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Immediate changes in the upper trapezius muscle stiffness, sensitivity, and mobility after application of manual therapy for trigger point release: A single blinded randomized placebo-control trial study

トリガーポイント治療の適用後における僧帽筋上部線維の筋硬度、圧痛閾値および頸部可動域の即時変化-単一盲検ランダム化プラセボ対照試験-

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Immediate changes in the upper trapezius muscle stiffness, sensitivity, and mobility after application of manual therapy for trigger point release: A single blinded randomized placebo-control trial study

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Abstract

Background: Prolonged and daily usage of electronic appliances leads to abnormal habitual body position. Myofascial trigger points are one reason of this. Young adults, especially university students, are vulnerable to this condition. These trigger points are classified as active and latent trigger points. Active trigger points cause spontaneous pain, whereas latent trigger point cause pain only during palpation. No study till date has examined the combined use of transverse friction massage and ischemic compression to treat trigger points on the right upper trapezius muscle.

Purpose: This study aimed to identify the effectiveness of manual therapy, namely ischemic compression and transverse friction massage over placebo ultrasound treatment on the latent trigger points in the right upper trapezius muscle by comparing pre and post-treatment measures.

Methods: This randomized experimental study involved 20 healthy male and female participants with latent trigger points on the right upper trapezius. All the participants were university students. With the assessor blinded, 11 subjects in group 1 and 9 subjects on group 2 were randomized using a closed paper chit such that treatment was concealed. The following outcome measures were evaluated: muscle stiffness, pressure pain threshold (PPT), visual analog scale (VAS), and the range of lateral cervical flexion (ROM).

Results: There was a significant improvement in ROM only in the manual therapy group (P = 0.02). However, there was no statistically significant impact on other outcomes. Only the manual therapy group showed significant improvement from pre- to post-treatment outcome. Post treatment measurements showed a significant tendency between the groups (P=0.07).

Conclusion: The manual therapy intervention of ischemic compression with transverse friction massage shows immediate improvement in cervical lateral flexion with latent trigger points in the upper trapezius.

Keyword: *myofascial trigger point, latent trigger point, transverse friction massage, ischemic compression, ultrasound therapy*

Introduction

An increasing population of computer users, mainly university students and office workers, are at high risk of developing musculoskeletal pain. The global prevalence of neck, shoulder, and

back pain has increased over the years, leading to disability and there is a high global burden of neck pain [1-2].

A high rate of myofascial trigger point (MTrPs) formation has been reported among university students and food service workers (FSWs), as they spend a lot of time on their jobs in the forward-head position, resulting in high stress on the neck and shoulder musculature [3,4]. The upper trapezius muscle is the most involved with MTrPs as compared to the other neck and shoulder musculature [5-6].

A trigger point is a hyper-irritable spot within a taut band, palpable nodules on the skeletal muscles, which is painful on applying pressure, stretch, or contraction, and causes pain, produces local twitch response (LTR) when stimulated and referred pain that can be perceived distally from the trigger point site. It is classified into Active trigger point and Latent trigger point [7, 8].

Active trigger points cause spontaneous and referred pain symptoms even without applying manual pressure, whereas latent trigger points produce pain only when manual pressure is applied [9]. Latent trigger points in the upper trapezius cause neuro-musculoskeletal problems [10]. Since they are present in a dormant state, a majority of healthy individuals ignore their presence or fail to recognize them, and many assume the presence of other etiologic causes, however, these trigger points affect normal muscular function [11], and very few studies have looked into treating these [12]. Therefore, it is important to treat latent trigger points to prevent future problems.

The Current methods of treating trigger points include dry needling, which is an invasive process and not beneficial for those with needle phobia [13].

Furthermore, according to a review by Tsertsvadze (2014) on cost-effectiveness and cost-utility analysis based on quality-adjusted life-year (QALYS), incremental cost-effectiveness ratio (ICER), and other determinants, manual therapy interventions were more cost-effective than other health areas [14].

Past systematic reviews on the use and application of manual therapies indicate that use of ischemic compression and transverse friction massage is an effective treatment approach for myofascial trigger points [15]. In a recent literature review by Charles (2019), it was shown that manual therapy can be effective in treating myofascial trigger point, and it is essential to focus [16].

