control). A chronological alternation effect was displayed between the stimulation and non-stimulation groups (p < 0.0001).

Systolic blood pressure: In the stimulation group, systolic blood pressure decreased at 90 seconds (p = 0.017), 120 seconds (p = 0.047), and 150 seconds (p = 0.005) during stimulation and at 0 seconds (p = 0.003), 30 seconds (p < 0.0001), 60 seconds (p < 0.0001), 90 seconds (p < 0.0001), 120 seconds (p < 0.0001), and 150 seconds (p < 0.0001) post-stimulation, compared to pre-stimulation (Control).The non-stimulation group showed a decrease at 30 seconds (p = 0.014), 60 seconds (p = 0.004), 90 seconds (p = 0.001), 120 seconds (p = 0.001), and 150 seconds (p < 0.0001) in the post-stimulation period, compared to the pre-stimulation period (Control). No alternation effect was displayed between the groups (p = 0.051).

Diastolic blood pressure: In the stimulation group, diastolic blood pressure decreased at 30 seconds (p = 0.023) 60 seconds (p = 0.036), 90 seconds (p = 0.001), 120 seconds (p = 0.012), and 150 seconds (p = 0.001) during stimulation and at 0 seconds (p = 0.001), 30 seconds (p < 0.0001), 60 seconds (p < 0.0001), 90 seconds (p < 0.0001), 120 seconds (p < 0.0001), and 150 seconds (p < 0.0001) post-stimulation, compared to pre-stimulation (Control).The non-stimulation group showed a decrease at 90 seconds (p = 0.014), 120 seconds (p = 0.043), and 150 seconds during the stimulation period and at 30 seconds (p = 0.031), 60 seconds (p = 0.007), 90 seconds (p = 0.003), 120 seconds (p < 0.0001) and 150 seconds (p < 0.0001) in the post-stimulation period, compared to the pre-stimulation period (Control). No alternation effect was displayed between the groups (p = 0.622).

IV. Discussion

In this study, results indicated changes to pupil diameter, heart rate, and systolic and diastolic blood pressure due to shiatsu stimulation of the interscapular region. Also, additive action was displayed for left-side pupil diameter and heart rate, relative to the non-stimulation group.

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[13), 14)], but Ohsawa et al[15)] and Shimura et al[16)] 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 conducted up to last year have confirmed that significant pupil constriction occurs with shiatsu stimulation to the abdominal, anterior cervical, sacral, head, and antebrachial regions[8)-12)]. The current study shows that a pupillary constriction response also occurs due to shiatsu stimulation to the interscapular region. This pupillary response suggests that shiatsu stimulation probably causes excitation of the parasympathetic nervous system.

In the report on the lateral crural region by Yokota et al[9)], when comparing the stimulation and non-stimulation groups, no significant constriction in pupil diameter was observed. This suggests that the constriction response differs depending on which region is subject to shiatsu stimulation. Further study is necessary to determine the different effects of shiatsu stimulation depending on the region.

Also, although the pupillary reflex is bilaterally consensual in response to light, in this study additive action was only confirmed on the left side. It is possible that the pupillary reflex in response to shiatsu stimulation differs from the response to light.

V. Conclusions

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

Shiatsu stimulation of the interscapular region with the subject in the right lateral position resulted in left pupil diameter constriction and reduced heart rate both during and after stimulation, and displayed additive action compared to the non-stimulation group. Also, in the stimulation group, right pupil diameter constriction and reduced blood pressure occurred both during and after stimulation, with no interaction effect compared to the non-stimulation group.

The above indicates that shiatsu stimulation of the interscapular region had a greater effect on autonomic nervous system function than rest alone.

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

1 Mori H, editor: Zukai kihon jutushiki anma massaji shiatsu ni yoru zenshin chosei. Ishiyaku Publishers, Inc., Tokyo, 2006 (in Japanese)
2 Koyata S et al: Shiatsu shigeki ni yoru shinjunkankei ni oyobosu koka ni tsuite. Toyo ryoho gakko kyokai gakkaishi 22: 40-45, 1998 (in Japanese)
3 Ide Y et al: Ketsuatsu ni oyobosu shiatsu shigeki no koka. Toyo ryoho gakko kyokai gakkaishi 23: 77-82, 1999 (in Japanese)
4 Kamohara H et al: Massho junkan ni oyobosu shiatsu shigeki no koka. Toyo ryoho gakko kyokai gakkaishi 24: 51-56, 2000 (in Japanese)
5 Sato K et al: Katai shiatsu shigeki ni yoru idenzu no henka. Toyo ryoho gakko kyokai gakkaishi 30: 34-38, 2006 (in Japanese)
6 Kurosawa K et al: Fukubushiatsu shigeki ni yoru idenzu no henka. Toyo ryoho gakko kyokai gakkaishi 31: 55-62, 2007 (in Japanese)
7 Kato R et al: Zenkeibu shiatsu shigeki ga jiritsu shinkei kino ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 32: 75-79, 2008 (in Japanese)
8 Kurihara K et al: Fukubu shaitsu shigeki ga dokochokkei ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 34: 129-132, 2010 (in Japanese)
9 Yokota M et al: Zenkeibu katai gaisokubu no shiatsu shigeki ga dokochokkei ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 35: 77-80, 2011 (in Japanese)
10 Watanabe T et al: Senkotsubu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 36: 15-19, 2012 (in Japanese)
11 Tadaka J et al: Tobu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 37: 154-158, 2013 (in Japanese)
12 Kadomoto Y et al: Zenwanbu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 38: 13-17, 2014 (in Japanese)
13 Ward AAJ, Reed HL: Mechanism of pupillary dilation elicited by cortical stimulation. J Neurophysiol 9: 329-335, 1946
14 Lowenstein O, Loewenfeld IE: Role of sympathetic and parasympathetic systems in reflex dilation of the pupil. Arch Neurol Psych 64: 313-340, 1950
15 Ohsawa H, Yamaguchi S, Ishimaru H et al: Neural mechanism of pupillary dilation elicited by electro-acupuncture stimulation in anesthetized rats. J Auton Nerv Syst 64: 101-106, 1997
16 Shimura M, Ohsawa H, Tomita A, Sato A: Hifu shingai shigeki ni yoru hanshasei dokohanno. Jiritsushinkei 37: 584-590, 2000 (in Japanese)

