Comparison Between the Effects of Passive and Active Soft Tissue Therapies on Latent Trigger Points of Upper Trapezius Muscle in Women: Single-Blind, Randomized Clinical Trial

Marzieh Mohammadi Kojidi, MSc, PT,[a] Farshad Okhovatian, PT, PhD,[b] Abbas Rahimi, PT, PhD,[b] Alireza Akbaezade Baghban, PhD,[b] and Hadi Azimi, PhD[c]

Abstract

Objective: The purpose of this study was to investigate the effects of passive versus active soft tissue therapies on pain and ranges of motion in women with latent myofascial trigger points.

Methods: Forty-two female patients, aged 18 to 64 years, with a history of neck pain and latent myofascial trigger points in the upper trapezius muscle were randomly assigned to 3 groups: group A received passive soft tissue therapy, group B received active soft tissue therapy, and a control group C received a sham procedure. The treatment consisted of 3 sessions in a 1-week period with 1-day break between each session. The local pain intensity, measured with a visual analog scale and pain pressure threshold (PPT) using algometry, and active cervical contralateral flexion (ACLF) measured with goniometry, were obtained at baseline, after the third session, and a week after the third session.

Results: The results indicated a significant decrease in local pain intensity on the visual analog scale within each group (A and B) compared with the control group (C) ($P < .05$). The passive group had significant improvement in PPT compared with the control group ($P < .05$). There were no significant differences in ACLF after treatment between the 3 groups ($P > .05$).

Conclusion: Both passive and active soft tissue therapies were determined to reduce pain intensity and increase ACLF range of motion, although passive therapy was more effective in increasing PPT in these patients compared with the control group. (J Chiropr Med 2016;15:235-242)

Key Indexing Terms: *Musculoskeletal Manipulations; Trigger Points; Trapezius Muscle; Therapy, Soft Tissue; Massage; Myofascial Pain Syndromes*

Introduction

Musculoskeletal disorders are tissue dysfunctions in the musculoskeletal system that arise as a result of continuous exposure to abnormal, adverse physical conditions during rest or while performing job duties, as well as steady and repeated movements leading to pain and injury in the body, especially in the neck and shoulder.[1-4] Some consider musculoskeletal pain related to the neck and shoulder areas as affected by occupational injuries, which, by a prevalence of more than 50%, are ranked the first compared with pain in other areas of the body. Given the importance of the issue, ignoring proper treatment can cause postural disorders, reduce performance in daily activities and quality of life, and, consequently, increase work absences and medical expenses over time, which impose a heavy financial burden on the individual and society.[5-7]

Computer use, especially among office workers and for the purpose of work-related duties, has prominently spread around the world.[8-12] A review of published reports reveals a number of risk factors for neck and shoulder pain among computer-using office workers. These risk factors include lack of or low job satisfaction, unfavorable work environment

[a] Student Research Committee, School of Rehabilitation Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
[b] Physiotherapy Research Centre, School of Rehabilitation Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
[c] Department of English Language Teaching, School of Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
Corresponding author: Farshad Okhovatian, PT, PhD, Physiotherapy Research Centre, Shahid Beheshti University of Medical Sciences, Tehran, Iran. Tel.: +98 21 77576268. (e-mail: *farshadokhovatian1965@gmail.com*).
Paper submitted April 13, 2016; in revised form August 18, 2016; accepted August 25, 2016.
1556-3707

http://dx.doi.org/10.1016/j.jcm.2016.08.010

and physical conditions, failure to comply with ergonomic factors (lack of proper footrest, improper mouse, and incorrect angle of the monitor),[13-18] and gender (women, because of differences in anatomical and physiological structure and also hormonal cycle changes in the second to fifth decade of their lives, compared with those for men, are more susceptible to musculoskeletal pains and disorder in a similar workplace with a constant pressure).[11]

Repetitive tasks with long static loads lead to the development of clinical disorders such as myofascial pain syndrome (MPS) with trigger points (TPs) and, subsequently, the relevant musculoskeletal disorders such as MPS.[10,19-23] In accordance with the clinical manifestations, the TPs are classified as active or latent: The active type manifests as referred pain even during rest, and the latent type, according to Simons, causes limitation of motion and muscle weakness and can be painful only with direct firm pressure.[24] Trigger points can occur in any muscle, but a common place is in the muscles that are involved in maintaining posture.[15,20] Trester et al reported that the upper trapezius muscle is the most common muscle involved in MPS associated with TPs among computer users.[14]

Given the high prevalence of musculoskeletal injuries among staff who use computers, the present study was carried out to investigate effective treatment to improve these injuries with minimal side effects. There are many therapeutic approaches available for the treatment of patients with TPs, among which is manual therapy.

