

## The Effectiveness of Different Physical Therapy Techniques for Relieving Pain and Increasing Neck Range of Motion in Patients with Diagnosed Latent Myofascial Trigger Points

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### Abstract

**Aim:** Researchers are demonstrating increasing interest in latent myofascial trigger points (LMTP) because of their significantly higher prevalence, compared to active myofascial trigger points (AMTP). Even though LMTP are quite prevalent and are important for muscle function, their effect is essentially under-researched due the lack of studies in the area. The aim is to compare the effectiveness of different physical therapy techniques for relieving pain and increasing neck range of motion in patients with diagnosed latent myofascial trigger points.

**Population:** The study included 27 volunteers (group I – 15 subjects, and group II – 12 subjects) with at least one LMTP in the upper part of the trapezius muscle and without any health problems that could affect the results of the study.

**Methods:** Prior to the physical therapy, immediately after it, and one week after its completion, algometric measurements were performed in order to determine which pressure force provoked pain. Also, a 10-point visual analogue pain scale (VAS) was applied in order to determine the severity of pain that could be caused by 4 kg/cm<sup>2</sup> pressure. Goniometric measurements were performed to evaluate changes in the range of motion when performing neck flexion, extension, and lateral flexion.

**Results:** In subjects who underwent ischemic compression procedures (group I), the pain threshold increased significantly from 2.27 ± 0.28 kg/cm<sup>2</sup> at baseline to 3.01 ± 0.33 kg/cm<sup>2</sup> immediately after physical therapy, and to 2.63 ± 0.3 kg/cm<sup>2</sup> at one week after physical therapy (p<0.05). Meanwhile, pain intensity statistically significantly decreased from 5.20 ± 0.56 points at baseline to 3.20 ± 0.78 points immediately after physical therapy, and to 4.53 ± 0.74 points at one week after physical therapy (p<0.05). The range of flexion in the neck statistically significantly increased both immediately and at one week after physical therapy, whereas no changes in the range of motion were observed during extension or lateral flexion. In subjects who underwent taping procedures (group II), the pain threshold increased significantly from 2.13 ± 0.43 kg/cm<sup>2</sup> at baseline to 2.30 ± 0.36 kg/cm<sup>2</sup> immediately after physical therapy, and to 2.33 ± 0.46 kg/cm<sup>2</sup> at one week after physical therapy (p<0.05). Meanwhile, pain intensity statistically significantly decreased only immediately after physical therapy - from 5.33 ± 0.78 points to 5 ± 0.74 points (p<0.05). No changes in the range of motion during neck flexion, extension, or lateral flexion were observed. The comparison of the groups showed that pain intensity in group I subjects (i.e., in those who underwent ischemic compression procedures) was statistically significantly lower immediately after physical therapy and at one-week follow-up. There were no statistically significant differences in the range of motion during neck flexion, extension, or lateral flexion between the groups.

**Conclusion:** Ischemic compression proved to be a more effective physical therapy technique than taping in reducing pain in latent myofascial trigger points.

**Keywords:** Latent myofascial trigger point; Pain; Physical therapy

### Introduction

Myofascial pain syndrome (MPS) is a well-known condition of regional pain caused by myofascial trigger points and tense fibers [1-4]. Myofascial trigger points are the most extensively discussed cause of myofascial pain because this pain may significantly affect patients' daily life and even psychological condition [5].

Myofascial trigger points (MTP) are classified into active and latent ones [6]. The active form of MTP manifests itself either through spontaneous pain or pain provoked by certain movements [7] as well as by reduced muscle elasticity, muscle weakness, and pain related to direct pressure. Pain intensity and radiation depend on MTP stimulation [8]. Latent MTP (LMTP) have the same – albeit not as severe – clinical characteristics as active MTP (AMTP) do [9]. However, the pain is not persistent – instead, it is provoked only by direct pressure on the latent MTP [10]. For this reason, people frequently do not realize that they have latent MTP [11,12]. Even though attention is mostly focused on active MTP, latent MTP are starting to attract increasing

attention of researchers because even though these MTP do not cause spontaneous pain, they can cause such musculoskeletal problems as local hypersensitivity, pain on mechanical stimulation, reduced range of motion, muscle weakness, fatigue, and cramps [13,14]. In addition, the prevalence of LMTP is significantly higher than that of AMTP [1]. LMTP cause the myofascial pain syndrome when they are activated

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[15]. Latent trigger points may become active if their trigger is active permanently [14].

