Journal of Evidence-Based Integrative Medicine
Volume 26: 1-8

DOI: 10.1177/2515690X211030852
journals.sagepub.com/home/cam
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Myofascial Pain Syndrome Focused on the Upper Trapezius Muscle: A Comparative Randomized Controlled Trial of the Court-Type Traditional Thai Massage versus the Thai Hermit

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Abstract

Myofascial pain syndrome is a common problem that can develop at any age. This study compares the efficacy of the court-type traditional Thai massage (CTTM) to the Thai hermit exercise (THE) in improving the cervical range of motion (CROM) and reducing pain in the upper trapezius muscle. In this study, 46 patient subjects were randomized into 2 groups, with 1 group administered CTTM and the other administered THE. Prior to and following the experiment, their demographic characteristics, pain levels and CROM were measured using a visual analog scale (VAS) and a goniometer, respectively. Data was then analyzed using descriptive statistics, percentage, mean, and standard deviation, as well as inferential statistics. The findings indicate that subjects in both groups demonstrated significantly lower pain and significantly better CROM ($P < 0.05$). In terms of comparative treatment between the CTTM and THE groups, the results were not found to differ in the range of motion, but a clear difference in pain level measured by VAS was found, in which CTTM provides a better way of reducing pain at the trigger point than THE ($P < 0.05$). From the findings, it can be concluded that both CTTM and THE are comparably efficacious therapies for myofascial pain in the upper trapezius muscle.

Keywords

massage therapy, pain management, traditional medicine

Received March 8, 2021. Received revised May 24, 2021. Accepted for publication June 20, 2021.

Introduction

Modern lifestyles have changed drastically from those of the past in terms of housing architecture and design, diet and nutrition, commute, and occupational health and safety, which all entail negative consequences. To illustrate, past studies have shown that office workers who use desktop computers for more than 6 hours per day tend to experience musculoskeletal disorders (MSDs) and worsening physical and mental health.[1] MSDs can lead to acute and chronic pain, especially myofascial pain syndrome (MPS). The most common cause of the disorder is poor ergonomics associated with occupations, exercise intensity, and use of electronic devices, which may be aggravated by factors such as age, personal illness, stress, and body mass index (BMI).[2]

Treatment of MSDs and MPS involves pain relief through medicinal or non-medicinal approaches. For the former, little evidence has thus far established medication that can alleviate trigger point pain. Meanwhile for non-medicinal approaches, although several types of potentially efficacious therapies such as acupuncture, traditional Thai massage, muscle stretching, and meditation have been explored, these approaches have

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their own strengths and weaknesses that must be carefully addressed. In severe cases with extreme complications, a combination of therapeutic techniques is often required.[3]

In traditional Thai medicine, the treatment of MSDs and MPS can be treated or mitigated in a number of ways, such as herbal remedy used, normal traditional Thai massage or Nuad Chaleisak, the court-type traditional Thai massage or Nuad Raja Sum Nak (CTTM), or performing exercises with the Thai hermit exercise (THE). CTTM is the massage procedure inherited from Thai traditional medicine practitioner in the master's palace. The practitioner uses only fingers and hands to massage the lines and signal points of different parts of the body. Use the posture and angle of the massager to determine the direction, and the size of the force used to massage. In addition, THE is traditional Thai healing and culture which is a form of exercise recorded in Thai history, first evidenced in the reign of King Phra Phutthayodfa Chulalok the Great (King Rama I) in 1788 with objective of rest, relaxation and relief pain.[4] This can be considered as a basic way to take care of the health of the Thai people that are about to be erased due to the unpopularity and no concrete promotion of the people.