Some studies have been conducted to identify effective treatments for soft tissue–related problems. Research on active techniques includes applying pressure to nodules or bands in a muscle and then the abnormal tissue being taken from contracted position to elongated position, while the therapist maintains directed manual contact along the muscle fibers.[25-27]

Passive methods have also been used as a clinical tool for the treatment of muscle dysfunction. This technique aims to interrupt the pain spasm cycle and influence the muscle by correcting musculoskeletal and neurologic imbalances in a relaxed position for a specified period (90 seconds or 3 minutes).[22]

A review of the related published reports revealed that no study has reported the comparison of these passive and active soft tissue therapies. Therefore, the purpose of this study was to examine the effects of these manual therapy techniques on pain and ranges of motion in women with latent myofascial TPs.

Methods

Design and Participant Selection

This was a randomized single-blind sham controlled clinical trial approved by the Ethics Committee of Physiotherapy Research Centre (PTRS# IR.Sbmu.ram.Rec.1394.310), at Shahid Beheshti University of Medical Sciences, Tehran, Iran, with the registration code no. IRCT2016010425847N1 in the Iranian Registry of Clinical Trials. Random sampling was used to select the participants from the available community—that is, all women among the staff and students of the School of Rehabilitation, Shahid Beheshti University of Medical Sciences, Tehran.

To calculate the sample size, because we had 3 independent groups and also because of the quantitative nature of the variables, 1-way analysis of variance menu of power and sample size (version II) was used. In the SPSS software (version 16), considering the first error type the level of α was considered to be .05 and considering the second error type, β was considered to be .1—that is, a power of 90% and average pain of $\mu 1 = 2$, $\mu 2 = 1.08$, and $\mu 3 = 0.67$ (standard deviation [SD] = 0.9), based on the study by Trivedi et al.[28] So, a sample size of 14 participants in each group (42 in total) was obtained.

Before the random distribution of the participants into groups of 14, they were first examined to determine the most sensitive latent TP in the left or right upper trapezius by evaluating the level of sensitivity using hand palpation and algometry. Next, informed consent was obtained from each of the participants after an explanation of the study. The researchers made sure that participants did not incur any additional cost. All participants' rights were observed throughout the study. Participants were included if they had a minimum of 1 palpable nodule in the upper trapezius muscle and hypersensitive tender spot in a taut band in response to 2.5 kg/cm^2 of pressure and were excluded if they had a history of thyroid disease, neck pain after a motor vehicle accident and cervical surgery, myofascial pain therapy within the month before the study, presence of spontaneous referred pain pattern (active TP), or jump sign.[29-36] A total of 42 women (because of availability issues), aged between 18 and 64 years, were selected as the final participants of the study. The volunteers were female because gender differences may have influenced the results.[37] The selected participants were then randomly allocated to 3 groups using a lottery draw: each participant received a sealed envelope containing one of the letters A, B, or C. Those who received letters A, B, and C became members of passive, active, and control groups, respectively.

Outcome Measures

The variables assessed were active cervical contralateral flexion (ACLF) range of motion (ROM) by goniometer, intensity of pain on the visual analog scale (VAS), and pain pressure thresholds (PPTs) by algometry. The algometer used in the present study was the Taiwan 5020 version, with a 1-cm square disc area; the calibration was approved by the official manufacturer before data collection commenced. The validity and reliability of the instruments were previously verified in other studies (intraclass correlation coefficient: 0.75-0.89).[38,39] Using the algometer, 2.5 kg/cm^2 pressure was applied on the latent TP while the patient was asked to mark the pain level on VAS (a 10-cm line with 0 representing the lowest and 10 representing the highest level of pain),[40,41] then range of ACLF was carried out via a goniometer. Participants were asked to sit upright. The fulcrum of the goniometer was placed on the spinous process of the first thoracic spine with the center of the goniometer arm on the occipital protuberance at a right angle; then the device's horizontal arm was stabilized manually and its vertical arm was placed on the occipital protuberance to measure lateral flexion angle while the participant was asked to bend her neck toward the aching area without raising shoulders and, at the same time, the therapist moved the movable arm in accordance with the head.[42] This procedure was performed twice with a 15-second interval, and the average value was determined as the ROM of the cervical spine.

The reliability and validity of the goniometer were previously established in other studies.[43-45] Participants entered the treatment program 5 minutes after the baseline assessment. The study was carried out in 3 sessions over the period of 1 week. In contrast to other studies cited, a short follow-up period of 1 week was implemented after the last session. After completion of the 3 therapy sessions, participants in all the 3 groups (passive, active, and control) were asked to refrain from using any treatment, such as heat, cold, and drug treatments, so that the results could be reported without any bias. To encourage the participants to complete the process of treatment, compensation was provided.

All measurements and techniques were performed by a sixth-year physiotherapy student, who had been trained by a professor with at least 20 years of clinical experience.

