Original Article

Effects of the Self-Ischemic Compression by a T-shaped Wood Stick in Participants with Upper Trapezius Myofascial Trigger Point: A Randomized Controlled Trial

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ABSTRACT

Objectives: To determine the effectiveness of the self-ischemic compression by using a T-shaped wood stick and followed by sustained stretching on pain and quality of life in participants with upper trapezius myofascial trigger point (MTrP).

Study design: Single blinded randomized controlled trial.

Setting: Outpatient rehabilitation clinic at Siriraj Hospital, Thailand.

Subjects: Forty-eight participants (9 males, 39 females), aged 18-55 years old, with moderate pain of unilateral or bilateral upper trapezius myofascial pain syndrome.

Methods: The participants were randomized into two groups. The intervention group received the T-shaped wood stick to perform self-ischemic compression on MTrP followed by sustained stretching, whereas the controlled group was instructed to do sustained stretching. Both groups were asked to perform according to the instruction twice a day for 5 days. The outcomes were assessed before treatment and followed-up on day 8. A visual analog scale as the primary outcome, and pain pressure threshold were used to assess pain intensity. Active cervical lateral flexion range of motion, and the Thai-version of neck disability index was used to measure the quality of life.

Results: There was statistically significant improvement of visual analog scale between groups but no statistically changes in pain pressure threshold and the Thai-version of neck disability index were observed.

Conclusion: Self-ischemic compression with a T-shaped wood stick followed by sustained stretching showed short-term improvement of pain intensity in chronic upper trapezius myofascial pain syndrome with moderate pain.

Keywords*:* self-ischemic compression, myofascial pain syndrome, pain, trigger point, stretching exercise

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Introduction

Myofascial pain syndrome (MPS) is one of the most common causes of pain in general practice. Pongsatornkulpanit et al. reported the prevalence of MPS was 36% in Thai patients with musculoskeletal pain.[1] Higher incidence was noted among office workers and female.[1] Patients with MPS had worse quality of life in terms of pain, energy, physical mobility, sleep, and emotional reactions.[2-5] MPS is characterized by the presence of myofascial trigger points (MTrP) and an active MTrP causes a clinical pain complaint.[6] It is always tender, prevents full lengthening of the muscle, refers a patient-recognized pain on direct compression, mediates a local twitch response of muscle fibers when adequately stimulated, and when compressed within the patient's pain tolerance, produces referred motor phenomena and often autonomic phenomena, generally in its pain reference zone, and caused tenderness in the pain reference zone.[6] Whereas a latent MTrP is a clinically quiescent concerning spontaneous pain; it is painful only when palpated.[6-8] Reviews revealed that trapezius muscle is the most commonly found MTrPs.[9]

The treatments of MPS include symptomatic treatment and correction of precipitating factors. The common treatments are therapeutic exercise, massage, dry needling, and physical modalities.[6-8] For dry needling and physical modalities, the patients have to visit a hospital for the treatment which is time and resource consuming but ischemic compression, one of the effective mechanical treatments of MTrPs, consists of application of sustained pressure for a long enough time to inactivate the MTrPs and can be done by everyone and by themselves anywhere. Ischemic compression can reduce pain by 2 main mechanisms, reactive hyperemia and triggering spinal reflex mechanism producing reflex relaxation.[10-12] There are several ways to apply ischemic compression to MTrP including manual therapy and device created specifically the self-ischemic compression. Hanten et al. reported that a device called 'Thera cane', a plastic J-shaped cane, can be used to deliver self-ischemic compression followed by sustained stretching by patients themselves twice a day for 5 days was effective in reducing MTrP sensitivity and pain intensity in individuals with neck and upper back pain.[13]

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There is a T-shaped wood stick commercially available, which is sold widely as a Thai traditional medicine equipment, to treat muscle pain that people usually use to relieve muscle pain by themselves. This is similar to a J-shaped cane.[13] However, there is no study exploring the effectiveness of this T-shaped wood stick. From personal experience, the T-shaped wood stick used for self-ischemic compression might be effective in relieving pain. Therefore, the purpose of this study was to determine the effectiveness of self-ischemic compression with a Thai T-shaped wood stick followed by sustained stretching exercises in patients with upper trapezius MPS.