There are numerous LMTP examination and evaluation techniques, including electromyography, ultrasonography, and infrared thermography. However, the simplest and the most commonly used methods are palpation and pain threshold measurement [16].

The treatment of LMTP includes both invasive and non-invasive techniques. Invasive techniques include acupuncture and botulin injections, whereas non-invasive ones include joint manipulation, tension/relaxation, ischemic compression, transverse friction massage, post-isometric relaxation [14], spray and stretch [17,18], kinesio taping [19], transcutaneous electrical nerve stimulation, ultrasound, and lasers. Despite the abundance of MTP treatment techniques, manual therapy remains one of the main approaches, and the role of physical therapist in the treatment of MTP should not be underestimated [14].

Ischemic compression is a manual therapy technique frequently used as one of the main MTP treatment measures [20]. This massage technique involves the application of slight (usually effected with fingers) pressure on the MTP [21]. The mechanism of pressure and ischemic compression is based on the activation of blood supply to the MTP area [22]. The pressure force applied in this method is not specified. The pressure is applied until the therapist feels relaxation of the main affected tissue. This usually takes about 60 seconds. According to the most recent research data, the duration of the compression may range from 60 to 90 seconds [14].

A growing body of evidence indicates that taping may be used as a novel therapeutic technique. According to literature data, taping may be used in the presence of musculoskeletal problems, including myofascial trigger points. A study by Halski et al. conducted in 2015 showed that tapes used on trigger points located in the upper trapezius muscle reduced the subjective sensation of pain. The procedure also significantly improved lateral flexion of the neck [23].

Clinical studies have shown that appropriate treatment may suppress MTP symptoms, and yet if the real cause of MTP formation has not been removed, the symptoms will recur within days or weeks [24-26]. For this reason, it is highly important to eliminate MTP-causing factors such as microtraumas, infection, stress, depression, insomnia, etc. [27].

## Methods

### The studied sample

The study included 27 volunteers without any health problems that could affect the results of the study; of these, 19 were females, and 8 - males. The subjects were randomly distributed into two groups. Group I, in which ischemic compression was applied, consisted of 11 women and 4 men, and group II, in which taping was applied, consisted of 8 women and 4 men. The subjects were selected according to the following criteria:

- Absence of health disorders that could affect the results of the study.
- At least one latent myofascial trigger point in the upper part of the trapezius muscle on either side.

The first group, in which ischemic compression was applied, consisted of 15 subjects whose mean age was  $26 \pm 6.89$  years (20 – 39 years); the second group, in which taping was applied, consisted of 12 subjects whose mean age was  $23.83 \pm 3.66$  years (21-36 years). There was

no statistically significant difference between the groups concerning the subjects' age ( $p > 0.05$ )

### The methods of the study

Each subject who agreed to participate in the study underwent palpation of the upper part of the trapezius muscle. If a tense muscle fiber with a nodule and the pain threshold below  $3 \text{ kg/cm}^2$  was detected, latent MTP was diagnosed. Pain was evaluated with the help of an algometer and the visual analogue scale (VAS). The range of motion of the neck was measured by using a goniometer.

**Pain threshold measurements:** When measuring the compression pain threshold, the subjects were asked to report the onset of discomfort or pain during the measurement. The pressure was applied at the rate of approximately  $1 \text{ kg/cm}^2/\text{s}$ . Each measurement performed at baseline, immediately after physical therapy, and at one-week follow-up; the measurements were performed in triplicate, calculating the mean value of the measurements. The higher the pain threshold, the milder was the subjectively experienced pain.

**Pain intensity measurements:** Pain intensity was evaluated by using the visual analogue scale (VAS). The scale was graded from 0 to 10 points, where 0 points meant no pain, and 10 points – unbearable pain. During the study,  $4 \text{ kg/cm}^2$  pressure with an algometer was applied, and the subjects were asked to evaluate the pain they experienced on a ten-point pain scale [26].