CTTM and THE, a muscle stretching technique, have both been proven to be efficacious therapies. In an experiment on the efficacy of CTTM in alleviating upper trapezius pain, the subjects were better able to withstand pain, experienced lower pain levels, and had a greater cervical range of motion (CROM).[5] Similarly, in a study investigating satisfaction toward THE, the subjects reported enjoying more leg and hand muscle strength, greater knee, shoulder, and spine joint flexibility, and higher exercise ability. Although CTTM is effective in healing, CTTM also has some limitations. The treatment of massage needs a professional practitioner to perform the treatment. Moreover, THE are viewed as health-promoting exercise and are being forgotten by society. Therefore, the objective of the present research is to compare the efficacy of CTTM and THE at enhancing CROM and reducing pain in the upper trapezius muscle. This present study was hypothesized that both CTTM and THE will show the improvement of patients' quality of life. THE will be an equivalate method for primary healthcare and will ease the treatment burden borne by hospitals, clinics, and the country at large.

Materials and Methods

Study Design

This research was a single-blind randomized controlled trial conducted on 46 patients randomized into a CTTM group and a THE group following a simple random sampling method and a pregenerated random assignment scheme enclosed in envelopes.

Study Settings

The subjects were male or female patients aged 20-60 years old with chronic upper trapezius muscle pain which had lasted over 3 months (8 April 2018 to 22 July 2019) and who had received treatment from the Faculty of Medicine, Thammasat University at the time of the study.

Ethics

The study was approved by the Ethics Committee for Research Involving Human Subjects of the Faculty of Medicine of Thammasat University (COA No. 067/2018, effective from 8 March 2018 to 1 March 2019).

Subjects

The subjects included 46 patients clinically diagnosed with myofascial pain syndrome (MPS) in the upper trapezius muscle who had volunteered to participate in the study while receiving treatment from the Faculty of Medicine, Thammasat University. The subjects were requested to sign a consent form before being randomized into the CTTM group or the THE group.

Inclusion Criteria

- Clinically active MPS and expression of symptoms of MPS in the right or left upper trapezius or both which had lasted for at least 3 months.
  - Expression of at least 2 of the following manifestations of CROM problems:
    - Flexion lower than 45° (from the normal range of 45-50°).
    - Extension lower than 45° (from the normal range of 45-50°).
    - Lateral flexion lower than 45° (from the normal range of 45°).
- Male or female patients aged 20-60 years old.
- Computer literate
- Experienced a pain level of at least 3 on a visual analog scale (VAS).
- Expression of symptoms of taut bands and referred pain and present a sign of the trigger point on upper trapezius muscles
- Diagnosis by a physician as shoulder pain following criteria of the Thai Association for the Study of Pain[6] and Travell JG and Simons DG, 19902,7[7]
- No use of diclofenac during the previous month.
- Not receiving any other form of treatment during the previous month.
- Signed consent form and willing to participate throughout the study period.

Exclusion Criteria

- History of hypertension, cardiovascular disease, osteoporosis, cancer, herniated disc, and contagious skin disease such as scabies.
- History of neck, spinal, or costa fractures, cracks, or splits that had not completely healed.
- Receiving any other form of treatment, such as conventional medication and acupuncture within the previous month.
- Pregnancy
- Broken bones or shoulder injury
- Hyperirritable spot, jump sign and referred pain from neuropathy
- Received steroid or herbal remedies as medications within 2 weeks prior to the program

Withdrawal or Termination Criteria

- Not received a full course of CTTM or THE therapy.
- Expression of worsening symptoms during the study period, such as increasing pain intensity, swelling, and bruises, in which case a referral to conventional medicine would be given.