Effects of Shiatsu Stimulation to the Lateral Cervical and Superior Nuchal Line Regions on Pupil Diameter, Heart Rate, and Blood Pressure

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Hideo Ohsawa (Tsukuba University of Technology), Hidetoshi Mori (Tsukuba University of Technology)

I. Introduction

It is known that shiatsu therapy produces a variety of physiological responses, including improvement of autonomic nervous system function and relaxation of muscle tone[1]. 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 that shiatsu stimulation of healthy test subjects results in lower heart rate[2), 3)], lower blood pressure[2)], increased muscle blood flow[3)], and increased electrogastrography dominant power[5)-7)]. These reports have shown that shiatsu stimulation affects various autonomic nervous system functions.

Because the pupil, which is innervated by autonomic nerves, is used as one 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, sacral region, head region, antebrachial region, and interscapular region significantly reduce pupil diameter[8)-13)]. On the other hand, shiatsu stimulation to the lateral crural region did not result in significant reduction in pupil diameter[9)].

Based on previous research, in this report we measure changes to pupil diameter due to shiatsu stimulation of the lateral cervical and superior nuchal line regions, an area that has not been studied before. We also measure blood pressure and heart rate.

II. Methods

1. Subjects

Research was conducted on 35 healthy adult students and instructors of the Japan Shiatsu College (24 male, 11 female) between the ages of 19 and 63, with an average age of 34.7 ± 11.2 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 16 and July 13, 2016. Regarding the test environment, room temperature was 22 ± 2.0°C, humidity was 79 ± 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), with the subject in the supine position. Changes in blood pressure and heart rate were measured using a continuous blood pressure manometer (MediSense MUB101) (Fig. 2), detected at either the right middle or the right ring finger (Fig. 3).

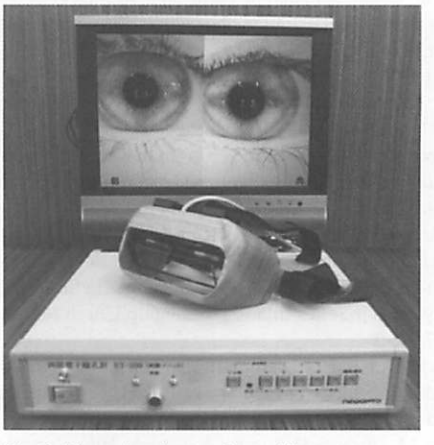

Fig. 1. Binocular electronic pupillometer (Newopto Corp. ET-200)

Fig. 2. Measurement using continuous blood pressure manometer (MediSense MUB101)

Fig. 3. Scene from research lab

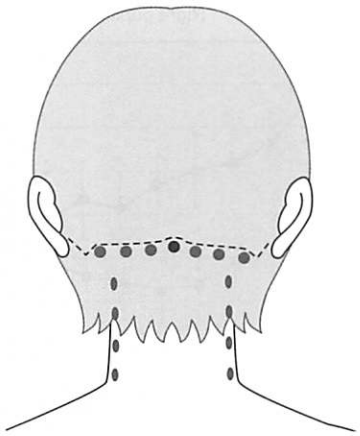

Fig. 4. Area of stimulation
4 points of lateral cervical region; 3 points of superior nuchal line; 1 point of medulla oblongata

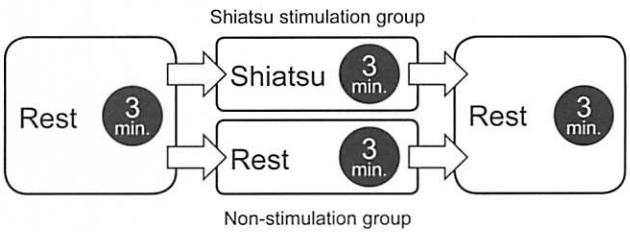

Fig. 5. Test procedure

4. Stimulation

With the subject in the supine position, stimulation was applied bilaterally to the four points of the lateral cervical region, bilaterally to the three points of the superior nuchal line, and to the one point of the medulla oblongata (occipital condyle) (Fig. 4). 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 5)

Prior to testing, test subjects were 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 test subjects on different days.