**Measurements of the range of motion of the neck:** Lateral flexion in the subjects was evaluated depending on the side on which LMTP were detected. Lateral flexion was performed towards the contralateral side of the LMTP, i.e., if the LMTP was detected on the right side, the flexion was performed to the left, and if the LMTP was located on the left side, the flexion was performed to the right. In addition, neck flexion and extension (tilting of the head) were measured. Each measurement was performed at baseline, immediately after physical therapy, and at one-week follow-up. The measurements were performed with the subjects being in the sitting position.

Neck flexion and extension. The axis of the goniometer was held at the external meatus of the ear, holding the immovable part vertically, and the movable part – horizontally, in parallel with the floor at the nostril level.

Lateral flexion of the neck. The axis of the goniometer was held at the spinous process of the C7 vertebra, holding the immovable part vertically at the spinal column, and the movable part – vertically at the midline of the head [27].

### Organization of the study

The study was initiated after receiving the permission of the Bioethics Committee of the Lithuanian University of Health Sciences (No. BEC – FMR(M) – 05). The study was carried out during January-February of 2016 at the Clinic of Neurology, the Hospital of the Lithuanian University of Health Sciences Kauno klinikos.

All individuals who agreed to participate in the study underwent primary examination in order to determine if they had LMTP in the upper part of the trapezius muscle. After the inclusion, the subjects suitable for the study were randomly distributed into two groups. In group I, ischemic compression was applied for the treatment of LMTP, and in group II, taping was used.

### Application of ischemic compression

Ischemic compression was applied within the limits of tolerable

pain. The pressure was applied to the subjects until they reported pain intensity as 7-8 points according to the VAS. In order to make ischemic compression effective, pain intensity was maintained during its application. If the subjects reported a decrease in pain intensity, the pressure was slowly increased until pain intensity reached 7-8 points according to the VAS. Ischemic compression was applied three times for approximately 60-90 seconds, making 10-second breaks between the compressions. The overall duration of the procedure was about 5 min.

**Application of taping:** The space correction technique was selected for taping. The kinesiotope Dream®K was used for the study. The tape was kept in place for 24 hours. Four I-shaped strips (width - 2.5 cm, and length - 8 cm) were used for taping. The tape was attached to the skin over the LMTP located in the upper trapezius. The tape was stretched to 50% of its maximum length. If the subjects started experiencing discomfort or itching, the tape was removed to avoid any skin allergy [23,28].

Prior to the therapy, subjects in both groups underwent measurements of the range of neck flexion, extension, and lateral flexion, measurements of pain threshold using an algometer, and measurements of pain intensity using the VAS. These measurements were also performed immediately after physical therapy and after one week following the completion of the therapy.

### Statistical data analysis

The data were analyzed by using the SPSS Statistics 17.0 software. The data were presented as an arithmetic mean ± standard error. The comparison of two dependent samples was carried out by applying Wilcoxon's criterion, and the comparison of two independent samples – by applying the Mann-Whitney criterion. Differences were considered to be statistically significant when  $p < 0.05$ .

## Results

### Pain threshold

The obtained results showed that at baseline (prior to physical therapy), the pain threshold in group I subjects (those who underwent ischemic compression procedures) was  $2.27 \pm 0.28$  kg/cm<sup>2</sup>, and in group II subjects (those who underwent taping procedures) –  $2.13 \pm 0.43$  kg/cm<sup>2</sup>. The groups were homogeneous concerning baseline pain threshold measurement data ( $p > 0.05$ ).

Immediately after physical therapy, the pain threshold in group I subjects statistically significantly increased to  $3.01 \pm 0.33$  kg/cm<sup>2</sup> ( $p < 0.05$ ). In group II subjects, it also increased statistically significantly – to  $2.30 \pm 0.36$  kg/cm<sup>2</sup> ( $p < 0.05$ ). Even though the measurement results after physical therapy were statistically significantly higher than baseline findings in both groups, pain threshold in group I after physical therapy was statistically significantly higher than in group II ( $p < 0.05$ ).

