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Pre- and post-treatment study of the application of a traditional Thai massage protocol for treating office syndrome

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Abstract

Office workers display a high prevalence of musculoskeletal disorders, especially myofascial pain syndrome (MPS). The objective of the present study was to measure the effect of a single application of a traditional Thai massage (TTM) protocol designed to treat office syndrome. The protocol was applied to treat 33 office workers (average age 36.5 ± 10.5 years) who were experiencing shoulder pain. Each participant received one 90-min session of whole-body massage from one of 11 TTM therapists who had attended a week-long course. Pre- and post-treatment measurements were recorded for Pain (i.e., pain intensity using a visual analog scale (VAS) and pain sensitivity using pressure pain threshold (PPT)), flexibility (i.e., cervical range of motion (CROM) including left cervical lateral flexion (LCLF), right cervical lateral flexion (RCLF), cervical flexion (CF) and cervical extension (CE) and sit-and-reach box test (SRB)) and tissue hardness (TH). Results revealed there to be a significant difference between the pre- and post-treatment values (a modified ANOVA-type statistic (MATS) $p< 0.001$), and for the two categories of Pain and Flexibility (a wald- type statistic (WTS) $p<0.001$). Pain intensity and pain sensitivity were both reduced, as reflected by a decrease in VAS and increase in PPT and the Flexibility measures LCLF, RCLF, CF, CE and SRB were all increased. Furthermore, participants reported no serious side effects. The protocol will now be applied in clinical studies of office workers with MPS to compare with other treatments.

Keywords: Office workers, Pain, Primary care, Traditional Thai Massage, Work-related disorders

1. Introduction

Office workers, such as computer users, dentists, and laboratory scientists, often work repetitively, remaining in the same position for long periods in an office setting, and have been frequently found to experience myofascial pain syndrome (MPS) [1-3]. MPS is defined as a syndrome of pain caused by hypersensitive palpable nodules called myofascial trigger points (MTrPs), which occur in taut bands of muscle. There are two types of MTrPs: active trigger points (ATrPs) which produce pain constantly or during movement [4] and latent trigger points (LTrPs) which are painful only when they are pressed.

In office workers, low-level and continuous muscle contractions combined with visual stress during 30 min of typing may induce changes in the MTrPs [1]. MTrPs are typically found along the various anti-gravity muscles, such as those in the neck, shoulder, and back, and the upper trapezius muscle has been identified as a particularly common site for MTrPs [3]. In office workers with MPS, LTrPs can rapidly become ATrPs by the

temporary release of sensitizing substances [1,4]. Increased stiffness of certain muscles [5] reduces blood circulation and muscle cell metabolism, which can also increase the severity of MPS.

The most common theory to explain pathophysiological alteration within MTrPs is motor endplate dysfunction and insufficient adenosine triphosphate (ATP) synthesis [4]. In particular, repetitive excessive acetylcholine (ACh) release at the terminal nerve sustains sarcomere contraction, which causes reduced blood flow and ischemia. Reuptake of Ca^{2+} into the sarcoplasmic reticulum (SR) requires ATP, and reduced ATP synthesis causes accumulation of Ca^{2+}. This destructive cycle can form LTrPs during prolonged office working leading to release of sensitizing substances, metabolic waste products, and inflammatory markers, which can be accumulated until giving rise to ATrPs. These pathophysiological alterations represent the clinical hallmarks of patients diagnosed with MPS [4], such as pain, reduced pressure pain threshold (PPT), restricted range of motion of the cervical region and reduced flexibility. There is no standard treatment for office workers with MPS and pain relief is typically achieved using medications such as non-steroidal anti-inflammatory drugs (NSAIDs), complemented by procedures to improve muscle function, such as stretching exercises, mobilization and manual therapy [4].