Methods

Study design

This single-blinded randomized controlled trial was registered at the Thai Clinical Trials Registry (TCTR 20191110001) and approved (COA 563/2018) by the Medical Ethics Committee of the Siriraj Hospital Human Research Protection, Bangkok, Thailand.

Participants

We recruited participants from Rehabilitation Medicine outpatient clinic, Siriraj Hospital, Mahidol University, from December 2018 to June 2019. They were diagnosed with MPS by a physiatrist who determined active MTrPs in trapezius muscle according to the criteria defined by Travell and Simons.[6] All participants were asked to sign an informed consent form.

Then, those who met the following criteria: having unilateral or bilateral upper trapezius MPS with VAS 50-100 (moderate to severe pain); aged between 18-55 years old; and had to understand written and verbal Thai language, were included. Those with the following exclusion criteria: received upper trapezius MTrP treatment (including massage, physical therapy, dry needling and trigger point injection) in the previous one month; shoulder disorder, cervical spine degeneration, cervical nerve root irritation and severe rheumatic disease); bleeding tendency, received anticoagulants; pregnant, any cancer; and BMI < 18 or > 25 kg/m^2, were excluded from the study.

We conducted a computer-generated block of four randomization by using the web site tool (http://www.randomizer.org/). To test the null hypothesis at significant at level alpha < 0.05 with 80% power and a uniform dropout rate of 20% was assumed. The sample size was calculated total 24 participants in each group.

Intervention

On the first day, a physical therapist with musculoskeletal expertise for 10 years, who was blinded to the participants, performed assessments and collected the following data: age, sex, working hours per week, duration of pain, pain visual analog scale (VAS), involved side active cervical lateral flexion range of motion (ROM), and the Thai-version of Neck Disability Index (Thai-NDI).

To identify possible MTrPs, each participant was asked to point out all painful areas of the neck and upper back, and then lay in prone position. The assessor palpated and marked all MTrPs that matched the inclusion criteria by a nonpermanent marker. Each marked MTrP was measured for pain pressure threshold (PPT). The MTrP with the lowest PPT was designated as the primary MTrP and labeled with semi-permanent henna ink, which could stay on the skin for more than eight days.

Another physical therapist instructed each participant with verbal and written instructions, and a demonstration.

In the intervention group, participants were instructed to perform self-ischemic compression to trapezius MTrP by using a T-shaped wood stick with 2 knobs placed at tips on the stick. The stick which was designed to create sustained pressure in hard-to-reach areas, by holding it over a primary MTrP (Figure 1), then gradually increasing pressure until feeling moderate pain for 60 seconds, and repeating compression steadily until pain was fully dissolved or at least not relieved any further. Thereafter, they were asked to perform self-sustained stretching exercises 10 times each of the following muscles (Figure 2): upper trapezius, posterior neck, middle trapezius, rhomboid, pectoral, and upper back muscles holding each for 30-60 seconds, while sitting near the edge of a stool with both feet firmly on the floor while performing these exercises. Both self-ischemic compression and self-sustained stretching exercises should be done twice a day for 5 days, and stopped on days 6 and 7 to minimize post-compression soreness.

In the control group, participants were instructed to perform only self-sustained stretching exercises of the above-mentioned muscles, 10 times each, twice a day, for 5 days, same as in the intervention group.

All participants were asked not to take any analgesic medication or other physical therapy during the study, They

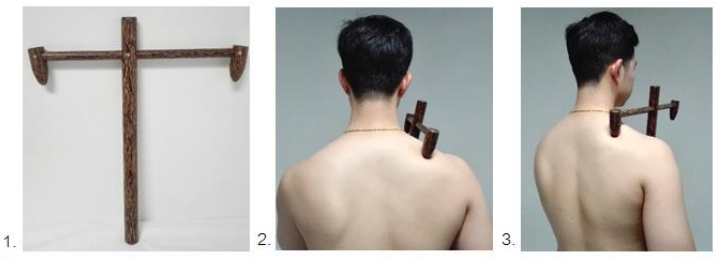

Figure 1. Self-ischemic compression: 1) a T-shaped wood stick, 2) and 3) Holding a T-shaped wood stick over upper trapezius MTrP and pulling the stick to compression

Figure 2. Self-sustained stretching exercises of the following muscles: 1) upper trapezius muscle, 2) posterior neck muscles, 3) middle trapezius and rhomboid muscles, 4) pectoral muscle, and 5) upper back muscles

were informed to report any intolerable soreness and other feelings induced by the instructed treatment, and record their adherence to the instruction in a provided logbook.