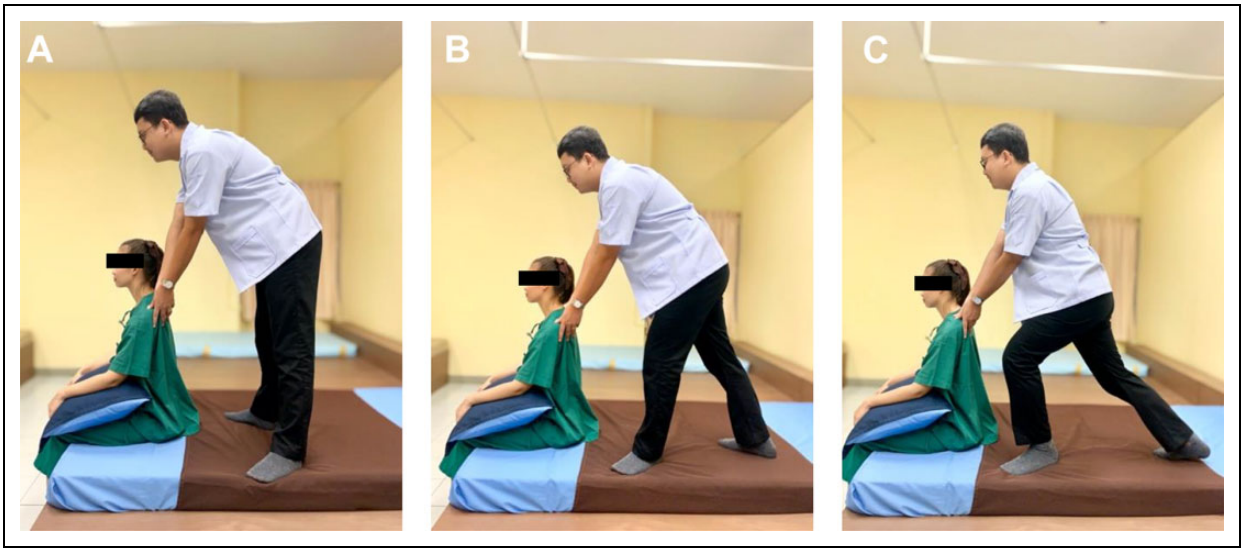

Figure 1. Shoulder massage posture: high-standing posture (A); mid-standing posture (B); low standing posture (C).

Study Intervention

The subjects in the CTTM group received CTTM therapy lasting 30 minutes every other day for 2 weeks for a total of 6 sessions. The therapy involved 4 massage points on the upper trapezius. When conducting the therapy, the practitioner began with a shoulder massage, as shown in Figure 1, using a high-standing posture. In the first round of shoulder massage, the practitioner pressed their thumbs at the edge of the upper trapezius muscle close to the acromion as the first point, and then gradually massaged inwards along upper trapezius muscle to the second point located at the base of the neck. In the second round of shoulder massage, the practitioner changed from a high-standing posture to a mid-standing posture, pressing the thumbs against the second point gradually outwards along upper trapezius muscle to the first points. In the last round of shoulder massage, the practitioner repeated the same steps as during the first, but with a low-standing posture instead.

After the shoulder massage, the practitioner changed to a mid-standing posture and massaged the cervical-thoracic and cervical areas. During the final stage of the therapy, the practitioner changed back to a low-standing posture and massaged the omohyoid area.[8,9] Data was recorded on therapy days, while on non-appointment days, data was collected via telephone conversations.

The subjects in the THE group performed 10 repetitions of 2 procedures lasting for 30 minutes every other day for 2 weeks for or a total of 6 sessions. The first procedure involved head, shoulder, abdominal, and ankle exercises aimed to enhance the functions of such body parts and to stimulate blood circulation in the upper body, while the second procedure involved arm stretching exercises also intended to promote the functions of the upper body, especially the eyes. To ensure that the subjects were able to perform the second procedures unattended (Figures 2 and 3), the subjects were provided a manual and instructions and were also asked to rehearse the exercise during the first appointment. Data was recorded on appointment days (baseline on day 0, experiment on day 7, and follow-up on day 11) and on days without appointments, the subjects were required to perform the THE exercise independently, with data collected via telephone conversations.

Research Instrument

Visual analog scale (VAS) is a 10-cm scale instrument commonly used to assess variables that are not directly measurable on a continuum of values ranging from "0" (no pain) to "10" (worst imaginable pain).[10] In this research, VAS was employed to measure the patients' pain intensity levels, and hence the efficacy of CTTM and THE in relieving their upper trapezius pain.

In addition, cervical range of motion (CROM) is the test procedure for motion segment dysfunction observation especially the rotation in the cervical spine. In this assessment, a goniometer, an angle measurement instrument,[5] was used to assess the subjects' CROM and hence the efficacy of CTTM and THE in improving upper trapezius functions by measurement of flexion, extension, left lateral flexion, and right lateral flexion in triplicate.