For the stimulation group, test subjects rested in the lateral position for 3 minutes prior to shiatsu stimulation (60 seconds prior to stimulation: Control), followed by 3 minutes of stimulation (St. 0, St. 30, St. 60, St. 90, St.120, St.150), and 3 minutes post-stimulation (Af. 0, Af. 30, Af. 60, Af. 90, Af.120, Af.150), for a total of 9 minutes.

For the non-stimulation group, test subjects rested in the supine position, as with the stimulation group, for 9 minutes. (Fig. 5)

For measurement of pupil diameter, test subjects were told to focus on a mark affixed within their field of vision.

6. Data analysis

The measurement taken 60 seconds prior to stimulation (Control) was established as the control value, and calculations performed using data taken at 30-second intervals during stimulation (St.) and post-stimulation (Af.) Analysis was performed using IBM SPSS Statistics (ver. 22).

7. Statistical processing

Pupil diameter, heart rate, and blood pressure were subject to linear analysis using a mixed-model, Bonferroni multiple comparison. The groups were compared using reciprocal effect. Significance level was 5%.

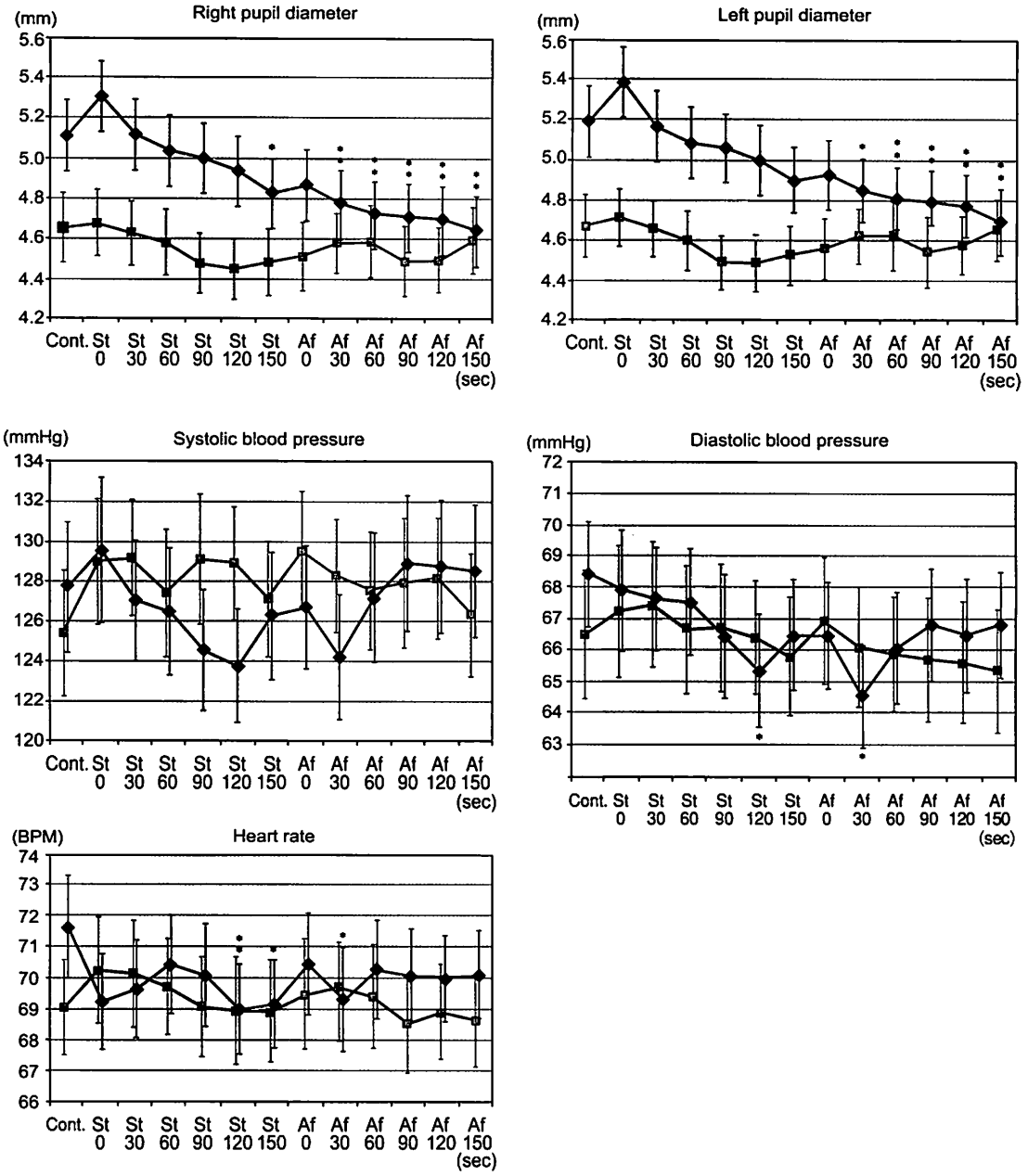

Fig. 6. Changes to pupil diameter, blood pressure, and heart rate due to shiatsu stimulation of the lateral cervical and superior nuchal line regions
The vertical axis represents pupil diameter (mm) and the horizontal axis represents elapsed time (sec). On each graph, Cont: pre-stimulation (control); St: during stimulation; Af: post-stimulation. n = 35, mean ± SE
Stimulation group: (◆), Non-stimulation group: (▣), * $p < 0.05$, ** $p < 0.01$

III. Results

1. Pupil diameter (Fig. 6)

Right pupil response: In the stimulation group, pupil constriction was observed at St. 150 ($p = 0.031$), Af. 30 ($p = 0.002$), Af. 60 ($p < 0.001$), Af. 90 ($p < 0.001$), Af. 120 ($p < 0.001$), and Af. 150 ($p < 0.001$), compared to Control. In the non-stimulation group, no chronological change occurred. A comparison of chronological changes between the stimulation and non-stimulation groups indicated a cancellation effect ($p < 0.001$).