Intervention

Passive Soft Tissue Therapy. Participants (n = 14) were encouraged to relax as much as possible before the pressure was applied. After identifying and marking the most sensitive latent TP in the upper trapezius muscle, the patient was asked to lie in a supine position and the therapist stood over her at the end of the bed, putting her thumb on the area and applying pressure to the extent that the participant felt the pain; the contact with the TP was maintained all through the treatment. Then the therapist passively moved the participant's head and neck in a position of comfort (ipsilateral side flexion, cervical contralateral rotation, 5-8 degrees) so that participants reported 75% reduction in pain. This condition was maintained for 90 seconds and performed 3 times per session, with a 15-second rest interval.[46-49]

Active Soft Tissue Therapy. Participants sat on a chair. The therapist stood behind the participant and held 1 hand over her head as the support, with the thumb of the other hand on the painful area of the latent TP of the upper trapezius muscle along the fibers; also, the participant was asked to simultaneously and actively change the muscle from shorted position to elongated state (ipsilateral side flexion of the cervical to the opposite side). This technique was repeated 3 times per session, and each repetition was maintained for 20 seconds, with a 15-second rest interval.[49,50]

Control. The aim of using the algometer was homogenization of therapy methods. Participants who were randomly assigned to the control group received sham manual treatment. The participant sat on the chair and leaned back, with her feet completely on the ground. The therapist stood behind her and placed the algometry disk on the latent TP, applying the minimum pressure (no greater than 1 kg/cm^2) in a way that it only touched the TP. This was maintained for 60 seconds[51] and repeated 3 times per session, with a 15-second interval.

Data Analysis

Data was analyzed using SPSS software (version 16). A normal distribution of quantitative variables was assessed by means of the 1-sample Kolmogorov-Smirnov test. A 1-way analysis of variance was run to determine whether there was a difference among the 3 groups regarding age, body mass index, and all 3 outcome measures (PPT, VAS, and ACLF) at baseline. For multiple comparisons, a Tukey procedure was used. The statistical analysis was conducted at a 95% confidence level. P values <.05 were considered to be statistically significant.

Results

Forty-two participants, aged 18 to 64 years (total mean age: 28.07, SD: 6.24; and total mean of pain intensity on VAS: 6.32, SD: 0.89), participated in the present study (Fig 1). According to the analysis of the data to assess the lasting effects of the methods used, the results of the comparison between the third and follow-up meetings in each group (with a period of 1 week as the follow-up period) proved lasting effects of reduction of pain on VAS and increase in PPT, but the ROM change in ACLF was not observed to significantly differ within groups.

According to Table 1, no significant difference was found for body mass index ($P = .2$), age ($P = .9$), or VAS ($P = .6$) among the 3 groups, so it could be assumed that all 3 groups were comparable at the onset of the study.

Results of Data Analysis

Shapiro test results indicated normality of distribution. Also, participants in the 3 groups were determined to be similar in terms of background information (Tables 2–5).

Pairwise comparison of the treatment times (at baseline, after the third session, and after the follow-up) within participants for each group using the Bonferroni method revealed significant reduction in the level of pain (VAS) and increase in PPT between all treatments sessions ($P < .001$). The rate of increase in ACLF between the first and the third treatment sessions was also statistically significant ($P = .000$). After applying the 3 methods under the study, it was revealed that pain intensity on VAS decreased over time in positional