Statistical Analysis

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS Inc., USA). The descriptive statistics used to analyze the data included percentage, mean, and standard deviation, while the statistics used to compare between the groups included repeated measurement ANOVA for VAS and CROM. Additionally, paired t-test was used to compare the differences between pain and joint mobility before and after the experiment.

Study Flowchart

Figure 4 presents the conceptual framework underpinning this research.

Results

Demographic Characteristics

The demographic characteristics of the subjects are presented in Table 1. Those in the CTTM were slightly older than those in the THE group, while a majority of subjects in both groups were

Figure 2. First step of the second procedure: preparation posture (A); clasp hands and raise arms (B); lower arms (C); and finishing posture (D).

Figure 3. Second step of the second procedure: preparation posture (A); left-side arm stretching (B); right-side arm stretching (C); face-forward arm streching (D); clasp hands and raise arms (E); and finishing posture (F).

female. The subjects included a range of occupations, including students, government officials, and company employees, all of whom were likely to regularly experience extended periods of computer use. For shoulder pain patterns, subjects in both the groups had been experiencing MPS in both shoulders, followed by right shoulder pain and left shoulder pain, respectively.

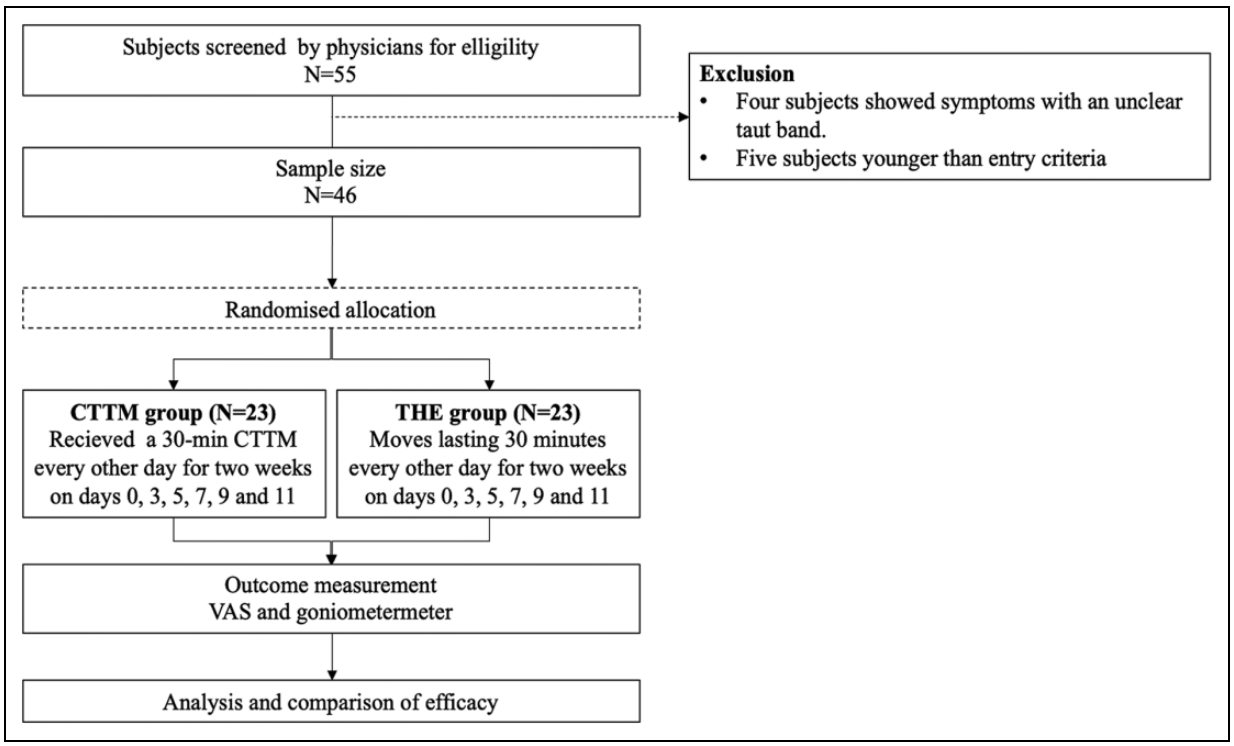

Figure 4. Conceptual framework.