In group I, the pain threshold measured one week after the completion of physical therapy was  $2.63 \pm 0.3$  kg/cm<sup>2</sup>, which was significantly higher than baseline measurements ( $p < 0.05$ ), but significantly lower than measurement results obtained immediately after physical therapy ( $p < 0.05$ ). In group II, the pain threshold measured one week after the completion of physical therapy was  $2.33 \pm 0.46$  kg/cm<sup>2</sup>. This was significantly higher than baseline measurements ( $p < 0.05$ ), but the change was not significant when compared to measurement results obtained immediately after physical therapy (Table 1). The comparison of the two groups showed that the pain threshold in group I was statistically significantly higher than in group II ( $p < 0.05$ ) (Figure 1).

### Pain intensity

During the measurements of pain intensity, the pressure of 4 kg/cm<sup>2</sup> to the LMTP was applied in all subjects, and the subjects were asked to evaluate the pain they experienced according to the VAS.

At baseline (prior to physical therapy), group I subjects (those who underwent ischemic compression procedures) evaluated the intensity of the pain in  $5.20 \pm 0.56$  points, while group II subjects (those who underwent taping procedures) – in  $5.33 \pm 0.78$  points. There was no statistically significant difference between the groups concerning pain intensity evaluations at baseline ( $p < 0.05$ ).

After physical therapy, group I subjects evaluated the intensity of the pain in  $3.20 \pm 0.78$  points. Compared to the baseline measurements, pain intensity statistically significantly decreased after physical therapy ( $p < 0.05$ ). Subjects of group II evaluated pain intensity in  $5 \pm 0.74$  points. Compared to the baseline measurements, pain intensity statistically significantly decreased after physical therapy ( $p < 0.05$ ). However, pain intensity in group I after physical therapy was statistically significantly lower than in group II ( $p < 0.05$ ).

One week after the completion of physical therapy, group I subjects reported pain intensity of  $4.53 \pm 0.74$  points. These measurements were significantly ( $p < 0.05$ ) lower than baseline values, whereas compared to measurements performed immediately after physical therapy, pain intensity increased statistically significantly ( $p < 0.05$ ). In group II subjects, the reported pain intensity at one-week follow-up was  $5.08 \pm 0.52$  points (Table 2). There was no statistically significant difference between these measurements and findings recorded at baseline or immediately after physical therapy ( $p > 0.05$ ). At one-week follow-up, pain intensity in group I was statistically significantly lower than in group II ( $p < 0.05$ ) (Figure 2).

### Range of motion of the neck

In group I, the range of motion of the neck during flexion statistically

Ischemic compression procedures	Range of flexion (kg/cm <sup>2</sup> )
Threshold pain	$2.27 \pm 0.28$
Baseline	$3.01 \pm 0.33$

Table 1: Statistical analysis of physical therapy for Group 1.

Ischemic compression procedures	Range of flexion (kg/cm <sup>2</sup> )
Threshold pain	$2.13 \pm 0.43$
Baseline	$2.30 \pm 0.36$

Table 2: Statistical analysis of physical therapy for Group 2.