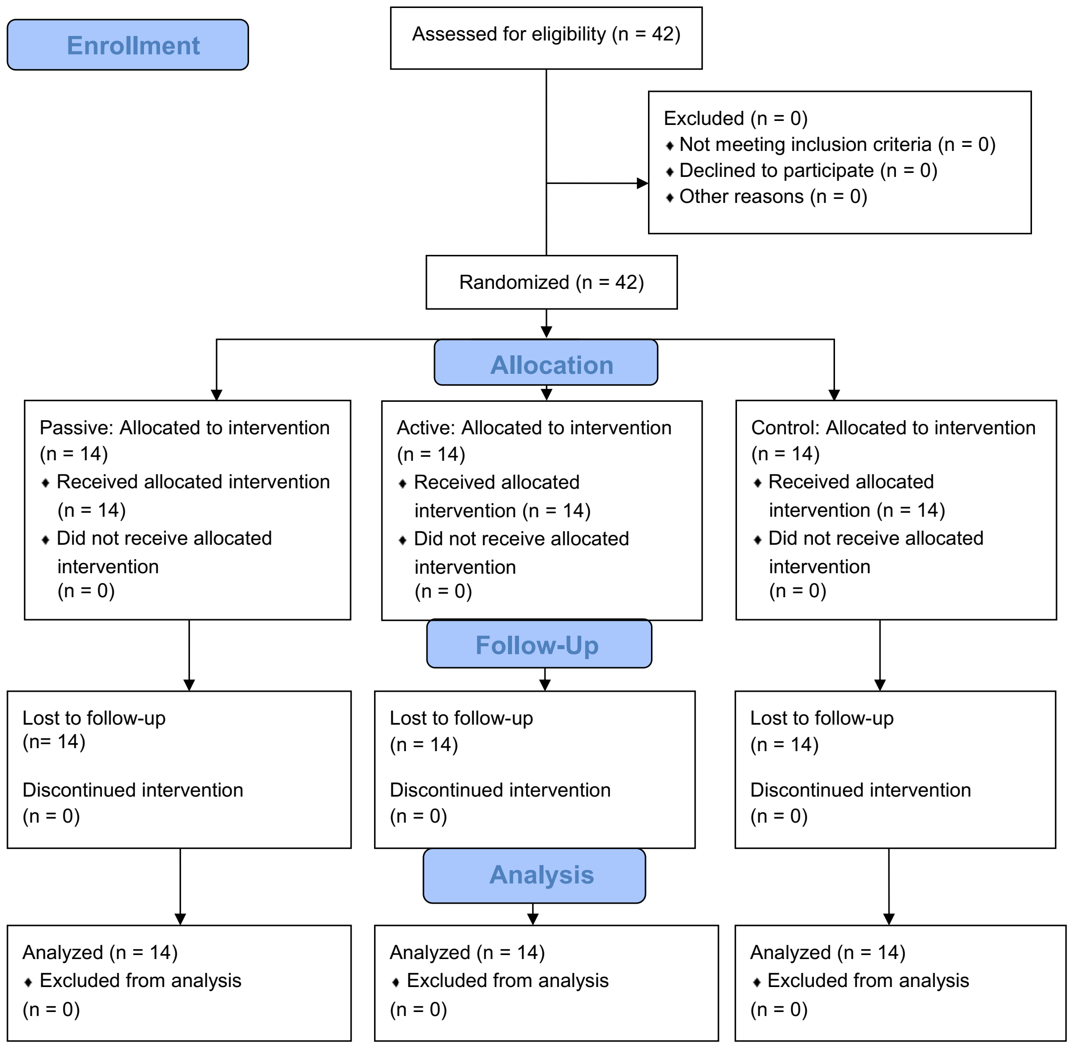

Fig 1. *CONSORT flow diagram.*

Table 1. *Preintervention Data of Participants for Each Group*

Group	Passive (A) n = 14	Active (B) n = 14	Control (C) n = 14	*P*
Age, y	27.86 ± 6.64	28.07 ± 5.94	28.29 ± 6.58	.984
BMI, kg/m^2	22.68 ± 1.41	21.86 ± 1.07	22.39 ± 1.18	.217
Pain intensity, VAS	6.5 ± 0.80	6.25 ± 1.06	6.21 ± 0.82	.666
PPT, kg/cm^2	1.54 ± 0.11	1.51 ± 0.11	1.50 ± 0.13	.679
ROM, degree	28.14 ± 5.65	29.28 ± 5.71	28.92 ± 4.71	.848

BMI, body mass index; *PPT,* pain pressure threshold; *ROM,* range of motion; *SD,* standard deviation; *VAS,* visual analog scale.
Values are expressed as mean ± SD.

release and active release groups significantly more than that in the control group, whereas the difference between the 2 treatment groups (active and passive) was insignificant. Pain pressure threshold underwent a significant change in the passive group compared with that in the control group, whereas the same variable in the passive group compared with that in the active group, and in the active group compared with that in control group, did not have a significant difference. The range of ACLF was not found to be significantly different in the treatment and control group during the study.

Discussion

Our study is the first to compare changes on PPT, pain intensity, and cervical ROM after the treatment of latent myofascial TPs in the upper trapezius muscle with passive and active soft tissue techniques and sham as a control group.

According to the results of the present study, no significant difference was observed between the effects of passive and active groups in reducing pain intensity on the VAS and increasing ACLF, but passive therapy was determined to have better effects on PPT, compared with that in active therapy. This is possibly because of the easy position, because in this position the patient's head and neck muscles are

Table 2. *Statistical Indicators of Dependent Variables in Separate Groups After the Third Session and Follow-up*

Variable	Sessions	Passive (A)	Active (B)	Control (C)	*P*
Pain intensity (VAS)	Baseline	6.5 ± 0.80	6.25 ± 1.06	6.21 ± 0.82	.666
	Third sessions	3.46 ± 0.90	3.41 ± 0.67	4.79 ± 0.87	.000*
	Follow-up	3.10 ± 0.85	3.19 ± 0.64	4.56 ± 0.99	.000
PPT (kg/cm^2)	Baseline	1.54 ± 0.11	1.51 ± 0.11	1.50 ± 0.13	.679
	Third sessions	1.74 ± 0.08	1.66 ± 0.14	1.55 ± 0.12	.001*
	Follow-up	1.77 ± 0.7	1.68 ± 0.14	1.55 ± 0.12	.000
Range of ACLF (degree)	Baseline	28.14 ± 5.65	29.28 ± 5.71	28.92 ± 4.71	.848
	Third sessions	32.86 ± 5.37	34.29 ± 4.64	30.36 ± 4.41	.107
	Follow-up	33 ± 5.22	34.36 ± 4.70	30.36 ± 4.41	.093

ACLF, active cervical contralateral flexion; *PPT,* pain pressure threshold; *SD,* standard deviation; *VAS,* visual analog scale.
Values are expressed as mean ± SD.

completely loose, positioning is passive, and the muscle is in shortened position; the therapist's manual contact blocks sending impulses from the TP, causing reduction of tissue and fascia sensitivity as well as local tenderness. Another reason for obtaining different results in comparison of these 2 techniques was probably the differences in duration of performing the techniques, which were 90 seconds for passive and 20 seconds for active therapy.