Table 1. Demographic Characteristics of the Subjects.

Characteristics	Subject groups	
	CTTM (N = 23)	THE (N = 23)
Age (years)[a]	24.74 ± 5.81	22.26 ± 2.34
Gender[b]		
Female	21 (91.3)	16 (69.6%)
Male	2 (8.7)	7 (30.4)
Heart rate (bpm)[a]		
Baseline	71.83 ± 5.02	72.78 ± 5.82
Experiment	71.88 ± 6.84	72.43 ± 5.45
Follow up	71.74 ± 6.92	72.91 ± 5.54
Weight[a]	57.83 ± 9.91	57.04 ± 11.01
BMI[a]	22.51 ± 3.27	21.48 ± 3.13
Occupation[b]		
Students	15 (65.2)	21 (91.3)
Government officials	7 (30.4)	2 (8.7)
Company employees	1 (4.3)	–
Shoulder pain patterns[b]		
Right	6 (26.1)	7 (30.4)
Left	2 (8.7)	6 (26.1)
Both sides	15 (65.2)	10 (43.5)

Abbreviations: CTTM, Court-type traditional Thai massage; THE, Thai hermit exercise.
[a]Mean ± standard deviation.
[b]Number (percentage).

Pain Intensity

Table 2 and Figure 5 present the adjusted estimated means of pain intensity measured as VAS scores for the CTTM and THE groups using the GLM and a graphic comparison of the findings. The CTTM group showed slightly higher estimated means of pain intensity at the baseline with 5.20 and 4.95 in THE group. Later in the follow-up treatment (7 days later) found that both CTTM and THE groups had lower scores at 3.37 and 3.33 respectively. Finally, on the last follow-up, it was also found that the adjusted estimated means of pain intensity measured by VAS scores in both CTTM and THE groups significantly reduced with 1.87 and 2.34 respectively.

Table 2. Adjusted Estimated Means of Pain Intensity Measured by VAS Scores for the CTTM and the Groups Using the GLM.[a]

	CTTM (N = 23)		THE (N = 23)		
VAS	Mean	95%CI	Mean	95%CI	P-value
Baseline	5.20	4.93, 5.47	4.95	4.68, 5.21	.184
Experiment	3.37	2.97, 3.77	3.33	3.33, 4.12	.209
Follow-up	1.87	1.38, 2.25	2.34	1.86, 2.83	.169

Abbreviations: VAS, visual analog scale; GLM, generalized linear model; CTTM, court-type traditional Thai massage; THE, Thai hermit exercise; CI, confidence interval.
[a]Baseline, experiment and follow-up measurement on day 0, 9, and 11 respectively; P-value, compared VAS between CTTM and THE groups, repeated measures ANOVA.

Range of Motion

The results of the present study indicate a significant increase in the cervical range of motion (CROM) in either CTTM or THE (Table 3).