Traditional Thai massage (TTM) is one of the primary care methods in Thailand for promoting physical health and mental wellbeing and combines acupressure and assisted yoga postures performed under the concept of normalizing the "flow" of energy throughout the whole body along Sen Seb lines. An increase in blood flow after massage can explain the effects of the practice [6]. This effect can occur on a local level within muscle [7], which could, in principle, break the MTrP cycle described above. There have been many scientific studies of the effects of TTM, which include reports of reduced pain intensity [8,9], increased PPT [9,10], increased cervical range of motion (CROM) [11], increased body flexibility [8,9], and decreased tissue hardness [10]. In addition, self-reported stress score has been reported to be improved immediately after receiving whole-body TTM [12]. There have been several reports that TTM provides an effective treatment for office workers with MPS [13]. However, in these studies TTM was applied according to the practice developed by the therapist, and not according to a standardized Protocol and which may produce inconsistent outcomes [14].

The TTM protocol for treating office syndrome used in the present study was developed using the knowledge of experts and key stakeholders (a consortium of TTM therapists, owners of massage businesses, and clients). The protocol comprises 25 discrete steps, involves initial manual acupressure, proceeding to assisted stretching including shoulder joint mobilization, administered over 90 min. The Protocol is simple for TTM therapists tolearn and to be replicated in different research studies. The objective of the present study was to measure the effects of a single application of the TTM protocol in office workers experiencing shoulder pain associated with MPS.

2. Materials and methods

2.1 Design and setting

The present study used a pre-versus post-treatment design. Participants were recruited via bulletin boards and oral requests at a private TTM clinic, hospital and other public service departments between September and October 2020.

2.2 Participants

Office workers who were experiencing pain in the area of the upper trapezius muscle were recruited. Inclusion criteria were male or female subjects aged between 20 and 60 years. The criteria used for defining MPS [15] were pain and at least one MTrP (active and/or latent) lying within one or both upper trapezius muscles on either side. Exclusion criteria were history of any potentially confounding diseases (e.g., neuromuscular problems, other diseases of the cervicothoracic shoulder, previous surgery affecting the cervicothoracic shoulder, bone fracture, osteoporosis or hemophilia), and contraindication of TTM (e.g., contagious skin disease, injury or inflammation of the muscle, fever, open wound, alcohol intoxication, heart disease or current prescription of anticoagulant medications.

Sample size was defined based on visual analog scale (VAS) scores of pain intensity that were reported in a previous study in which TTM was used to treat scapulocostal syndrome. In particular, Buttagat et al [8] and colleagues reported that the average pre-TTM VAS score was 5.94 (± 1.58) cm. and the average post-TTM VAS score was 3.88 (± 2.39) cm, with pooled standard deviation (SD) of 2.03. If the present TTM study was to have a power of 80% and significance level = 0.05 and assuming to detect 1 cm VAS score difference and assuming the same standard deviation reported by Buttagat et al [8] at least 33 participants would need to be recruited.

2.3 Intervention

Eleven licensed TTM therapists with 3 to 5 years of experience underwent one week of training in using the TTM protocol. During the training period, TTM experts provided coaching until each TTM therapist met 80% of the approval criteria for their practice skills, which includes application of appropriate acupressure force and rhythm, time spent on each body part, correct order of the massage sequence and positioning of themselves and the patient.

The 25 steps of the TTM massage protocol developed for treatment of office syndrome are administered in four sections, which comprise supine, side (first the left and then the right side), prone and supine lying (Table 1). The TTM therapist uses their thumb, palm, or heel of hand to apply acupressure massage in an appropriate pattern along the energy lines in each body region, with most of the acupressure massage focused on the upper and lower back. The magnitude of the applied pressure is categorized according to the TTM therapist's body weight into three levels: light (no body weight), moderate (body weight with bent elbow), and intense (body weight with straight elbow). The rhythm of the acupressure massage component of the protocol consisted of three phases: gentle touch, gradually increasing pressure, and touch just below the pain threshold of each subject. The pressure was maintained for anywhere between 5 sec (each massage point) and 45 sec (artery occlusion) at different stages of the protocol.

Table 1 The 25 steps of the 90-min whole-body TTM massage protocol.