Passive Soft Tissue Therapy

The possible mechanism of passive soft tissue therapy may be that it reduces tenderness and local pain by provoking the TP. Considering the patient's position, which is a position of comfort in which the muscle is in the shortened position, the activity of intrafusal and extrafusal fibers and the discharge of gamma motor neuron are reduced. This technique leads to reduction of muscle spindle activity, muscle tension, pain, and restoration of the normal movement of the muscle as a result of the therapist's manual contact and application of manual pressure on the TPs.[52] Passive therapy may achieve its benefits by means of secretion of hormones as a result of mechanoreceptor stimulation, reducing pain symptoms, improving blood circulation by removing chemical mediators of inflammation from the pathologic area, and decreasing nociceptive sensitivity, leading to pain relief and increasing PPT.[48,53-56] Other studies, considering the evaluation criteria, reported similar results as those in the present study.[22,48,52-54,57,58]

Active Soft Tissue Therapy

Considering the physiology of the formation of TPs, the central nervous systems of individuals who have prolonged exposure to low-intensity forces, like computer users, become sensitive to this condition and its consequences, leading to the formation of a pain-spasm-pain cycle. Taking into account the manner of performing active therapy, where the therapist applies deep vertical tension on the TP, type IV receptors are activated, and consequently, supraspinal directions in the brainstem release an inhibitory neurotransmitter called endocannabinoid, which, by linking to its inhibitory receptor (CB1) located in the central nervous system, leads to decreasing tone, contracting muscles, and thus breaking the cycle of pain-spasm-pain.[50,59]

Control Sham

No study was found with a control group similar to that in our study, but some studies implemented similar techniques, including one study by Okhovatian et al,[36] which investigated the effects of strain counterstrain and manual pressure release

Table 3. *Postvalues of Comparison Between Groups After Treatment via VAS*

Variable: Pain Intensity (VAS)	Mean Difference		SE	*P*	95% Confidence Interval	
					Lower Bound	Upper Bound
Passive	Active	0.50	0.315	.986	−0.719	0.819
	Control	−0.877		.022*	−1.64	−0.108
Active	Control	−0.927		.015*	−1.69	−0.158
	Passive	−0.50		.986	−0.819	0.719
Control	Passive	0.877		.022*	0.108	1.64
	Active	0.927		.015*	0.158	1.69

SE, standard error; *VAS,* visual analog scale.

Table 4. *Postvalues of Comparison Between Groups After Treatment via PPT*

Variable: PPT	Mean Difference		SE	*P*	95% Confidence Interval	
					Lower Bound	Upper Bound
Passive	Active	0.666	0.044	.300	−0.041	0.174
	Control	0.131		.014*	0.023	0.239
Active	Control	0.065		.317	−0.042	0.173
	Passive	−0.666		.300	0.174	0.041
Control	Passive	−0.131		.014*	−0.239	−0.023
	Active	−0.065		.317	−0.173	0.042

PPT, pain pressure threshold; *SE,* standard error.

Table 5. *Postvalues of Comparison Between Groups After Treatment via ACLF*

Variable: ACLF (ROM)	Mean Difference		SE	P	95% Confidence Interval Lower Bound	Upper Bound
Passive	Active	−1.16	1.86	.809	−5.70	3.38
	Control	1.91		.566	−2.63	6.45
Active	Control	3.07		.239	−1.47	7.61
	Passive	1.16		.809	−3.38	5.70
Control	Passive	−1.91		.239	−6.45	2.63
	Active	−3.07		.239	−7.61	1.47

ACLF, active cervical contralateral flexion; *ROM,* range of motion; *SE,* standard error.

and control group (with the ultrasound turned off). They reported that the results of pretreatment and posttreatment and assessment in the control group were significant and stated that a possible reason could be the massage effects of the ultrasound device. Klein et al[60] compared the effect of SCS in patients with pain and restriction of neck ROM in 18- to 65-year-old participants and a control group, and the results indicated equal effects in both groups; the authors declared that the results could be justified because only 1 session of treatment was performed for the patient group. Trivedi et al[28] is the only study with a control group investigating the effects of active and myofascial release technique on 36 patients with chronic lateral epicondylitis. The differences between this study and the present study are the number of therapy sessions, examination of elbow area, and the follow-up period. In the study by Trivedi et al, improvement was reported after 12 treatment sessions using active technique; these results regarding improvement and decrease in pain intensity, compared with those in control group, confirm the results of the present study.[28]

Limitations

Limitations of this study include the short duration of therapy and that the participants were all women. Thus, the findings of this study are limited. Given the difference among people in terms of pain threshold, further studies are recommended to include a larger population, both men and women. It is recommended that future studies include symptomatic participants with active TPs (both male and female), a larger population, longer treatment and assessment periods, and follow-up of at least 1 month, which would enable the duration of treatment effect to be investigated.