On day 2, the instructor therapist made a phone call to all participants to check their performance and on day 5, inform them to stop the treatment.

On day 8, the first blinded therapist re-assessed VAS score for average pain intensity within the last 24 hours, PPT of the primary MTrP, and the Thai-NDI, of all participants. Any medications and complications in the logbook were checked.

Termination criteria were adverse effects (including intolerable soreness and hematoma)

Outcome measurement

The primary outcome was VAS. The VAS scale was 100 mm long, "0" anchored with the words "no pain" and maximum of 100 with "worst pain imaginable" at the opposite end. The test-retest reliability was 0.77 and the validity was 0.51.[14,15]

The secondary outcomes were PPT, active cervical lateral flexion ROM of the involved side, and the Thai-NDI.

PPT was defined as the least amount of pressure needed to provoke pain. The participant was in a prone position. The procedure was performed with an algometer (Force dial FDK20, Wagner), by placing the tip area (1 cm^2) perpendicular to the identified MTrPs and pressing at a rate of 1 kg/sec. The MTrPs were identified with the presence of local or referred pain. The participants were asked to report "yes" as soon as they began to feel pain and then the compression was stopped. Three repetitive measurements at an interval of 30 seconds were performed at the same point, the average value was calculated and used for further analysis.[16-18]

Active cervical lateral flexion ROM of the involved side was measured when the participants were asked to actively lateral flex their heads to the uninvolved side. The angle was measured with a 360-degree goniometer. Three repetitive measurements at an interval of 30 seconds were performed, the average value was calculated and used for further analysis.

The Thai-NDI was used to evaluate the impact of pain on daily activities. This questionnaire has 10 items concerning

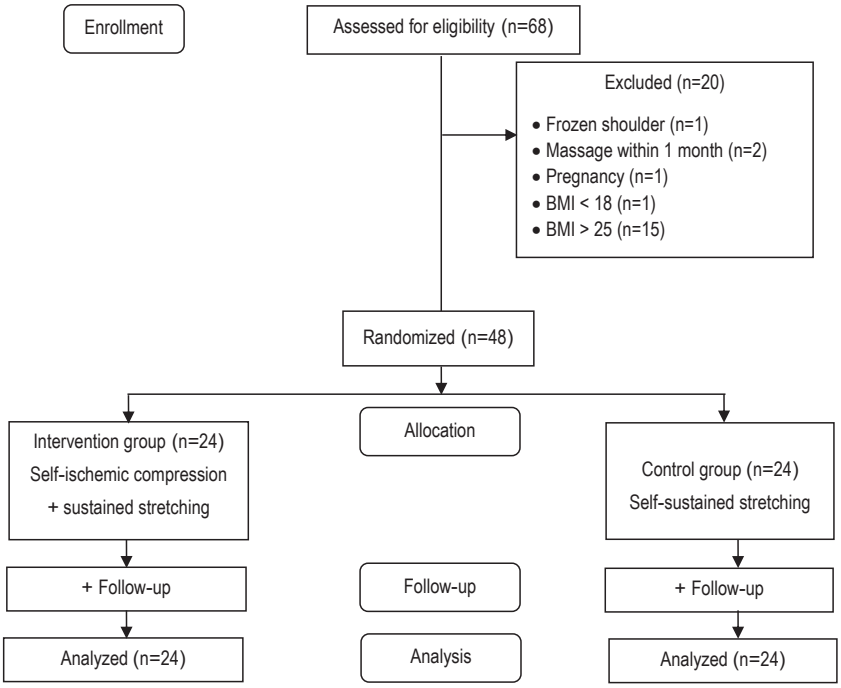

Figure 3. CONSORT diagram outlining the identification, enrollment, and allocation of participants to the two groups: intervention group (self-ischemic compression followed by sustained stretching) and control group (self-sustained stretching).
CONSORT, Consolidated Standards of Reporting Trials.

pain and activities of daily living including personal care, lifting, reading, headaches, concentration, work status, driving, sleeping, and recreation. The Thai-NDI test-retest reliability was 0.986 and validity was 0.886.[29-20]

The minimal clinically important differences (MCIDs) of VAS, PPT, and the Thai-NDI were a 33% decrease in pain,[21] 0.45 kg/cm^2 and 10.5[17] respectively.