Section	Sequences	Area of application of TTM	Part of the body	Level of pressure exerted	Timing (min)
1.Supine lying *	1	Dorsal foot	TP	Light	01.30
			CTP	Intense	
	2	Anterior leg and thigh	HP	Light	01.30
			CTP	Intense	
	3	Lateral thigh	CTP	Intense	01.00
	4	Femoral artery occlusion	DHP	Moderate	00.45
	5	Palmar	TP	Moderate	00.45
	6	Anterior arm	DTP	Moderate	01.30
			CTP, STP	Intense	
	7	Dorsal hand	TP	Moderate	01.00
			CTP	Intense	
	8	Posterior arm	TP, DTP	Moderate	01.30
			CTP	Intense	
	9	Anterior shoulder point	TC	Light	00.20
			TP	Moderate	
	10	Axillary artery occlusion	HP	Light	00.45
			PP	Moderate	
2.Side lying *	11	Plantar	TP	Moderate	01.30
			CTP	Intense	
	12	Medial leg and thigh	PP	Moderate	01.30
			STP	Intense	
	13	Lateral leg and thigh	PP	Moderate	02.00
			STP	Intense	
	14	Gluteus point	STP	Intense	00.45
	15	Lateral lower and upper back	TP	Moderate	05.00
			CTP	Intense	
	16	Scapular	TP	Moderate	02.00
	17	Posterior neck and shoulder	TP	Moderate	02.00
			STP	Intense	
	18	Lateral head	TC	Light	02.00
	19	Upper extremity stretching	N/A	N/A	03.30
	20	Lower extremity stretching	N/A	N/A	01.30
3.Prone on stomach*	21	Posterior leg	HP	Light	01.00
			PP	Moderate	
	22	Posterior thigh	SPP, DPP	Intense	01.00
	23	Posterior lower and upper back	DTP	Moderate	04.00
			CTP	Intense	
4.Supine lying	24	Postero-anterior head	TC	Light	02.00
	25	Trunk stretching	N/A	N/A	03.00

Note: (*), repeated on another side before changing sections; N/A, non-assessable; minutes (min), thumb circle (TC), heel press (HP); thumb press (TP), double thumb press (DTP), double heel press (DHP), palm press (PP), cross thumb press (CTP), side thumb press (STP), double palm press (DPP), and side palm press (SPP).

2.4 Outcome measures

2.4.1 Measurement of pain

The outcome measures of pain comprised pain intensity and PPT participants reported pain intensity on a numerical VAS scale ranging from 0 to 10 cm, which corresponds to ‘‘no pain anywhere’’ to ‘‘worst pain imaginable’’. PPT was measured using the pressure algometry technique (Tissue Hardness Algometer Combo, OE-220, Japan) [9,16,17]. Measurements were recorded by asking participants to signal the moment at which the pressure stimulus produced a feeling of pain at the MTrP that the participant reported as being unbearable.

2.4.2 Measurement of flexibility

Flexibility was assessed using the CROM and sit-and-reach box (SRB) tests. CROM was measured using a CROM goniometer (Performance Attainment Associate, St. Paul, Minnesota, USA), which has been shown to have high reliability [18]. Participants were asked to make cervical movements, including left cervical lateral flexion (LCLF), right cervical lateral flexion (RCLF), cervical flexion (CF) and cervical extension (CE) in the anterior to posterior direction, until the limit of the range of motion was reached, and which was measured using the CROM goniometer. For the SRB test participants were asked to sit and to keep the knees fully extended and feet dorsiflexed and positioned flat against the foot-support platform, with fingertips placed together on top of the box. Next, the participant slowly and concentrically contracted the hip flexor and abdominal muscles to bring the body forward. The outcome of SRB was measured as the longest distance from the border of the box to the furthest reach-out finger of the overlapped hands [19].

2.4.3 Tissue hardness (TH)

Tissue hardness was measured using an OE-220 pressure algometer [10]. The 10-cm-diameter plastic disk of the algometer was placed on the skin over the same MTrP as was chosen for assessment of PPT and tissue hardness was recorded [20].

2.4.4 Satisfaction and adverse effects

The satisfaction of the participants was measured using 0-4 point Likert’s scale [21], for the following eight items, namely whole-protocol satisfaction, return to work normally, pain relief, appropriate positioning, appropriate duration in each area, appropriate applied force pressure directly over pain points.