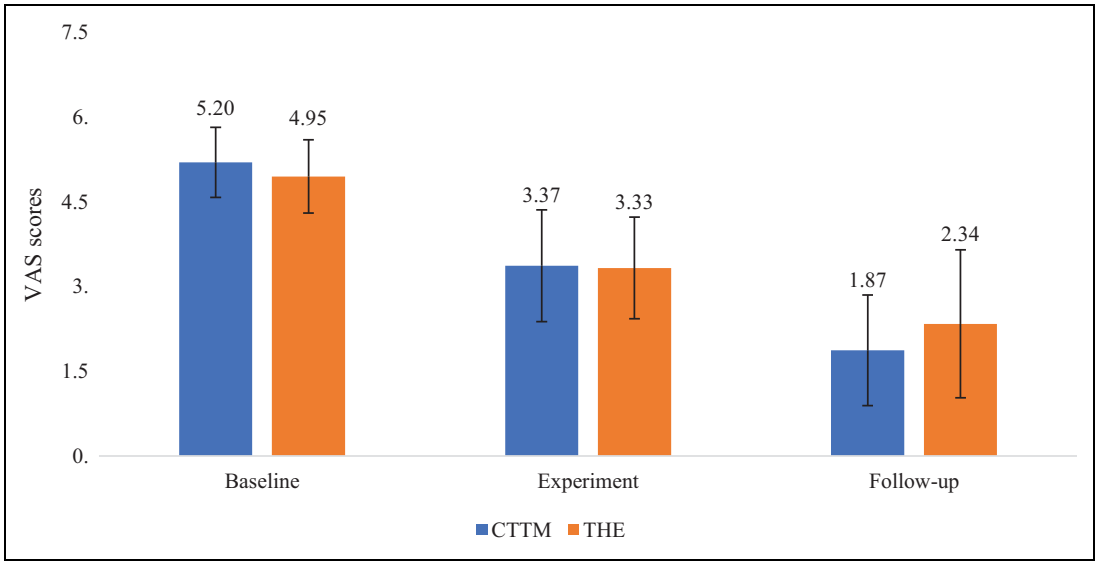

Figure 5. VAS comparison of CTTM and THE at reducing upper trapezius pain.

Table 3. Adjusted Estimated Means of CROM Scores for the CTTM and THE Groups Using the GLM.[a]

	CTTM (N = 23)		THE (N = 23)		
CROM	Mean	95% CI	Mean	95% CI	P-value
Flexion—baseline	30.08	27.30, 32.87	33.56	29.99, 37.13	0.118
Flexion—experiment	37.34	33.79, 40.90	37.69	34.46, 40.92	0.881
Flexion—follow-up	42.65	39.12, 46.18	45.30	42.30, 48.30	0.241
Extension—baseline	34.00	30.71, 37.28	35.47	32.73, 38.21	0.478
Extension—experiment	41.47	38.79, 44.16	46.21	43.19, 49.23	0.019
Extension—follow-up	50.00	47.66, 53.47	52.09	48.52, 55.65	0.496
Right lateral flexion——baseline	32.00	29.06, 34.39	34.04	31.58, 36.50	0.223
Right lateral flexion—experiment	36.47	34.12, 38.83	39.00	36.49, 41.50	0.136
Right lateral flexion—follow-up	42.09	38.90, 45.27	42.70	40.18, 45.21	0.757
Left lateral flexion—baseline	32.30	30.54, 34.84	32.69	30.38, 35.00	0.796
Left lateral flexion—experiment	37.52	35.37, 38.66	36.39	34.33, 38.45	0.435
Left lateral flexion—follow-up	41.43	37.47, 48.38	41.30	39.01, 43.59	0.929

Abbreviations: CROM, cervical range of motion; GLM, generalized linear model; CTTM, court-type traditional Thai massage; THE, Thai hermit exercise; CI, confidence interval.

[a]Baseline, experiment and follow-up measurement on day 0, 9 and 11 respectively; P-value, compared CROM between CTTM and THE groups, repeated measures ANOVA.

Discussion

The objective of the present research is to compare the efficacy of the court-type traditional Thai massage (CTTM) and Thai hermit exercise (THE) in enhancing CROM and reducing pain in the upper trapezius muscle. At present, CTTM is believed to be a reliable pain management tool for either traditional Thai practitioners or applied traditional Thai practitioners.