Therefore purpose of this study was to determine the outcome of manual therapy intervention for myofascial trigger point and to compare them with the outcomes of placebo.

Methods

All the participants in this study were students of Tokyo Metropolitan University Arakawa campus. The exclusion and inclusion criteria are listed below:

Inclusion criteria [17, 3].	Exclusion criteria.
i. Age range, 20 - 40 years.	i. With Active trigger point.
ii. Minimum 2 hours of daily use of computer.	ii. Trigger point other than upper right trapezius.
iii. And, palpated with latent trigger point on the upper right trapezius.	iii. Traumatic injury to the head, shoulder, or neck.

iv. Willingness to participate.	iv. Have undergone treatment for neck and shoulder pain within the past month. v. Contraindications to manual therapy. vi. Primary headaches examples migraine. vii. Degenerative or inflammatory diseases in the cervical region. viii. And lack of cooperation.

This was a randomized and single-blinded study where the assessor as well as the participants were blinded to the intervention and outcome throughout the study.

Physical examination to locate latent trigger points was carried out by a physiotherapist who had 2 years of work experience, followed by an experienced physical therapist to confirm the finding. After signing an informed consent form prior to their participation, the participants were randomly allotted into two different groups using a sealed opaque envelope such that the treatment approach was concealed. The diagnosis of latent trigger point was based on the diagnostic features described by Simon [18], Fernandez-de-las-penas [19], and Alvarez [7].

i. Presence of a palpable taut band in skeletal muscles
ii. Presence of a hyperirritable spot in the taut band
iii. Palpable or visible local twitch response on snapping palpation or needling pain of the trigger point
iv. Reproduction of pain without referred pain pattern, without familiarization, due to compression or palpation of the hyperirritable spot [21]
v. Presence of spontaneous pain, presence of typical referred pain pattern

But only the above first four criteria were considered in this study.

Outcome measures:

Outcome measures in this study consisted of the pressure pain threshold (PPT) at the trigger point, the visual analog scale (VAS) score, active range of left lateral side flexion, and muscle stiffness.

1. Pressure pain threshold (PPT)

It is defined as the minimal amount of pressure where a sense of pressure in a certain point first changes to pain and discomfort. To measure the PPT an algometry device (OE-220, ITO, japan) was used, as by Sacramento [22]. It consists of a 1-cm^2 rubber tube. Values are expressed in (kg/cm^2) [20]. It is a reliable and valid in trails to 80N ($r = 0.990$) and incremental trials ($r = 0.999$) instrument to quantify pain and perhaps track healing as described by Kinser [23].

2. Active range of lateral flexion:

We used a digital goniometer named by 'EasyAngle' to measure the cervical lateral side flexion (left side flexion). A digital goniometer and inclinometer work on the principle of earth's geo-gravitational field, as describe by Kolber [24].

3. Visual analog scale:

It was used to indicate the level of pain intensity experienced during an algometry reading when a pressure of 2.5 kg/cm^2 is applied. It is a scale with a 10 cm long vertical line, where 0 cm denotes no pain and 10 cm denotes unbearable pain. The test-retest reliability shows ($r = 0.94$, $P < 0.001$

among literate patients; $r = 0.71$, $P < 0.001$ among illiterate patients) that it is a feasible scale which can be commonly used to measure the quantity of pain in musculoskeletal problems [25].

4. Muscle stiffness:

We used Myoton PRO (Myoton AS Lootsa 8A, Tallinn 11415, Estonia) to measure stiffness. The Myoton PRO has moderate to very high validity and reliability as described by Pruyn, and its interclass correlation coefficient (ICC) value ranges from 0.69 to 0.98[26].

Instrumentation & data collection

1. Pressure pain threshold:

To measure PPT an algometer was used as mentioned above. During, the measurement, the participant sat in a relaxed sitting upright position with their back supported, their hip and knee were flexed at 90°, and they adopted this position for all the other measurements. The tip on the algometer was positioned vertically over the marked trigger point area and pressure was gradually generated at the rate of 1 kg/cm^2.