Any adverse effects were recorded immediately after and again 1-day post-TTM treatment. When the participants reported any adverse effects, they were asked to continue to report each day until they had no symptoms.

2.5 Procedure

Prior to the commencement of the present study the three investigators, comprising one physiotherapist with eight years’ experience and two fourth-year physiotherapy students (S1 and S2), performed repeatability and reproducibility tests in 28 student volunteers with upper trapezius muscle pain but who were not diagnosed with MPS. In particular, for each outcome variable except pain intensity (VAS) all three investigators repeated the measurement three times with a 2-min interval between measurements. The physiotherapist measured all variables, S1 measured PPT and TH and S2 measured flexibility (LCLF, RCLF, CF, CE, SRB).

For a period of one week prior to TTM massage, participants refrained from exercise and any pain management or treatment. Each of the 33 participants who met the inclusion criteria were randomly assigned to receive the TTM protocol for treating office syndrome from one of 11 TTM therapists who were trained in administering the new TTM Protocol and who would each treat three participants. The TTM therapists were monitored by the research team to ensure that the TTM protocol was delivered correctly. Outcome measures of PPT and TH were recorded pre- and post-TTM treatment by S1 three times, and the Flexibility outcome measures were recorded by S2 three times with the post-treatment measures obtained within 5 min of receiving treatment. To ensure all measurements were taken within the time schedule the physiotherapist occasionally assisted in assessing all outcome measures. The result of each outcome measure was obtained by taking the average of the three measurements.

2.6 Data analysis

Data analysis was performed using International Business Machines Corporation Statistical Package for the Social Sciences (IBM SPSS) version 28 (copyright Khon Kaen University (KKU), Thailand). Normality of the outcome measures was investigated by using the Shapiro-Wilk Test. Intra-class correlation coefficient (ICC) with model (3,1), which is a type of reliability test to assess intra-rater repeatability with the same assessors and inter-rater reproducibility with different assessors within the same session [22], was conducted to examine reliability of the measurement. Since several of the outcome measures did not exhibit a normal distribution a non-parametric multivariate analysis of variance (MANOVA) was performed to investigate whether a significant effect of TTM existed for the set of all outcome measurements as well as for the three categories of (1) pain (VAS and PPT), (2) flexibility (LCLF, RCLF, CF, CE and SRB) and (3) TH. The analysis was performed used the MANOVA.RM package of R software (R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/). A modified ANOVA-type statistic (MATS) $p< 0.05$ was considered for analysis of the total set of all variables, since the covariance matrix was singular. Subsequently, a wald-type statistic (WTS) $p< 0.05$ was considered for the analysis of the three categories as the covariance matrix was not singular.

3. Results and discussion

3.1 Demographic data

Demographic data for the 33 participants are presented in Table 2. Nineteen participants were female and 14 were male.

Table 2 Baseline characteristics of the 33 office workers who were diagnosed as having myofascial pain syndrome affecting upper trapezius muscle.

General characters		Health status	
Age (years)	36.52 ± 10.50	Underlying disease	7 (21.1%)
Weight (kg)	63.91±21.43	Drug	4 (12.1%)
Height (cm)	159.40±26.69	Smoking	2 (6.1%)
BMI (kg/cm^2)	22.42±3.51	Alcohol	8 (24.2%)
Systolic BP (mmHg)	117±14.62	Duration of work (h/day)	7.85 ± 2.34
Diastolic BP (mmHg)	75.46±16.80	Duration of work (days/week)	5.45 ± 0.87
Pulse (bpm)	76.21±11.39	Regular pain management	23 (69.7%)
RR (bpm)	19.96±6.35	Right upper trapezius pain	24 (72.72%)

Note: values are presented as number of participants, n (%) and mean ± SD; mmHg, millimeter of mercury; bpm, beat per min.

Furthermore, 28 (84.8%) of participants were private employees, 23 (69.7%) were computer users, 21 (63.6%) had private general Thai health insurance and 25 (75.8%) slept less than six h per day.