The demographic characteristic of this present study was collected from patients aged range 20-60 years old since the prevalence of chronic regional pain may range from 20-74 years of age.[11] The demographic characteristic was also revealed that the patients recruited in this study mostly are female with 4 times to male patients. In accordance with the previous study that chronic musculoskeletal pain is common in the general population, while data collected from a Swedish cross-sectional survey determined a 2-fold higher prevalence of chronic muscle pain than female experienced pain with 2 times higher than male.[11] This may be the result of behavioral differences between males and females, and maybe because biologic and psychosocial factors might account for these differences.[12,13] Moreover, this present study was also found that most patients are students, which similarly alarming results to the previous studies. The study of prevalence of musculoskeletal pains in 2018 found that students had pain in the musculoskeletal system with the most severe pain in neck pain which accounted for 27.3%.[14]

In term of pain intensity, Table 2 and Figure 5 presented VAS scores for the CTTM and THE groups using the GLM and a graphic comparison of the findings. The pain levels felt by the

subjects in both the groups were statistically lower on day 7 and at follow-ups on day 11, at a significance level of $P > 0.05$. The VAS instrument was employed to measure the patients' pain intensity levels.[15] In this study, the CTTM group patients had lower pain levels than the THE group patients. CTTM better reduced pain since the massage may deactivate trigger points, thus resulting in pain reduction, and involved a different exercise pattern which delivers pain relief through stretching.[15] Nonetheless, both methods are considered to be capable of reducing pain with $P > 0.05$. Two previous studies also supported that CTTM and THE can be used to manage muscle pain.[16,17]

In addition, the cervical range of motion (CROM) in either CTTM or THE which showed in Table 3 agree with some previous studies.[10,18] Both CTTM and THE were found to enhance the flexion, extension, left lateral flexion, and right-lateral flexion by significant elevate the degree of motion (Table 3). Likewise, other studies have indicated that CTTM can reduce muscle tension and pain intensity in addition to increasing joint range of motion.[19] In addition, the THE could also improve muscle flexibility by elevating the ROM for both flexion and extension as previous study showed that the Thai hermit exercise can enhance and promote shoulder range of motion (ROM) and improved joint function.[4,20]

Meanwhile, non-significant results were observed by comparing the effectiveness between both methods. This result indicates that CTTM and THE did not have different effects and both increased the range of movement as a result both methods are comparable in terms of reducing pain and increasing joint mobility, but for further clarity, a future comparison should be conducted in the study parameters of additional muscle stiffness or blood chemistry.

Conclusions

The court-type Thai traditional massage provides a better way to reduce pain at the trigger point than the Thai hermit exercise, yet both CTTM and THE are comparably efficacious therapies for myofascial pain in the upper trapezius muscle. Moreover, CTTM and THE showed the improvement of patients' quality of life. With this, THE which is disappearing with social change should be internationally promoting, unfold and maintain as an option for primary healthcare.

Authors' Note

Jurairat Boonruab and Watchara Damjuti designed the study. Wichit Supamethangkura recruited the patient and take care of the welfare of the patients during the trial. Jurairat Boonruab and Phiyaphon Poonsuk collected the data. Jurairat Boonruab, Phiyaphon Poonsuk and Watchara Damjuti performed data analysis and interpretation. Jurairat Boonruab revised the article for important content and Watchara Damjuti drafted the manuscript. The study was approved by the Ethics Committee for Research Involving Human Subjects of the Faculty of Medicine of Thammasat University (COA No. 067/2018, effective from 8 March 2018 to 1 March 2019).

Acknowledgments

The author would like to express their sincere gratitude to University for awarding a Fast-track research grant (Contract No. TUFT 15/2019) in support of the present study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was supported by Faculty of Medicine of Thammasat University (Fast-track research grant Contract No. TUFT 15/2019).