The participants were then asked to specify when the pressure sensation changed to pain and instructed to press the hand held switch immediately so that the pressure reading would be recorded as the PPT.

This was repeated three times and the average was calculated and used as the baseline value for MTrP pain sensitivity even for the post-treatment evaluation we followed the same procedure as

described by Abu Taleb [27]. Between each algometry readings 60 seconds of break-time was allowed to prevent tissue sensitization [28].

2. Visual analogue scale:

The VAS was used to measure the local pain evoked from the trigger point when 2.5 kg/cm^2 of pressure was applied using algometer, and to quantify the pain intensity.

3. Cervical range of motion:

Active cervical lateral flexion to the left was measured using a digital goniometer, as mentioned above. The resting base of the tool was positioned over the coronal suture (frontal plane) and the reading was set to zero, the examiner stabilized the participant's right shoulder to restrict any shoulder elevation; then, he/she was asked to flex the neck gently to the side and maximally to the contralateral side (i.e., towards the left). The stabilization method used to measure the left lateral flexion because it was found to have excellent interrater reliability (ICC 0.94) as described by Bush [29]. ROM was measured three times. The same process was repeated at the post-evaluation.

4. Myoton PRO tissue measurement:

The Myoton PRO was placed perpendicular to the target site. The probe, which is 3 mm in diameter, produces constant pre-pressure of 0.18 N, resulting in constant compression. The pre-pressure from the probe is used to tap the target point five times during which a mechanical

impulse force of 0.40 N and at a duration of 15 ms is delivered to the muscle causing tissue to undergo deformation for a short period of time, and the tissue responds to the mechanical impulse by producing a damped natural oscillation recorded by the accelerometer in the device [30, 26]. We measured the stiffness values three times.

(B) Intervention:

Participants in group 1 received ischemic contraction (IC) and transverse friction massage (TFM); group 2 as the control group received deactivated ultrasound therapy. Ischemic compression was administered for 5 minutes with the patient sitting comfortably. The therapist gradually applied pressure on the trigger point until the pressure sensation was changed to pain sensation as experienced by the participant; the pressure was maintain at that level at which the pain and discomfort perceived by the participant was 50%.

Further pressure was applied until a new tissue barrier was reached where the participants once again perceived pain; this was done for 90 seconds, which is reported to show good results [19]. A rest period of 10 seconds was allowed between each treatment session to permit blood reperfusion to the spot [21]. TFM was applied as recommended by Tampas, at pain score level of 7 (VAS pain score) [32]. The treatment duration was 90 seconds with 10 second of rest. Participants in group 2 received placebo treatment that involved application of de-activated ultrasound therapy. Aguilera had used similar method [33]. The duration of application was 10 minutes for each participant.

Data Analyses:

We used SPSS version 26 (IBM CORP., JAPAN). Descriptive statistics were used to calculate all parameters. Dependent variables were analyzed by repetitive two-way ANOVA, with 95% confident interval and P value set at 0.05.

Results: Table 1: Demographic characteristics.

	Group 1 (n=11)	Group 2 (n=9)
Gender	M: 9	M: 6
	F: 2	F: 3
Age (Mean ± SD)	25.3 ± 7.2	27.9 ± 6.6
Body weight (Mean ± SD)	62.5 ± 5.9	67.1 ± 13.9
Height (Mean ± SD)	168.7 ± 8.8	168.9 ± 7.1

Table 2: Descriptive statistics

Outcome measure	Groups	Pre (Mean ± SD)	Post (Mean ± SD)	N
1. Myoton	Group-1:	16.15 ± 1.45	15.87 ± 1.42	11
	Group-2:	15.54 ± 1.35	16.03 ± 1.69	9
2. Algometer	Group-1:	3.06 ± 1.23	3.27 ± 1.34	11
	Group-2:	3.60 ± 0.55	2.98 ± 0.44	9
3. VAS	Group-1:	5.18 ± 1.40	5.00 ± 1.34	11
	Group-2:	4.11 ± 1.05	4.22 ± 1.39	9
4. ROM	Group-1:	38.24 ± 5.48	42.45 ± 5.29	11
	Group-2:	34.14 ± 6.78	36.40 ± 8.77	9