3.2 Intra-rater repeatability and inter-ratter reproducibility

Intra-rater repeatability and inter-rater reproducibility of outcomes measurements showed that for PPT the ICC was 0.94 ($p<0.001$) for intra-rater repeatability and 0.97 ($p<0.001$) for inter-rater reproducibility, respectively, for all variables in CROM the ICC varied between 0.94 and 0.98 ($p<0.001$) for intra-rater repeatability and varied between 0.93 and 0.97 ($p<0.001$) for inter-rater reproducibility, respectively. For SRB test the ICC was 0.99 ($p<0.001$) for intra-rater repeatability and 0.99 ($p<0.001$) for inter-rater reproducibility, respectively, and for TH the ICC was 0.92 ($p<0.001$) for intra-rater repeatability and 0.89 ($p<0.001$) for inter-rater reproducibility, respectively.

3.3 Results of outcome measures

Results for the outcome measures are presented in Table 3 and plotted in Figure 1, which shows that TTM produced a significant effect for the total set of all outcome measures (VAS, PPT, LCLF, RCLF, CF, CE, SRB, TH) (MATS $p< 0.001$) and for the two categories of pain and flexibility (WTS $p< 0.001$), where pain and pain sensitivity were both reduced, as reflected by a decrease in VAS and increase in PPT. Flexibility also showed significant improvements with increases in LCLF, RCLF, CF, CE and SRB. However, there was no significant change in TH (WTS $p> 0.05$).

Table 3 Comparison of clinical outcomes measured between baseline and after receiving the TTM protocol, using non-parametric MANOVA analysis.

Outcomes	Baseline (Mean ± SD)	Post-test (Mean ± SD)
VAS (cm)	5.15 ± 1.97	2.82 ± 2.51
PPT (kg/cm^2)	1.83 ± 0.74	2.20 ± 1.05
LCLF (º)	34.42 ± 6.44	39.30 ± 6.95
RCLF (º)	36.00 ± 7.69	41.30 ± 8.87
CF (º)	46.10 ± 11.9	51.50 ± 11.4
CE (º)	53.61 ±12.1	60.42 ± 10.5
SRB (cm)	-4.54 ± 11.3	-1.77 ± 11.3
TH (%)	64.74 ± 7.17	63.60 ± 8.62

Note: Values are shown as mean ± standard deviation (SD) with units indicated in parentheses.