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References

1. Klussmann A, Gebhardt H, Liebers F, Rieger MA. Musculoskeletal symptoms of the upper extremities and the neck: a cross-sectional study on prevalence and symptom-predicting factors at Visual Display Terminal (VDT) workstations. *BMC Musculoskelet Disord*. 2008;9:1-16.
2. Keyserling WM. Workplace risk factors and occupational musculoskeletal disorders, part 2: a review of biomechanical and psychophysical research on risk factors associated with upper extremity disorders. *Am Ind Hyg Assoc J*. 2000;61(2):231-243.
3. Plakornkul V, Vannabhum M, Viravud Y, et al. The effects of the court-type Thai traditional massage on anatomical relations, blood flow, and skin temperature of the neck, shoulder, and arm. *BMC Complement Altern Med*. 2016;16(363):1-16.
4. Thonglong T, Rattanathantong K. Effects of traditional Thai Hermit's exercise or Ruesi Dudton on flexibility and range of motion in Female University Students. *Thai Pharm Health Sci J*. 2017;12(3):129-132.
5. Kolber MJ, Hanney WJ. The reliability and concurrent validity of shoulder mobility measurements using a digital inclinometer and goniometer: a technical report. *Int J Sports Phys Ther*. 2012;7(3): 306-313.
6. Thai Association for the Study of Pain (TASP). *Clinical Guidance for Acute Pain Management. Vol 1*. Thai Association for the Study of Pain; 2009.
7. Donnelly JM, Simons DG. *Travell, Simons & Simons' Myofascial Pain and Dysfunction: the Trigger Point Manual*. 3rd ed. Wolters Kluwer Health; 2019:xxvii, 935.
8. Ayuraved Thamrong School ATTMC, Faculty of Medicine, Siriraj Hospital, Mahidol University. *Traditional Therapeutic Thai Massage: Basic Massage. Vol 1*. Suphawanit Printing; 2014.
9. Ayuraved Thamrong School ATTMC, Faculty of Medicine, Siriraj Hospital, Mahidol University. *Traditional Therapeutic Thai Massage: Pressure Point Massage Vol 2*. Suphawanit Printing; 2014.
10. Boonruab J, Niempoog S, Pattaraarchachai J, Palanuvej C, Ruangrungsi N. Effectiveness of the court-type traditional Thai massage versus topical diclofenac in treating patients with

myofascial pain syndrome in the upper trapezius. *Indian J Tradit Knowl*. 2016;15(2):30-34.
11. Bergman S, Herrstrom P, Hogstrom K, Petersson IF, Svensson B, Jacobsson LT. Chronic musculoskeletal pain, prevalence rates, and sociodemographic associations in a Swedish population study. *J Rheumatol*. 2001;28(6):1369-1377.
12. Wolfe F, Brähler E, Hinz A, Häuser W. Fibromyalgia prevalence, somatic symptom reporting, and the dimensionality of polysymptomatic distress: results from a survey of the general population. *Arthritis Care Res*. 2013;65(5):777-785.
13. Rollman GB, Lautenbacher S. Sex differences in musculoskeletal pain. *Clin J Pain*. 2001;17(1):20-24.
14. Amani F, Zakeri A, Abbasi V, Bahadoram M, Davoodi M, Dorestan N. The prevalence of musculoskeletal pains among students. *J Prev Epidemiol*. 2018;3(1):1-4.
15. Weiner RS. *Pain Management: A Practical Guide for Clinicians*. 6th ed. CRC Press; 2002:xxix, 1138.
16. Ngowsiri K, Karuhadej P, Napapongsa K. Effectiveness of Thai mind-body exercise "Rusie Dutton" on blood pressure and quality of life in older adults in Bangkok, Thailand. *J Public Health Dev*. 2018;16(3):41-53.
17. Sananpanichkul P, Sawadhichai C, Leaungsomnapa Y, Yapanya P. Possible role of court-type Thai traditional massage during parturition: a randomized controlled trial. *Int J Ther Massage Bodywork*. 2019;12(1):23-28.
18. Damapong P, Kanchanakhan N, Eungpinichpong W, Damapong P. Effectiveness of court-type traditional Thai massage in patients with chronic tension-type headache: a pilot study. *J Health Res*. 2015;29(5):351-356.
19. Tankitjanon P, Palanuvej C, Ruangrungsi N. A comparative study of court-type Traditional Thai Massage versus diclofenac gel on function of shoulder and ability of arm in patients with frozen shoulder: a randomized, controlled trial. *J Royal Thai Army Nurses*. 2017;18:32-40.
20. Tanasugarn L, Natearpha P, Kongsakon R, et al. Physical effects and cognitive function after exercising "Rue-si-dad-ton" (exercise using the posture of the hermit doing body contortion): a randomized controlled pilot trial. *J Med Assoc Thai*. 2015;98(3):306-313.