Conclusion

Treatment of latent TPs of the upper fiber of trapezius muscle, with 90 seconds of passive treatment or 20 seconds of active treatment, significantly decreased the sensitivity of myofascial TPs, increased flexibility of muscle fibers, and improved the ROM. These results indicate that passive and active soft tissue therapies may possibly benefit female patients with myofascial TPs in the upper trapezius muscle. Based on the results from the follow-up period, stability was observed in improvement of the patients regarding the variables studied.

Funding Sources and Conflicts of Interest

No funding sources or conflicts of interest were reported for this study.

Contributorship Information

Concept development (provided idea for the research): F.O., M.M.K.
Design (planned the methods to generate the results): F.O., M.M.K.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): F.O., M.M.K.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): F.O., M.M.K.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): A.A.B.
Literature search (performed the literature search): F.O., M.M.K., A.R.
Writing (responsible for writing a substantive part of the manuscript): F.O., M.M.K., A.R.
Critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): H.A.

Practical Applications

- Both active and passive soft tissue therapies improved latent TP upper trapezius signs.
- Both interventional therapies produced greater improvement in pain than the control group.

References

1. Kerosuo E, Kerosuo H, Kanerva L. Self-reported health complaints among general dental practitioners, orthodontists, and office employees. *Acta Odontol Scand.* 2000;58(5):207-212.
2. Andersen JH, Kaergaard A, Frost P, et al. Physical, psychosocial, and individual risk factors for neck/shoulder pain with pressure tenderness in the muscles among workers performing monotonous, repetitive work. *Spine.* 2002;27(6):660-667.
3. Buckle PW, Devereux JJ. The nature of work-related neck and upper limb musculoskeletal disorders. *Appl Ergon.* 2002;33(3):207-217.

