Comparison of the effects of muscle energy technique and positional release of latent trigger points of the sternocleidomastoid muscle on changes in pain threshold and bioelectrical activity of the trapezius muscle

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Abstract

Background: Trigger points TPs are defined as severely irritated areas in skeletal muscles or muscle fascia. They are painful during palpation, and generally, their symptoms are located away from the initial problem. Positional release (PRT) and muscle energy (MET) techniques stand out in particular and are among the most commonly used techniques by practitioners to treat TPs.

Aims: Comparison of the effects of MET and PRT of latent TPs of the sternocleidomastoid muscle (SMM) on changes in pain threshold and the bioelectrical activity of its antagonist, the trapezius muscle (TRM).

Material and methods: The study involved 72 students divided into two equal groups. In group A, the PRT procedure of latent TPs of SMM was applied using the Jones method. Group B underwent MET treatment of the same muscle. Pain threshold was assessed with a Microfet2 handheld dynamometer. Bioelectrical activity with NORAXON's surface electromyography (sEMG). Statistical analysis of the data was performed using Statistica 13.

Results: A single PRT and MET treatment significantly increased the compressive pain threshold of TRM, with no significant differences between the two. The mean TRM tension value at rest decreased using both therapies showing statistically significant changes. Changes in TRM tension during physical activity showed statistically significant differences only after MET treatment.

Conclusion: The comparability of both MET and PRT techniques in increasing the compressive pain threshold and decreasing the resting TRM tension after SMM therapy was demonstrated.

Key words

pain threshold, trigger points, bioelectric activity, muscle energy technique, positional release technique.

Introduction

One of the most common pain problems in the community is ailments affecting the cervical spine, which is often referred to as cervical pain syndrome. The head, neck, back, and shoulder pain co-occurs with it significantly impacts people's productivity and quality of life [1]. Pain in these areas is usually associated with characteristic stiffness, excessive and involuntary muscle contraction, and the presence of palpable, hypersensitive, small-shaped points referred to as myofascial trigger points (TPs) [2,3]. TPs are defined as severely irritated areas occurring in skeletal muscles or muscles fascia. They are painful during palpation, and generally, their symptoms are located away from the initial problem [4]. This, unfortunately, affects the difficulty of diagnosing symptoms resulting from myofascial tissue pathology. Proper assessment and treatment of myofascial pain is an important part of the rehabilitation of musculoskeletal pain syndromes [5].

In order to effectively treat myofascial pain syndromes, it is useful to carefully assess the potential causal issues and the factors that generate them [6]. Several techniques are currently available to treat TPs. Positional release (PRT) and muscle energy (MET) techniques stand out in particular and are among the most commonly used techniques by practitioners [7,8]. In the available literature, it is easy to find articles demonstrating the effectiveness of the above-mentioned methods for reducing pain. However, there are still few studies regarding the effects of these therapies for a given muscle on changes in pain threshold and bioelectrical variations in antagonistic muscles.

The research reported below seeks to compare MET and PRT and answer whether either of the aforementioned therapies applied to the sternocleidomastoid muscle (SMM) has a greater effect on reducing pain and tension in the trapezius muscle (TRM).

Aims

Comparison of the effects of MET and PRT of latent TPs of SMM on changes in pain threshold and bioelectrical activity of the TRM muscle.

Material and methods

Study settings

The research was conducted between 11.10.2020 and 26.11.2020 at the Functional Diagnostics Laboratory, a part of the Central Science and Research Laboratory of the Academy of Physical Education in Krakow, Poland.

Participants

A group of 72 students who met the inclusion criteria was included in the study: (1) age range: 19-26 years old and (2) occurrence of characteristic symptoms in cases of latent TPs on SMM. Exclusion criteria included: (1) cancer, (2) acute inflammatory diseases, (3) venous thromboembolism, (4) impairment/lack of sensation in the treated area, (5) severe cardiovascular disease, (6) pregnancy, (7) rheumatic disease, (8) intake of medications that affect muscle tension and pain threshold, and (9) general contraindication to the use of manual therapy.

Randomization

After appropriate classification, participants were randomly divided into two separate treatment groups. Group A comprised of 36 subjects (23 females, 13 males) who underwent a single positional release therapy of latent TPs of SMM according to the Jones method. Group B included 36 subjects (21 females, 15 males) who underwent a single treatment with the muscle energy technique introduced by Chaitow. Before the study, each subject's body height was measured using a centimeter tape and body weight using a ZEEGMA Gewit scale. Each participant gave written consent to participate in the study after reading the research plan and familiarizing themselves with the measurement methodology.