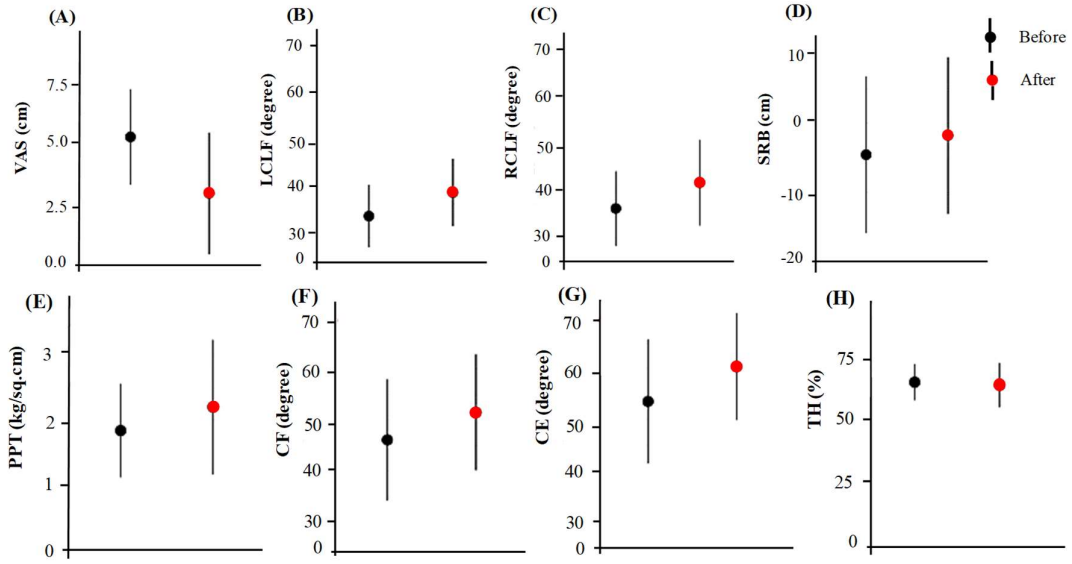

Figure 1 Plots of changes in the outcome measures for subjects before and after receiving the TTM Protocol for treatment of office syndrome. Error bars indicate Mean ± SD with units indicated in parentheses. The Pain intensity measures VAS and PPT are plotted in (A) and (E), respectively. The Flexibility measures LCLF, RCLF, CF, CE, and SRB are plotted in (B), (C), (F), (G), and (D), and the Tissue Hardness measure TH is plotted in (H). The direction of the short red arrow denotes the direction of change that is predicted to represent a beneficial effect and the direction of the short blue arrow denotes a deterioration.

3.4 Satisfaction and adverse effects

Participants reported their level of treatment satisfaction with the 90-min TTM Protocol, scored from neutral to very satisfied for all eight items on the 0-4 Likert's scale (Figure 2) including, whole guidance, return to work, pain relief, appropriate positioning, duration and pressure, accuracy of application of pain point and addressing painful points. In particular, results revealed that more than 80% of participants reported the TT massage from satisfied to very satisfied, and no participants reported dissatisfaction.

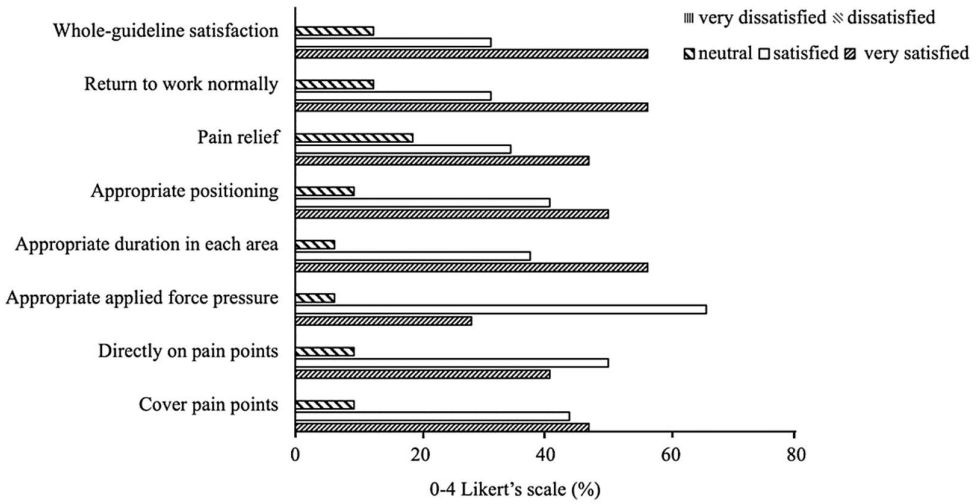

Figure 2 The responses of the 33 office workers to the eight items on the 0-4 point Likert's scale (0=very dissatisfied; 1= dissatisfied; 2=neutral; 3=satisfied; 4=very satisfied), indicating their degree of satisfaction after receiving the 90-min TTM Protocol.

With regard to adverse effects, one participant reported feeling uncomfortable immediately after receiving treatment. In addition, three participants reported mild muscle soreness one day after receiving treatment, and which required treatment with paracetamol in one participant. Within two days following TTM, no participants reported any persisting adverse effects.

3.5 Discussion

Application of a 90-min whole body TTM protocol developed to treat office syndrome in participants with specific symptoms of shoulder pain produced by MTrPs, had a significant immediate effect on pain, reducing intensity and decreasing sensitivity, and significant immediate effect on flexibility (of both the cervical region and the torso), but with no effect on TH.