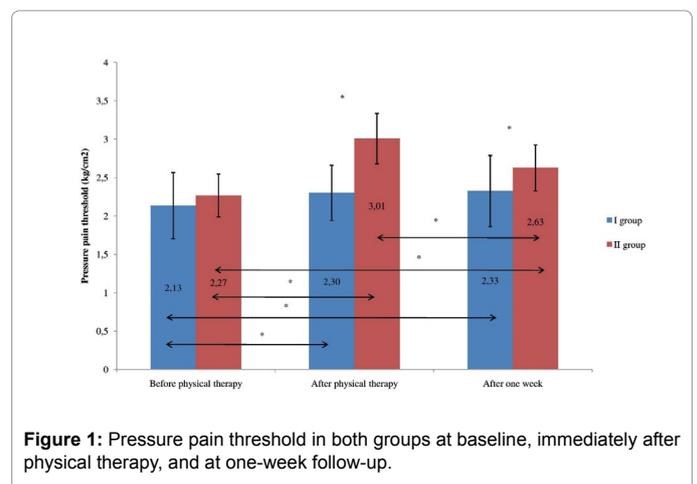
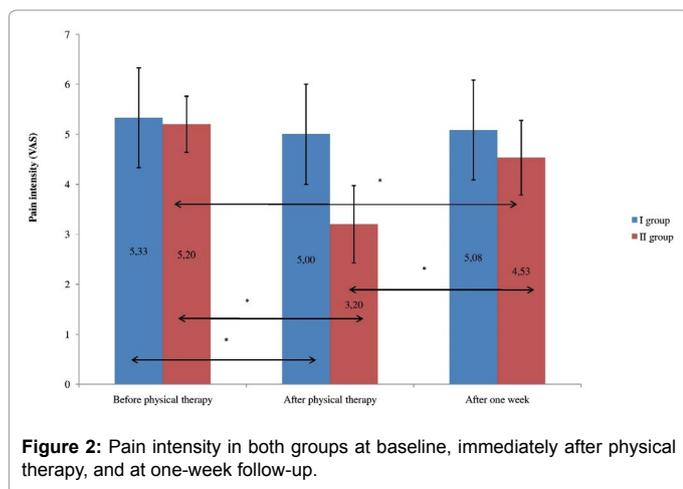


Figure 1: Pressure pain threshold in both groups at baseline, immediately after physical therapy, and at one-week follow-up.



**Figure 2:** Pain intensity in both groups at baseline, immediately after physical therapy, and at one-week follow-up.

significantly increased from  $49.40 \pm 3.72$  degrees at baseline to  $52.13 \pm 4.03$  degrees after physical therapy ( $p < 0.05$ ). The range of neck flexion measured at one-week follow-up was also statistically significantly ( $p < 0.05$ ) greater, compared to baseline measurements. In group II, even though the range of neck flexion increased, but the increase was not statistically significant ( $p > 0.05$ ). There were no changes in the range of neck extension or lateral flexion observed during the study in either of the groups. There was no statistically significant difference between the groups when comparing measurements of the range of motion of the neck.

#### The relationship between pain threshold and pain intensity:

The study revealed a statistically significant strong linear relationship between pain threshold and pain intensity immediately after physical therapy and at one-week follow-up in both studied groups ( $p < 0.05$ ). The higher the pain threshold, the lower the pain intensity was reported.

## Discussion

This study included young people – the mean age in subjects of group I was  $26 \pm 6.89$  years, and the mean age of group II subjects –  $23.83 \pm 3.66$  years. Other studies on latent myofascial trigger points also included young subjects. A study by Ge et al. included young otherwise healthy volunteers whose mean age was  $27.4 \pm 3.6$  years [29], and the subjects in a study by Chen et al. were young otherwise healthy volunteers whose mean age was  $32.8 \pm 5.4$  years [30]. This shows that LMTP are a sufficiently common problem among young people.

Pain threshold measurements were performed using an algometer. According to Wytrzążek et al. algometry is a reliable technique for pain threshold measurements [11].

Ischemic compression was applied for 60-90 seconds three times in a row with 10-second breaks. In order to ensure the effectiveness of ischemic compression, pain of 7-8 points was maintained throughout the procedure – i.e., if the subject reported a decrease in pain, the pressure was increased until the pain reached 7-8 points again. Aguilera et al. in their study used the same duration of ischemic compression [31]. AL-Shawabka et al. [32] Chao et al. [33] and Okhovatian et al. [26] in their studies applied ischemic compression for 60 second or until pain disappeared, depending on which occurred first. Oliveira-Campelo et al. in their study applied ischemic compression until pain intensity dropped from 7 points to 3 points, then increased the pressure again until pain intensity reached 7 points, and maintained the pressure for 90 seconds [12]. Hou et al. when studying the immediate effect

of ischemic compression, applied procedures lasting 30, 60, and 90 seconds with varying pressure. The study showed that the results were statistically significant both when applying longer-lasting mild pressure and when applying shorter-lasting strong pressure [22].