4. Punnett L, Wegman DH. Work-related musculoskeletal disorders: the epidemiologic evidence and the debate. *J Electromyogr Kinesiol.* 2004;14(1):13-23.
5. Linton SJ, Hellsing AL, Hallden K. A population-based study of spinal pain among 35-45-year-old individuals. Prevalence, sick leave, and health care use. *Spine.* 1998;23(13):1457-1463.
6. Borghouts JA, Koes BW, Vondeling H, Bouter LM. Cost-of-illness of neck pain in the Netherlands in 1996. *Pain.* 1999; 80(3):629-636.
7. Driessen MT, Lin CW, van Tulder MW. Cost-effectiveness of conservative treatments for neck pain: a systematic review on economic evaluations. *Eur Spine J.* 2012;21(8):1441-1450.
8. Tepper M, Vollenbroek-Hutten MMR, Hermens HJ, Baten CTM. The effect of an ergonomic computer device on muscle activity of the upper trapezius muscle during typing. *Appl Ergon.* 2003;34(2):125-130.
9. Johnston V, Souvlis T, Jimmieson NL, Jull G. Associations between individual and workplace risk factors for self-reported neck pain and disability among female office workers. *Appl Ergon.* 2008;39(2):171-182.
10. Muñoz-Muñoz S, Muñoz-García MT, Alburquerque-Sendín F, Arroyo-Morales M, Fernández-de-las-Peñas C. Myofascial trigger points, pain, disability, and sleep quality in individuals with mechanical neck Pain. *J Manipulative Physiol Ther.* 2012; 35(8):608-613.
11. Cagnie B, Dewitte V, Coppieters I, Oosterwijck JV, Cools A, Danneels L. Effect of ischemic compression on trigger points in the neck and shoulder muscles in office workers: a cohort study. *J Manipulative Physiol Ther.* 2013;36(8):482-489.
12. Kamali Sarvestani F, Nematollahi M, Farahizadeh R, Khosravi R. Comparison of two manual therapy techniques on pain and function in subjects with neck pain. *J Res Rehabil Sci.* 2013;9(1):65-74.
13. Christensen K. Manual muscle testing and postural imbalance. *Dynamic Chiropr.* 2000;18(24):2.
14. Trester D, Marras WS, Burr D, Sheedy JE, Hart D. Myofascial trigger point development from visual and postural stressors during computer work. *J Electromyogr Kinesiol.* 2006;16(2): 115-124.
15. Yap EC. Myofascial pain. An overview. *Ann Acad Med Singapore.* 2007;36(1):43-48.
16. Ranasinghe P, Perera YS, Lamabadusuriya DA, et al. Work related complaints of neck, shoulder and arm among computer office workers: a cross sectional evaluation of prevalence and risk factors in a developing country. *Environ Health.* 2011;10:70.
17. Hakala PT, Saarni LA, Punamäki RL, Wallenius MA, Nygård CH, Rimpelä AH. Musculoskeletal symptoms and computer use among Finnish adolescents-pain intensity and inconvenience to everyday life: a cross-sectional study. *BMC Musculoskelet Dis.* 2012;13(1):41.
18. Agneta L, Wahlström J, Hagberg M, Vilhelmsson R, Toomingas A, Tornqvist EW. Perceived exertion, comfort and working technique in professional computer use and associations with the incidence of neck and upper extremity symptoms. *BMC Musculoskelet Dis.* 2012;13:38.
19. Huguenin LK. Myofascial trigger points: the current evidence. *Physical Ther Sport.* 2004;5(1):2-12.
20. Richards LD. The effectiveness of non-invasive treatments for active myofascial trigger point pain: a systematic review of the literature. *Inter J Osteop Med.* 2006;9(4):120-136.
21. Tulder MV, Malmivaara A, Koes B. Repetitive strain injury. *Lancet.* 2007;369(9575):1815-1822.
22. Singh LR, Chauhan V. Comparison of efficacy of myofascial release and positional release therapy in tension type headache. *JMSCR.* 2014;2(9):2372-2379.
23. Lari AY, Okhovatian F, Naimi SS, Baghban AA. The effect of the combination of dry needling and MET on latent trigger point upper trapezius in females. *Man Ther.* 2016;21:204-209.
24. Borg-Stein J, Simons DG. Focused review: myofascial pain. *Arch Phys Med Rehabil.* 2002;83(3 Suppl 1):S40-S49.
25. Drover JM, Forand DR, Herzog W. Influence of active release technique on quadriceps inhibition and strength: a pilot study. *J Manipulative Physiol Ther.* 2004;27(6):408-413.
26. Howitt S, Wong J, Zabukovec S. The conservative treatment of trigger thumb using Graston techniques and active release techniques. *J Can Chiropr Assoc.* 2006;50(4):249-254.
27. George JW, Tunstall AC, Tepe RE, Skaggs CD. The effects of active release technique on hamstring flexibility: a pilot study. *J Manipulative Physiol Ther.* 2006;29(3):224-227.
28. Trivedi P, Sathiyavani D, Nambi G, Khuman R, Shah K, Bhatt P. Comparison of active release technique and myofascial release technique on pain, grip strength & functional performance in patients with chronic lateral epicondylitis. *Int J Physiother Res.* 2014;2(3):488-494.
29. Sciotti VM, Mittak VL, DiMarco L, et al. Clinical precision of myofascial trigger point location in the trapezius muscle. *Pain.* 2001;93(3):259-266.
30. Mehdikhani R, Okhovatian F. Immediate effect of muscle energy technique on latent trigger point of upper trapezius muscle. *Clin Chiropr.* 2012;15(3-4):112-120.
31. Atienza-Meseguer A, Fernandez-de-las-Penas C, Navarro-Poza JL, Rodriguez-Blanco C, Bosca Gandia JJ. Immediate effects of the strain/counter-strain technique in local pain evoked by tender points in the upper trapezius muscle. *Clin Chiropr.* 2006; 9(3):112-118.
32. Ruiz-Sáez M, De-Las-Penas CF, Blanco CR, Martínez-Segura R, García-León R. Changes in pressure pain sensitivity in latent myofascial trigger points in the upper trapezius muscle after a cervical spine manipulation in pain-free subjects. *J Manipulative Physiol Ther.* 2007;30(8):578-583.
33. De-Las-Peñas CF, Alonso-Blanco C, Miangolarra JC. Myofascial trigger points in subjects presenting with mechanical neck pain: a blinded, controlled study. *Man Ther.* 2007;12(1):29-33.
34. Tough EA, White AR, Richards S, Campbell J. Variability of criteria used to diagnose myofascial trigger point pain syndrome—evidence from a review of the literature. *Clin J Pain.* 2007;23(3):278-286.
35. Aguilera FJM, Martin DP, Masanet RA, Botella AC, Soler LB, Morell FB. Immediate effect of ultrasound and ischemic compression techniques for the treatment of trapezius latent myofascial trigger points in healthy subjects: a randomized controlled study. *J Manipulative Physiol Ther.* 2009;32(7):515-520.
36. Okhovatian F, Mehdikhani R, Naimi SS. Comparison between the immediate effect manual pressure release and strain/counterstrain techniques on latent trigger point of upper trapezius muscle. *Clin Chiropr.* 2012;15(2):55-61.
37. Blikstad A, Gemmell H. Immediate effect of activator trigger point therapy and myofascial band therapy on non-specific neck pain in patients with upper trapezius trigger points compared to sham ultrasound: a randomized controlled trial. *Clin Chiropr.* 2008;11(1):23-29.
38. Gemmell H, Miller P, Nordstrom H. Immediate effect of ischaemic compression and trigger point pressure release on neck pain and upper trapezius trigger points: a randomised controlled trial. *Clin Chiropr.* 2008;11(1):30-36.
39. Reips UD, Funke F. Interval-level measurement with visual analogue scales in Internet-based research: VAS Generator. *Behav Res Methods.* 2008;40(3):699-704.
40. Price DD, McGrath PA, Rafii A, Buckingham B. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. *Pain.* 1983;17(1):45-56.