Left pupil response: In the stimulation group, pupil constriction was observed at Af. 30 ($p = 0.011$), Af. 60 ($p = 0.001$), Af. 90 ($p < 0.001$), Af. 120 ($p < 0.001$), and Af. 150 ($p < 0.001$), compared to Control. In the non-stimulation group, no chronological change occurred. A comparison of chronological changes between the stimulation and non-stimulation groups indicated a cancellation effect ($p < 0.001$).

2. Heart rate and blood pressure (Fig. 6)

Heart rate: In the stimulation group, heart rate decreased at St. 0 ($p = 0.018$), St. 120 ($p = 0.004$), St. 150 ($p = 0.01$) and Af. 30 ($p = 0.025$), compared to Control. The non-stimulation group showed chronological change.

A comparison of chronological changes between the stimulation and non-stimulation groups indicated a cancellation effect ($p < 0.011$).

Systolic blood pressure: No chronological changes compared to Control were observed in either the stimulation or the non-stimulation groups. A comparison of chronological changes between the stimulation and non-stimulation groups indicated a reciprocal effect ($p = 0.002$).

Diastolic blood pressure: In the stimulation group, diastolic blood pressure decreased at St. 120 ($p = 0.01$) and Af. 30 ($p < 0.001$) compared to Control. The non-stimulation group showed no chronological change. A comparison of chronological changes between the stimulation and non-stimulation groups indicated a cancellation effect ($p = 0.045$).

IV. Discussion

In this study, results indicated constriction of pupil diameter, decreased heart rate, and reduction of diastolic blood pressure due to shiatsu stimulation of the lateral neck and superior nuchal line regions.

It has been reported that pupil dilation occurs in response to pain stimulation[14]. 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[15, 16], but Ohsawa et al[17] and Shimura et al[18] 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 conducted up to last year have confirmed that significant pupil constriction occurs with shiatsu stimulation to the abdominal, anterior cervical, sacral, head, antebrachial, and interscapular regions[8-13], whereas no significant pupil constriction was observed due to shiatsu stimulation of the lateral crural region[9], suggesting that the constriction response differs depending on the region. The current study shows that a pupillary constriction response also occurs due to shiatsu stimulation to the lateral cervical and superior nuchal line regions. This pupillary response suggests that shiatsu stimulation probably causes excitation of the parasympathetic nervous system.

V. Conclusions

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

Shiatsu stimulation of the lateral cervical and superior nuchal line regions resulted in pupil diameter restriction and reduced heart rate both during and after stimulation, and displayed a compensation effect compared to the non-stimulation group.

Diastolic blood pressure was reduced both during and after stimulation, and displayed a compensation effect compared to the non-stimulation group.

The above indicates that shiatsu stimulation of the lateral cervical and superior nuchal line regions had a greater effect on autonomic nervous system function than rest alone.

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

1 Mori H, editor: Zukai kihon jutushiki anma massaji shiatsu ni yoru zenshin chosei. Ishiyaku Publishers, Inc., Tokyo, 2006 (in Japanese)
2 Koyata S et al: Shiatsu shigeki ni yoru shinjunkankei ni oyobosu koka ni tsuite. Toyo ryoho gakko kyokai gakkaishi 22: 40-45, 1998 (in Japanese)
3 Ide Y et al: Ketsuatsu ni oyobosu shiatsu shigeki no koka. Toyo ryoho gakko kyokai gakkaishi 23: 77-82, 1999 (in Japanese)
4 Kamohara H et al: Massho junkan ni oyobosu shiatsu shigeki no koka. Toyo ryoho gakko kyokai gakkaishi 24: 51-56, 2000 (in Japanese)
5 Sato K et al: Katai shiatsu shigeki ni yoru idenzu no henka. Toyo ryoho gakko kyokai gakkaishi 30: 34-38, 2006 (in Japanese)
6 Kurosawa K et al: Fukubushiatsu shigeki ni yoru idenzu no henka. Toyo ryoho gakko kyokai gakkaishi 31: 55-62, 2007 (in Japanese)
7 Kato R et al: Zenkeibu shiatsu shigeki ga jiritsu shinkei kino ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 32: 75-79, 2008 (in Japanese)
8 Kurihara K et al: Fukubu shaitsu shigeki ga dokochokkei ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 34: 129-132, 2010 (in Japanese)
9 Yokota M et al: Zenkeibu katai gaisokubu no shiatsu shigeki ga dokochokkei ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 35: 77-80, 2011 (in Japanese)
10 Watanabe T et al: Senkotsubu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 36: 15-19, 2012 (in Japanese)
11 Tadaka J et al: Tobu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 37: 154-158, 2013 (in Japanese)