The results of our study showed that in subjects who underwent ischemic compression procedures, the pain threshold increased statistically significantly. This agrees with the findings of another study that compared the effectiveness of various manual therapy techniques in individuals with detected LMTP – that study showed that in the group that underwent ischemic compression, the pain threshold was statistically significantly higher both immediately after the procedure and one week after its completion. In addition, changes in the ischemic compression group were greater than those observed in the group where stretching exercises were applied, and the reduction of the effect in this group at one-week follow-up was the smallest [12]. The results of another study also showed that immediately after the ischemic compression procedure and one week after its completion, the pain threshold in LMTP was statistically significantly higher than that registered at baseline [33]. The results of a study by Okhovatian et al. on LMTP located in the upper trapezius showed that ischemic compression significantly increased the pain threshold and statistically significantly decreased pain intensity [26]. In addition, the results of a study by Aguilera et al. showed that immediately after the application of ischemic compression, pain intensity according to the VAS was statistically significantly lower compared to that registered prior to the application of ischemic compression [31]. The results of a study by Fryer et al. showed that in subjects with LMTP in the upper trapezius, an ischemic compression procedure lasting 60 seconds statistically significantly decreased the pain threshold [34]. The results of a study that involved individuals with AMTP showed that immediately after the application of a single ischemic compression procedure, the pain threshold decreased statistically significantly [32].

Our study showed that in subjects who underwent taping procedures, the pain threshold immediately after the procedure statistically significantly increased, and pain intensity according to the VAS statistically significantly decreased. Other studies where the same taping technique was used yielded similar results [23,35].

In a study by Sip et al. pain intensity was measured immediately after tape application, after two hours, and after two days. The study showed that pain after taping statistically significantly decreased. The lowest intensity of the pain was reported at two hours following tape application. Immediately after tape application and two days later, pain intensity was statistically significantly lower, but the two readings did not differ from each other [35]. Halski et al. in their study compared the effect of kinesiotape and cross tape in subjects with LMTP detected in the upper trapezius muscle. Both kinesiotape and cross tape were left in place for three days, and pain intensity measurements were conducted immediately after tape removal and after 24 hours. The obtained results showed that the use of kinesiotape and cross tape statistically significantly decreased the pain [23]. Wang et al. in their study analyzed the effect of taping in subjects with MTP detected in the upper trapezius muscle immediately after tape application and after 24 hours. The results showed a statistically significant pain reduction [36].

We did not find any studies that would compare the effect of ischemic compression and taping. However Chao et al. in their study compared the effect of ischemic compression alone and in combination with taping. The results of the study showed that ischemic compression – both alone and in combination with taping – statistically significantly

reduced pain intensity in the subjects' myofascial trigger points, and the comparison of the findings between the groups showed that ischemic compression in combination with taping yielded better results in reducing pain intensity in MTP [33].

The results of our study showed that in the group of subjects who underwent ischemic compression procedures, the range of neck extension and lateral flexion did not change immediately after the procedure, whereas the range of flexion increased statistically significantly. Studies conducted by other researchers yielded similar results. The results of a study by Campelo et al. where ischemic compression was applied in individuals with LMTP showed that the range of neck flexion statistically significantly increased, whereas changes in the range of neck extension were the least and were not statistically significant, compared to changes in the readings obtained during other neck movements [12].

In our study, in the group of subjects who underwent taping, there were no changes in the range of neck flexion, lateral flexion, or extension. This is in contrast with the results of a study by Halski et al. where the same taping technique was applied – in that study, there was statistically significant increase in the range of both flexion and lateral flexion after taping [23]. Such results might have been influenced by a longer tape application time – in that study, the tape was left in place for 72 hours.

## Conclusion

In subjects who underwent ischemic compression procedures, the pain threshold statistically significantly increased, while pain intensity statistically significantly decreased. The range of neck flexion statistically significantly increased immediately after physical therapy and at one-week follow-up. There were no changes in the range of neck extension or lateral flexion. In subjects who underwent taping procedures, it was only immediately after physical therapy that the pain threshold statistically significantly increased and pain intensity statistically significantly decreased. There were no changes in the range of neck flexion, extension, or lateral flexion. Ischemic compression proved to be a more effective physical therapy technique compared to taping in reducing pain intensity in latent myofascial trigger points. There was no statistically significant difference in the range of neck flexion, extension, or lateral flexion between the groups.

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