41. Bijur PE, Silver W, Gallagher EJ. Reliability of the visual analog scale for measurement of acute pain. *Acad Emerg Med.* 2001;8(12):1153-1157.
42. Tajamoli Z, Ghasemi-Konjani M, Feizi M, Akbarzadeh-Baghban A. Effect of phonophoresis of hydrocortisone and dimethyl sulfoxide (DMSO) on latent trigger points of upper trapezius muscle. *J Rehab Med.* 2014;3(3):54-62.
43. Tousignant M, De Bellefeuille L, O'Donoughue S, Grahovac S. Criterion validity of the cervical range of motion (CROM) goniometer for cervical flexion and extension. *Spine.* 2000; 25(3):324-330.
44. Reeves JL. Reliability of the pressure algometer as a measure of myofascial trigger point sensitivity. *Pain.* 1986; 24(3):313-321.
45. Zamani S, Okhovatian F, Naemi SS, Baghban AA. Intra-examiner reliability of goniometer instrument for all active movement of cervical spine in asymptomatic young women. *J Rehab Med.* 2016;4(4):57-64.
46. D'Armbrogio KJ, Roth GB. *Positional Release Therapy: Assessment & Treatment of Musculoskeletal Dysfunction*. St. Louis, MO: Mosby; 1997:20.
47. Dispenza M, Iannazzo D, Johnson M, Younger k, Zonarich A. Bridges Library Catalog. Chesterfield, MO: Logan College of Chiropractic; 2004. http://www.logan.edu/mm/files/LRC/Senior-Research/2004-Dec-17.pdf. Accessed October 7, 2016.
48. Kelencz CA, Tarini VAF, Amorim CF. Trapezius upper portion trigger points treatment purpose in positional release therapy with electromyographic analysis. *North Am J Med Sci.* 2011;3(10):451-455.
49. Prentice WE. *Rehabilitation Techniques for Sports Medicine and Athletic Training With Laboratory Manual and ESIMS Password Card*. 5th ed. New York: McGraw-Hill; 2004:190-191.
50. Robb A, Pajaczkowski J. Immediate effect on pain thresholds using active release technique on adductor strains: pilot study. *J Bodyw Mov Ther.* 2011;15(1):57-62.
51. Fryer G, Hodgson L. The effect of manual pressure release on myofascial trigger points in the upper trapezius muscle. *J Bodyw Mov Ther.* 2005;9(4):248-255.
52. Alagesan J, Shah US. Effect of positional release therapy and tapping on unilateral upper trapezius tender points—randomized control trial. *Int J Health Pharm Sci.* 2012;1(2):13-17.
53. Al-Shawabka SAM, Shenouda MM, Balbaa AA. Positional release technique versus manual pressure release on the upper trapezius muscle in patients with myofascial pain dysfunction syndrome. *Bull Fac Phys Ther Cairo Univ.* 2013;18(1):55-63.
54. Pattanshetty RB, Raikar AS. Immediate effect of three soft tissue manipulation techniques on pain response and flexibility in chronic plantar fasciitis: a randomized clinical trial. *Int J Physiother Res.* 2015;3(1):875-884.
55. Gliedt JA, Daniels CJ. Chiropractic management of elbow tendinopathy following a sports related trauma. *J Can Chiropr Assoc.* 2014;58(1):52-57.
56. Saavedra FJ, Cordeiro MT, Alves JV, Fernande HM, Reis VM, Mont'Alverne DGB. The influence of positional release therapy on the myofascial tension of the upper trapezius muscle. *Rev Bras Cineantropom Desempenho Hum.* 2014; 16(2):191-199.
57. Doley M, Warikoo D, Arunmozhi R. Effect of positional release therapy and deep transverse friction massage on gluteus medius trigger point - a Comparative Study. *J Exerc Sci Physiotherapy.* 2013;9(1):40-45.
58. Harlapur MA, Vijay BK, Chandu B. Comparison of myofascial release and positional release therapy in plantar fasciitis—a clinical trial. *Indian J Physiother Occup Ther.* 2010;4(4):8-11.
59. Pacher P, Bátkai S, Kunos G. The endocannabinoid system as an emerging target of pharmacotherapy. *Pharmacol Rev.* 2006; 58(3):389-462.
60. Klein R, Bareis A, Schneider A, Linde K. Strain-counter strain to treat restrictions of the mobility of the cervical spine in patients with neck pain: a sham-controlled randomized trial. *Complement Ther Med.* 2013;21(1):1-7.