12 Kadomoto Y et al: Zenwanbu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 38: 13-17, 2014 (in Japanese)
13 Hayashi T et al: Kenkokanbu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 39: 83-87, 2015 (in Japanese)
14 Oono S: Pharmacological studies on pupillary reflex dilation. J Pharmacol 15: 95-112, 1965
15 Ward AAJ, Reed HL: Mechanism of pupillary dilation elicited by cortical stimulation. J Neurophysiol 9: 329-335, 1946
16 Lowenstein O, Loewenfeld IE: Role of sympathetic and parasympathetic systems in reflex dilation of the pupil. Arch Neurol Psych 64: 313-340, 1950
17 Ohsawa H, Yamaguchi S, Ishimaru H et al: Neural mechanism of pupillary dilation elicited by electro-acupuncture stimulation in anesthetized rats. J Auton Nerv Syst 64: 101-106, 1997
18 Shimura M, Ohsawa H, Tomita A, Sato A: Hifu shingai shigeki ni yoru hanshasei dokohanno. Jiritsushinkei 37: 584-590, 2000 (in Japanese)

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

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I. Introduction

It is known that shiatsu therapy produces a variety of physiological responses, including improvement of autonomic nervous system function and relaxation of muscle tone[1].

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 that shiatsu stimulation of healthy test subjects results in lower heart rate[2),3], lower blood pressure[2], increased muscle blood flow[3], and increased electrogastrography dominant power[5)-7]. These reports have shown that shiatsu stimulation affects various autonomic nervous system functions.

Because the pupil, which is innervated by autonomic nerves, is used as one indicator for autonomic nervous system function, we anticipated that shiatsu stimulation would affect pupil diameter via the autonomic nervous system. Starting in 2010, we have studied the effects of shiatsu stimulation on pupil diameter, and have shown that shiatsu stimulation to the abdomen, anterior cervical region, sacral region, head region, antebrachial region, interscapular region, and lateral cervical and superior nuchal line regions significantly reduce pupil diameter. On the other hand, shiatsu stimulation to the lateral crural region did not result in significant reduction in pupil diameter[8)-12].

Based on previous research, in this report we measure changes to pupil diameter due to shiatsu stimulation of the subscapular region, an area that has not been studied before. We also measure blood pressure and heart rate.

II. Methods

1. Subjects

Research was conducted on 34 healthy adult students and instructors of the Japan Shiatsu College (17 male, 17 female) between the ages of 20 and 64, with an average age of 38.2 ± 10.8 years old. Test procedures were fully explained to each test subject and their prior informed written consent obtained.

2. Test period and location

Testing was conducted in the basic medicine research lab at the Japan Shiatsu College between April 28 and June 30, 2017. Regarding the test environment, room temperature was 25 ± 2.0°C, humidity was 65 ± 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 (Newopto Corp. ET-200)

Fig. 2. Measurement using continuous blood pressure manometer (MediSense MUB101)

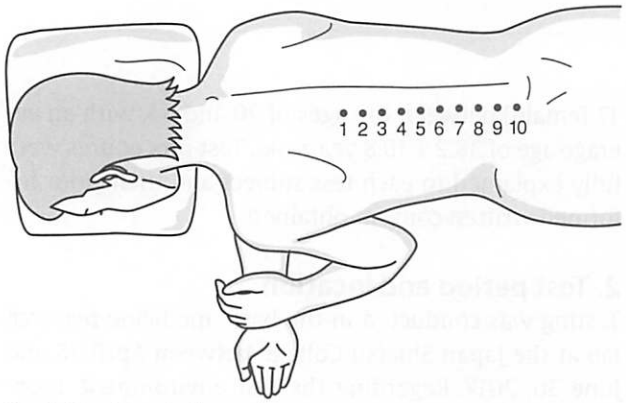

Fig. 3. 10 points of subscapular region

4. Stimulation

Area of stimulation (Fig. 3)

With the subject in the right lateral position, stimulation was applied to ten points parallel to the spine in the subscapular region, in accordance with the ten points of basic Namikoshi shiatsu for the left subscapular region, using thumb-on-thumb pressure. 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 subjects were questioned on physical condition and history of eye disease.

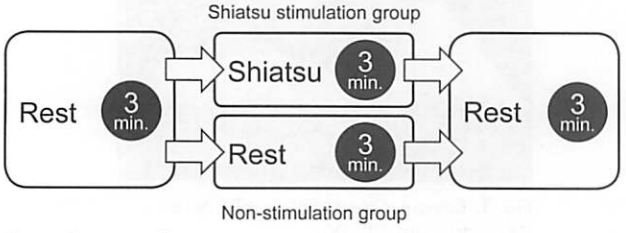

Fig. 4. Test procedure

Fig. 5. Measuring pupil diameter using pupillometer

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 test subjects on different days.

For the stimulation group, test subjects rested in the lateral position for 3 minutes prior to shiatsu stimulation, followed by 3 minutes of stimulation, and 3 minutes post-stimulation, for a total of 9 minutes, during which time their pupil diameter, blood pressure, and heart rate were measured.

For the non-stimulation group, test subjects rested in the lateral position, as with the stimulation group, for 9 minutes, during which time their pupil diameter, blood pressure, and heart rate were measured. (Fig. 5)

For measurement of pupil diameter, test subjects were told to focus on a mark affixed within their field of vision.