Statistical methods

VAS was set to be the primary outcome of this research. The minimal clinically important difference for VAS was a decrease of 33% from a baseline value.[21] Based on Hou et al. study, the baseline VAS was 52.[22] So a reduction in VAS of 23 mm represented a clinically significant difference in pain treatments.[22]

All data were analyzed using SPSS Version 18 for Windows (SPSS Inc, Chicago, IL). The demographic data examined by descriptive statistics, and measurements presented as means (standard deviation, SD). $p < 0.05$ considered statistically significant. Standard comparisons with Student t-test was performed when the data were normally distributed. Descriptive statistics (mean, SD and percentage) were used to calculate all parameters.

Results

Forty-eight participants (39 females, 9 males) participated in this study. There were 17 females and 7 males in the control group whereas 22 females and 2 males in the intervention group. At the baseline, the average age, working hours per week, duration of pain, PPT, ROM, and the Thai-NDI had no statistically significant differences between groups, except VAS (Table 1 and Table 2). Although the participants were randomly allocated by computer-generated block of four randomization into 2 groups, mean VAS of 73.5 (SD 7.1) in the intervention group at baseline was higher than the mean VAS of 68.1 (SD 10.8) in the control group ($p = 0.050$) (Table 2), and might have further room for pain reduction after treatment (Table 2). Therefore, percentage VAS reduction was also analyzed. The percentage of VAS reduction, 38.5% (25.1%) in the intervention group and 24.3% (23.1%) in the control group, were found to be statistically significant difference ($p = 0.048$). In addition, there were 13 participants (54.1%) in the intervention group and 8 participants (33%) in the control group who had a reduction in VAS more than 23 points, and no statistically significant difference between groups ($p = 0.146$). Other parameters including PPT, active cervical lateral flexion ROM, and the Thai-NDI score in pre-, post- and pre-post treatment showed no statistically significant difference between groups (Table 2 and Figure 4).

VAS, visual analog scale; PPT, pain pressure threshold; ROM: range of motion of active cervical lateral flexion of the involved side; Thai-NDI: the Thai-version of Neck Disability Index

Regarding complication, there were 8 participants in the intervention group reporting pain at the pressure point in the first two days and spontaneously resolved. In addition, one participant reported small hematoma at the pressure point.

Table 1. Comparison between intervention and control demographic data of 48 participants

Characteristics	Intervention (N = 24)	Control (N = 24)	*p*-value
Age[1] (year)	40.2 (8.9)	38.9 (8.7)	0.627
Sex[2] (female)	22 (91.7)	17 (70.8)	0.137
Working hours per week[1] (hr)	44.2 (11.3)	47.0 (11.7)	0.398
Duration of pain[2] (> 6 months)	17 (70)	15 (62)	0.848
Involved side MTrP[2] (right)	14 (58)	17 (70.8)	0.194

[1]Mean (SD), [2]number (%)

Table 2. Comparison of pre-treatment, post-treatment, and pre-post difference between groups

Parameters	Intervention Mean (SD)	Control Mean (SD)	*p*-value
Pre-treatment			
VAS	73.5 (7.1)	68.4 (10.3)	0.050
PPT	4.3 (1.6)	4.3 (1.0)	0.954
ROM	31.7 (7.1)	31.0 (8.0)	0.756
Thai-NDI	18.4 (7.3)	15.1 (6.3)	0.101
Post- treatment			
VAS	44.8 (18.1)	50.6 (15.6)	0.240
PPT	4.3 (1.2)	4.6 (1.1)	0.318
ROM	33.4 (7.1)	32.0 (9.2)	0.585
Thai-NDI	8.4 (4.2)	8.8 (4.4)	0.740

Pre-Post difference

VAS, visual analog scale; PPT, pain pressure threshold; ROM, range of motion; Thai-NDI, Thai-version of Neck Disability Index