Significant reduction in pain intensity after TTM is consistent with previous studies of patients with pain associated with MTrPs [8-10], although in these studies [8-10], massage was only performed for a particular region, such as the upper or lower back, and was only 10, 30 or 45 min in duration. Reduction in pain intensity has been interpreted in terms of gate control theory, with increasing presynaptic inhibition at the dorsal horn of the spinal cord decreasing the level of substance P. An alternative interpretation is that TTM may produce an increase in the abundance of natural anti-pain neurotransmitters, such as serotonin levels, positively affecting pain and stress levels [23]. In a previous study it was also reported that an increase in muscle blood volume measured using a laser blood flow meter, was associated with a reduction in pain intensity, as measured by VAS [7]. Therefore, a particularly important benefit of massage may be enhancement of the removal of metabolic waste products such as lactic acid and H^+ by increased blood flow, leading to pain relief.

In previous studies [24,25], it has been reported that PPT significantly increased two weeks and six weeks after receiving TTM. This reduction in pain sensitivity is interpreted to be due to improvement in blood circulation removing pain and inflammatory mediators [15]. Interestingly, however, in a study where an attempt was made to control massage force at a constant pressure of 2 kg/cm, sustained for 90 sec, a significant reduction in PPT in patients with MTrPs was reported immediately following treatment [26]. Microdialysis has revealed that the biochemical milieu (e.g., pH, neuropeptides, cytokines) within both active and latent MTrPs significantly differs from that in healthy muscle, with increased levels of sensitizing substances within painful muscle [27]. Further studies are required to characterize the changes that take place in the muscle tissue following TTM, and it is potentially interesting to consider focusing such investigations on the upper trapezius muscle, which is the most common location for ATrPs [3].

The improvement in Flexibility (i.e., CROM and SRB tests) observed in the present study is also consistent with previous reports [9,28]. In the present study, CROM was improved in every dimension. A previous study also reported similar results, in which significant improvement in CROM was found at six weeks [11]. A potential mechanism for the increased range of motion is decreased local reflex inhibition, as measured by a reduction in Hoffmann's (H)-reflex/M-wave ratios [29]. Moreover, stretching improves muscle compliance, leading to range of motion enhancement [30].

The present study found no significant changes in TH following TTM. However, in previous studies, it has been reported that TH measured using a tissue hardness meter was significantly decreased after massage [5,10]. However, mechanical properties in the muscles cannot be measured with the tissue hardness meter since Tissue Hardness is stiffness assessed from several tissues above the muscle layer including the skin, subcutaneous fat, and superficial and deep fascial layers [31]. Magnetic resonance elastography (MRE) is a non-invasive medical imaging technology to quantify the mechanical properties of tissue, and which may have potential for evaluating muscle stiffness after the application of TTM. It demonstrated MRE to the upper trapezius and identified the presence of myofascial taut bands by quantifying and differentiating localised areas of increased muscle stiffness from the surrounding tissue [32]. Further research is required concerning the effect of the TTM Protocol on muscle stiffness.

The vast majority (29/33) of participants expressed high satisfaction levels after receiving the 90-min TTM protocol for treating office syndrome. Furthermore, the TTM protocol produced no serious adverse effects and only four participants reported mild adverse effects. This is consistent with a previous study in which mild aching in the shoulders was reported after TTM treatment by participants who had never received TTM previously [10]. Furthermore, in a review of studies of Swedish massage, deep tissue massage and trigger point therapy, no major side effects such as bruising, headache, tiredness, increased discomfort, or soreness were found [33].

The application of the TTM protocol developed to treat office syndrome in participants experiencing shoulder pain associated with MPS had a significant beneficial effect on pain and flexibility, but not on TH. There are, however, some limitations in the present study. Firstly, the pre-versus post-treatment study design did not include investigation of any control subjects. For future research, we recommend that a randomized control trial should be used to study TTM effectiveness. Secondly, only the immediate effects of TTM were examined and further study is required to investigate short-term and longer-lasting effects. The physiological effects of TTM should also be investigated in future studies.

4. Conclusion

This present study has confirmed that the new TTM Protocol for treating office syndrome produced a significant immediate improvement in pain (decreased intensity and decreased sensitivity) and increased flexibility (cervical and body). Furthermore, the TTM Protocol does not cause serious adverse effects, and represents a potentially effective treatment for MPS in office workers.

5. Ethical approval

The study was approved by the Research Ethics Committee of the Center for Ethics in Human Research, Khon Kaen University (HE631017) and informed consent was obtained from all subjects recruited to the study.

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