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 before stimulation (Bf.), during stimulation (St.), and post-stimulation (Af.) Analysis was performed using IBM SPSS Statistics (ver. 22).

7. Statistical processing

Chronological changes to pupil diameter, heart rate, and blood pressure were subject to linear analysis using a mixed-model, Bonferroni multiple comparison. The groups were compared using reciprocal action. Significance level was 5%.

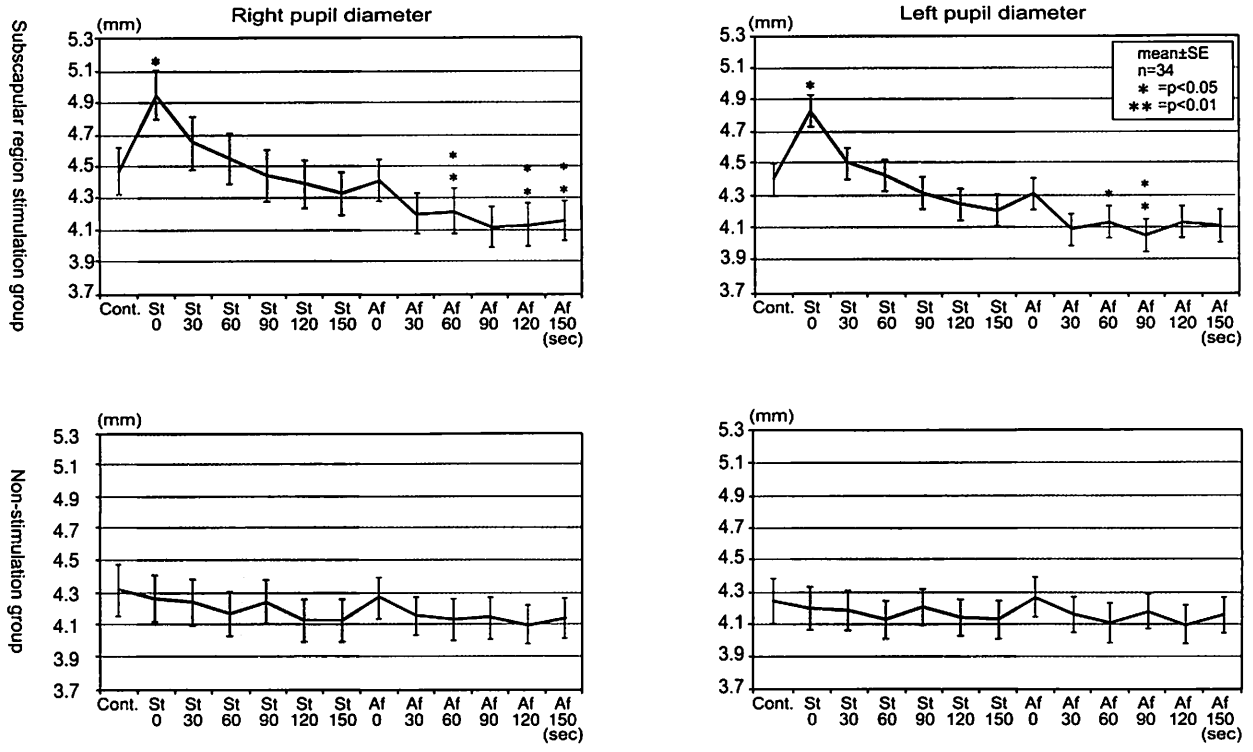

Fig. 6. Changes to pupil diameter due to shiatsu stimulation of the subscapular region
The vertical axis represents pupil diameter (mm) and the horizontal axis represents elapsed time (sec). On each graph, Cont: pre-stimulation (control); St: during stimulation; Af: post-stimulation. n = 34, mean ± SE, * $p < 0.05$, * * $p < 0.01$

III. Results

1. Pupil diameter (Fig.6)

Right pupil response: In the stimulation group, significant pupil dilation of 4.95 ± 0.91 mm ($p < 0.001$) was observed immediately after stimulation began, followed by gradual, continuing, significant pupil constriction observed post-stimulation at 60 sec. (4.17 ± 0.79 mm ($p < 0.002$)), 120 sec. (4.13 ± 0.80 mm ($p = 0.003$), and 150 sec. (4.16 ± 0.73 mm ($p = 0.010$)), compared to pre-stimulation (Control) values of 4.47 ± 0.85 mm (average ± SD). In the non-stimulation group, no chronological change occurred. A comparison of chronological changes between the stimulation and non-stimulation groups indicated a cancellation effect ($p < 0.001$).

Left pupil response: In the stimulation group, significant pupil dilation of 4.83 ± 0.79 mm ($p < 0.001$) was observed immediately after stimulation began, followed by gradual, continuing, significant pupil constriction observed post-stimulation at 30 sec. (4.08 ± 0.64 mm ($p = 0.029$)) and 60 sec. (4.09 ± 0.71 mm ($p = 0.004$), compared to Control values of 4.40 ± 0.78. In the non-stimulation group, no chronological change occurred. A comparison of chronological changes between the stimulation and non-stimulation groups indicated a cancellation effect ($p < 0.001$).