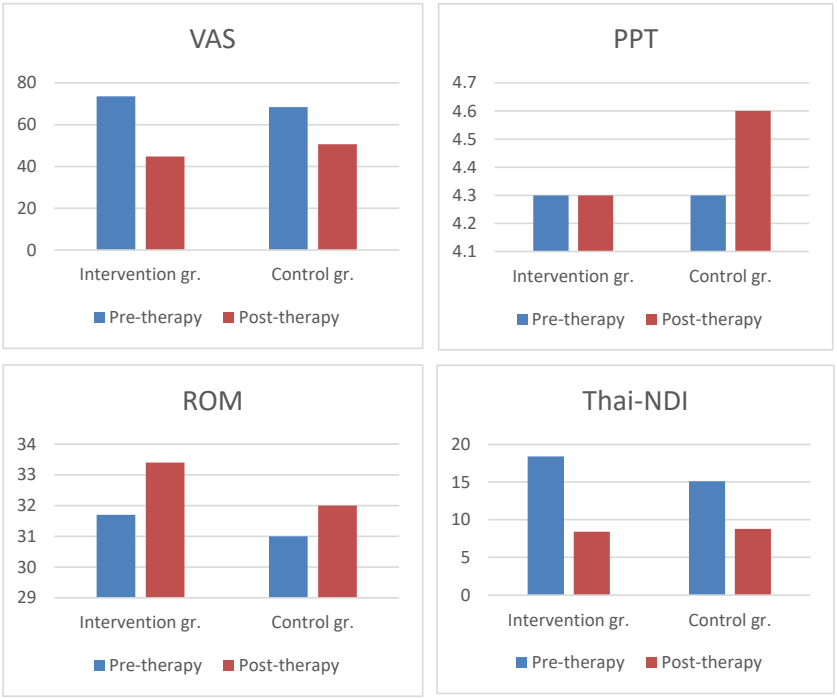

Figure 4. Comparison of values within the same group and between groups pre-therapy, post-therapy
VAS, visual analog scale; PPT, pain pressure threshold; ROM, range of motion; Thai-NDI, Thai-version of Neck Disability Index

In the control group, there were 3 participants reporting increased pain in their neck in the first few days and also spontaneously resolved. The log books showed 100% adherence. None of the participants received other treatment for upper trapezius MTrP.

Discussion

This study demonstrated that decrease in VAS pain intensity within the last 24 hours was found in both intervention and control groups. However, there was a statistical significance of pre-post difference in VAS between groups. Therefore, using a T-shaped wood stick for self-ischemic compression for 5 days as an additional treatment of trapezius MTrP to stretching exercises resulted in better improvement in pain intensity.

A previous study by Hanten et al. proved that self-ischemic compression with a Thera cane was effective in reducing trigger point sensitivity and pain intensity in individuals with neck and upper back pain.[13] The effectiveness of self-ischemic compression with this T-shaped wood stick resulted in pain relief same as Thera cane.

Secondary outcomes including PPT, active cervical ROM-lateral flexion, and the Thai-NDI score showed no statistically significant difference between groups. Barbara et al. examined the effect of ischemic compression on disability confirm our results.[23] There are two explanations, firstly this study did not calculate sample size for detecting MCID of the secondary outcomes. Therefore, calculating the sample size for the detect difference in PPT, ROM, and the Thai-NDI could be investigated in future studies. Secondly the baseline of secondary outcomes was low, so there was small room for change.

We unexpectedly found increased PPT changes of post-treatment in the control group. Possibility is the control group subjects psychologically concerned about the outcome of the treatment that did not improve as expected. Another rare possibility is the PPT measurement stimulates a latent MTrP to become an active MTrP. In accordance with this finding, Walton et al. reported that repetitive mechano-nociceptive stimulations of the trapezius muscle in healthy females evoked moderate and temporary changes in PPT that lasted for at least 35 minutes after cessation of stimulation.[24]

It is important to note that this study faced some limitations. Firstly, this study cannot blind the participants, which might result in biased estimates of treatment effects with VAS which is subjective. This current research investigated just a short-term effect of self-ischemic compression with a T-shaped wood stick on pain. Future studies should evaluate the long-term effects.

In conclusion, this study demonstrated that a daily treatment for 5 days of self-ischemic compression with a T-shape wood stick followed by sustained stretching resulted in a significant improvement in VAS in the short-term in participants with moderate chronic pain of upper trapezius myofascial pain syndrome; and could be one effective home program to reduce pain from upper trapezius myofascial pain syndrome.

Disclosure

All authors declared no personal or professional conflicts of interest, and no financial support from the companies that

produce and/or distribute the materials described in this study.

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