Table 3: Repeated measures two-way ANOVA; effects of intervention

Variables	Time (F Value)	Group (F value)	Time × group
Myoton	0.493, P = 0.492	0.122, (P = 0.730)	6.298, P = 0.022
Algometer	2.969, P= 0.102	0.078, (P = 0.784)	12.043, P= 0.003
VAS	0.020, P = 0.890	2.995, (P = 0.101)	0.339, P = 0.567
ROM	7.220, P = 0.015	3.506, (P = 0.077)	0.658, P = 0.428

Interaction effect from Myoton readings: There was a statistically significant interaction effect between time and group ($F_{(1, 18)} = 6.298$, $P = 0.022$); but the effects did not significantly change with time ($F_{(1, 18)} = 0.493$, $P = 0.492$); the main effects of the two types of interventions were not significantly different ($F_{(1, 18)} = 0.122$, $P = 0.730$). At post-treatment there was no differences between the two groups ($P = 0.83$).

Interaction effect from Algometer readings: There was a statistically significant interaction effect between time and group ($F_{(1, 18)} = 12.043$, $P= 0.003$). The main effects of the two types of intervention were not significantly different ($F_{(1, 18)} = 0.078$, $P = 0.784$). At post-treatment, there was no difference between the two groups ($P = 0.55$).

Interaction effect based on VAS: The VAS section did not show any interaction effect of time and group for all the factors. Post-treatment measurements showed no significant difference between the groups ($P = 0.22$).

Interaction effect based on ROM: There was a statistically significant effect with time ($F_{(1, 18)} = 7.220$, $P = 0.015$), from pre- to post-treatment, but not between groups ($F_{(1, 18)} = 3.506$, $P = 0.077$), with no time and group interaction effect ($P_{(1, 18)} = 0.658$, $P = 0.428$). Only the manual therapy group showed significant changes from pre- to post-treatment outcomes ($P = 0.02$). At post-treatment, there was no difference between the two groups ($P = 0.07$) but significant tendency was observed.

Discussion

Our findings suggest that single treatment with manual therapy like ischemic compression and transverse friction massage over the latent trigger point can increase the active ROM immediately. However, it did not improve subjective pain perception and stiffness level immediately.

In a study by Sandria, the application of manual therapy like active release a form of ischemic compression and muscle energy technique (MET) on the latent trigger point showed immediate increase in active cervical ROM ($P < 0.001$); it was also observed that subjective pain had decreased ($P < 0.05$) and tissue stiffness had reduced ($P < 0.001$) [17]. Similar findings were reported by Fernandez de-las-Penas: ischemic compression and TFM techniques in 40 young healthy adults with MTrPs in the upper trapezius led to significant improvement in the PPT ($P = 0.03$) and VAS ($P = 0.04$) within each treatment group [19]. In a study by Montanez Aguilera, ischemic compression and ultrasound showed immediate effect on the latent trigger points of 66 participants divided into two separate groups; both therapeutic approaches showed significant immediate improvement in pain sensitivity, and active ROM was improved only in the ischemic compression group ($P = 0.02$) [33]. Kashyap's study involved 45 female participants with non - specific neck pain who underwent manual pressure release or ischemic compression and MET, where the outcome measurement of VAS score, PPT, neck disability index questionnaire, and ROM showed a significant improvement-immediately as well as in the follow - up period [28].

However, despite the above findings of significant improvements in pain perception level apart from improvement in cervical ROM, our study did not establish similar desirable outcomes. A study by Trampas involving 30 males showed that manual therapy for trigger point release like TFM along with modified PNF stretching of major lower limb muscles led to significant changes over time in all outcomes measures like ROM, PPT, and VAS score ($P = 0.001$) [32].

Limitations

This study involved a small number of participants. The use of combined manual therapy seems unpopular. In, both the groups the sex ratio was uneven, which lead to mismatch, and the nature of the treatment was single application, so the outcomes might not have been significant. Thus, future studies should address these limitations.

Conclusions

The results indicate that TFM with IC can immediately improve active ROM, but there was no statistically significant difference on the other treatment outcomes of both groups treated for latent trigger points.

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