2. Heart rate (Fig. 7)

In the stimulation group, significant reduction in heart rate was observed during stimulation at 30 sec. (69.0 ± 9.6 bpm ($p < 0.001$)), 60 sec. (69.8 ± 10.0 bpm ($p = 0.001$)), and 120 sec. (70.4 ± 10.4 bpm ($p = 0.032$)), compared to the Control. value of 72.4 ± 10.3 bpm. In the non-stimulation group, no changes occurred. A comparison of chronological changes between the stimulation and non-stimulation groups indicated no cancellation effect ($p < 0.001$).

3. Blood pressure

No changes in systolic or diastolic blood pressure were observed in either the stimulation or the non-stimulation groups.

IV. Discussion

In this study, results indicated significant constriction of pupil diameter and decreased heart rate. Blood pressure did not show a significant response.

It has been reported that pupil dilation occurs in response to pain stimulation[15]. We may assume that a dilation response did not occur in this study because subjects received standard shiatsu stimulation, which

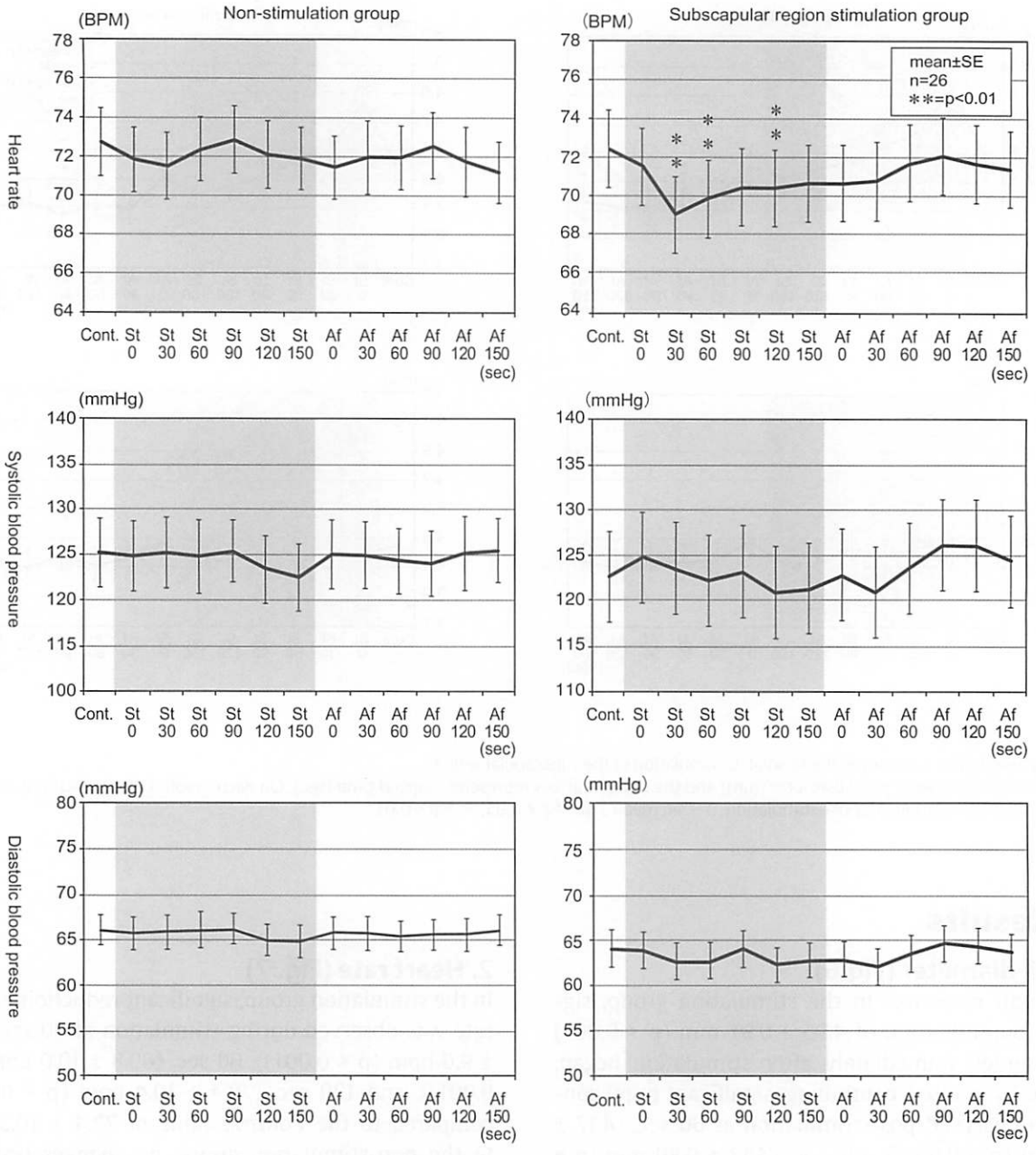

Fig. 7. Changes to heart rate and blood pressure due to shiatsu stimulation of the subscapular region
The graphs on the left represent the non-stimulation group and the ones on the right represent the subscapular stimulation group. On each graph, the vertical axis represents heart rate (bpm) or blood pressure (mmHg) and the horizontal axis represents elapsed time (sec).

is 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[16), 17)], but Ohsawa et al[18)] and Shimura et al[19)] 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, sacral, head, antebrachial, interscapular, and lateral cervical and superior nuchal line regions[8)-14)]. The current study shows that a pupillary constriction response also occurs due to shiatsu stimulation to the subscapular region. This pupillary response suggests that shiatsu stimulation probably causes excitation of the parasympathetic nervous system.

A reduction in heart rate (pulse) was observed due to shiatsu stimulation of the subscapular region. Heart rate is known to be regulated by the beta sympathetic nervous system and the parasympathetic nervous system. In this study, shiatsu stimulation resulted in reduction of heart rate (pulse), from which we can infer that shiatsu stimulation probably either suppresses the beta sympathetic nervous system, stimulates the parasympathetic nervous system, or a combination of the two.

A significant reduction in blood pressure was not observed as a result of stimulation of the subscapular region.

However, previous research has reported that shiatsu stimulation of almost all areas of the body results in pupillary constriction and reduction of heart rate and blood pressure[2)-14)].

The fact that a change in blood pressure was not observed in this study, similar to what was reported by Ide et al[3)] in a study conducted using pain-free standard shiatsu stimulation, may be influenced by the fact that shiatsu was applied with the subject in the right lateral position, causing light pressure to be exerted on the abdominal aorta that led to a temporary rise in blood pressure. Further study is required to determine the effect of subject positioning during shiatsu application.

Previous studies have confirmed that shiatsu stimulation of almost anywhere on the body, including the abdominal, anterior cervical, sacral, head, antebrachial, interscapular, and lateral cervical and superior nuchal line regions, results in pupillary constriction and reductions in heart rate and blood pressure. The results of this study of the subscapular region also showed pupillary constriction and a trend toward reduced pulse, indicating that shiatsu stimulation probably elicits systemic stimulation of the parasympathetic nervous system.

V. Conclusions

From this study consisting of shiatsu stimulation of the subscapular region performed on healthy adults in the right lateral position, the following is evident:

1. Pupil diameter was significantly constricted, and a reciprocal effect was indicated compared to the non-stimulation group;
2. Heart rate was significantly reduced, with no reciprocal effect compared to the non-stimulation group;
3. No changes to systolic or diastolic blood pressure were ascertained.

The above indicates that shiatsu stimulation of the subscapular region had a greater effect on autonomic nervous system function than rest alone.

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

1 Mori H, editor: Zukai kihon jutushiki anma massaji shiatsu ni yoru zenshin chosei. Ishiyaku Publishers, Inc., Tokyo, 2006 (in Japanese)
2 Koyata S et al: Shiatsu shigeki ni yoru shinjunkankei ni oyobosu koka ni tsuite. Toyo ryoho gakko kyokai gakkaishi 22: 40-45, 1998 (in Japanese)
3 Ide Y et al: Ketsuatsu ni oyobosu shiatsu shigeki no koka. Toyo ryoho gakko kyokai gakkaishi 23: 77-82, 1999 (in Japanese)
4 Kamohara H et al: Massho junkan ni oyobosu shiatsu shigeki no koka. Toyo ryoho gakko kyokai gakkaishi 24: 51-56, 2000 (in Japanese)
5 Sato K et al: Katai shiatsu shigeki ni yoru idenzu no henka. Toyo ryoho gakko kyokai gakkaishi 30: 34-38, 2006 (in Japanese)
6 Kurosawa K et al: Fukubushiatsu shigeki ni yoru idenzu no henka. Toyo ryoho gakko kyokai gakkaishi 31: 55-62, 2007 (in Japanese)
7 Kato R et al: Zenkeibu shiatsu shigeki ga jiritsu shinkei kino ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 32: 75-79, 2008 (in Japanese)
8 Kurihara K et al: Fukubu shaitsu shigeki ga dokochokkei ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 34: 129-132, 2010 (in Japanese)
9 Yokota M et al: Zenkeibu katai gaisokubu no shiatsu shigeki ga dokochokkei ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 35: 77-80, 2011 (in Japanese)
10 Watanabe T et al: Senkotsubu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 36: 15-19, 2012 (in Japanese)
11 Tadaka J et al: Tobu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 37: 154-158, 2013 (in Japanese)
12 Kadomoto Y et al: Zenwanbu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 38: 13-17, 2014 (in Japanese)
13 Hayashi T et al: Kenkokanbu he no shiatsu shigeki ga dokochokkei myakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 39: 83-87, 2015 (in Japanese)
14 Tanabe A et al: Sokkeibu jokobu he no shiatsu shigeki ga dokochokkei mayakuhakusu ketsuatsu ni oyobosu koka. Toyo ryoho gakko kyokai gakkaishi 40: 35-38, 2016 (in Japanese)
15 Oono S: Pharmacological studies on pupillary reflex dilation. J Pharmacol 15: 95-112, 1965
16 Ward AAJ, Reed HL: Mechanism of pupillary dilation elicited by cortical stimulation. J Neurophysiol 9: 329-335, 1946
17 Lowenstein O, Loewenfeld IE: Role of sympathetic and parasympathetic systems in reflex dilation of the pupil. Arch Neurol Psych 64: 313-340, 1950
18 Ohsawa H, Yamaguchi S, Ishimaru H et al: Neural mechanism of pupillary dilation elicited by electro-acupuncture stimulation in anesthetized rats. J Auton Nerv Syst 64: 101-106, 1997
19 Shimura M, Ohsawa H, Tomita A, Sato A: Hifu shingai shigeki ni yoru hanshasei dokohanno. Jiritsushinkei 37: 584-590, 2000 (in Japanese)

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