Measurements

The study began with bilateral palpation of the SMM to locate the key TP that caused the most pain. During the examination, the patient was in the supine position, and the therapist palpated on exposed skin using a pincer grip. The pincer grip consisted of compressing the tissue between the index finger and the thumb. The TP search aimed at finding a hypertonic muscle strand resembling a characteristic lump that causes radiating discomfort when compressed. When localizing TPs, the areas described in the literature for their presence and the symptoms they produce were taken into account [9,10]. TPs for the SMM are located in the clavicular and sternal parts of the muscle along its entire length. Recurrent muscle pain can cause a sensation of pain in the depths of the eye, the tongue during swallowing, and headaches over the eyes, at the top of the head, and behind the ears [8]. The aforementioned symptoms enabled the key TPs to be located accurately. If, on palpation, a patient was found to have latent TPs on both the right and left side, the side of the body causing more pain was eligible for therapy. When more than one TP was detected along the muscle's path, only one of them - the key point with the greatest pain complaints - was considered for therapy. After locating the TP on the SMM and selecting the side of the patient's body to be treated, a palpation assessment was undertaken on the descending part of the TRM. This assessment was carried out on the same side as previously selected. During the test, the patient was in a seated position in a chair with his hands resting on his thighs to maximize muscle relaxation. Two techniques were used for palpation assessment – a flat grip using the index finger pad and a pincer grip using the thumb and the index finger. In the flat grip, the fingertip was used to move across and along the hypertonic muscle fiber, while in the pincer grip, the thumb and index finger encompassed the muscle belly allowing accurate palpation. When finding the TPs of this muscle, the area of their occurrence described in the literature and the pain they cause were taken into account. In the case of the descending part of the TRM, the available sources show the presence of TP on the free edge of the descending part of the muscle, which is palpable as a hypertonic strand. The pain radiation of this muscle runs laterally and posteriorly near the neck, up to the mastoid process, especially near the eye sockets and temples and to the mandibular angle [9]. Once the TP was selected, it was marked with a pencil on the surface of the patient's skin so that this area could later be mapped after therapy and the patient's pain threshold could be tested in the same area.

The pain threshold of a previously marked TP on the descending part of the TRM was assessed sequentially. The subject remained seated in a chair with their hands resting on their thighs while the therapist began the examination. Pain threshold was measured using the Hoggan Microfet 2 Dynamometer. This equipment offers the possibility of precise pressure graduation due to the appropriate pad, which resembles a human thumb in size and shape. In addition, this dynamometer has a high sensitivity, making it possible to pick up even the smallest changes during the generated pressure. Changes in the subject's pressure pain threshold were measured before and after therapy. The dynamometer measurement was as follows. The device had to be applied at right angles to the pre-marked area and gradually, with increasing force, pressed deep into the tissue. The measurement value that was considered was the lowest TP compression force that gave the first pain complaint reported by the subject. As soon as the patient signaled the first pain complaint with the simultaneous utterance of the word 'Stop', the whole procedure was terminated. This measurement was taken twice to increase its reliability, and the arithmetic mean drawn from these measurements was the subject's final compression pain threshold score. The final result was expressed to the nearest 0.1 Kgf in the kilogram-force unit. During the measurement, the patient and therapist did not have a view of the handheld dynamometer screen until the end of the measurement, which further increased the reliability of this measurement (**Figure 1**).

Once the pain threshold measurement was completed, the assessment of the bioelectrical activity of the descending part of the TRM was undertaken. During the examination, the patient was in a seated position in a chair with the hands resting on the thighs and was as relaxed as possible. A NORAXON electromyograph (MyoTrace 400) was used for the study, and a special protocol was created for the analysis using the MyoResearch Master Edition software (**Figure 2**).

This protocol included measurement of the 30-second resting tension of the descending part of the TRM and its function. The function of this muscle was assessed by lifting the shoulder girdle three times, and the patient had 15 seconds to perform each movement. Noraxon's EMG is a measuring device suitable for examining muscle electrical signals and is used for a measurement technique called surface electromyography (sEMG). This technique is now used continuously, and, most importantly, it does not interfere with the human body, so the whole examination process is completely painless for the patient. The average values from the results obtained are expressed in microvolts (μV). Specialized surface electrodes applied to the skin surface are used during testing. Sorimex disposable electrodes designed for short-term testing and diagnostics were used in the study (**Figure 3**).

Before the measurement, it was the therapist's job to prepare the examined area. Their duties included cleansing the patient's skin with a cotton swab dipped in salicylic spirit and removing body hair. The next step was to apply the surface electrodes to the patient's skin. Three disposable surface electrodes from Sorimex were provided for each measurement. Electrodes were applied based on generally accepted methodology at appropriate

Figure 1. Handheld dynamometer Hoggan Microfet 2 used in the study.

Figure 2. Surface electromyography Noraxon used in the study.

Figure 3. Surface electrodes Sorimex used in the study.

locations on the patient's body. Two electrodes were placed in the central part of the muscle belly of the descending TRM parallel to the fiber direction. A gap of approximately 2 cm was left between the electrodes. The third one, called the reference, had to be fixed on the acromion of the scapula. This was followed by the bioelectrical activity measurement of the descending part of the TRM. At the end of the test, the taped electrodes had to be left on the patient's body for bioelectrical activity to be measured again after therapy.

Each of the above measurements was carried out in the same room by one individual. During the study, both the patient and the therapist were not able to view the results until all measurements were completed. This additionally made the research more reliable. After precise localization of the TPs and subsequent measurement of the pressure pain threshold and the bioelectrical activity of the descending part of the TRM, one of two therapies was initiated.

Interventions

Participants in group A were exposed to a one-time procedure of positional SMM relaxation according to the Jones method, which consisted of: adequate compression in the TP area with a force that leads to the patient's local discomfort and with a force that causes radiating/throwing discomfort; movement of the subject's body segments to the relaxed position – obtaining information from the patient regarding a decrease in pain for a minimum of 90 seconds; slow return to the neutral position of the joint - after the subject's pain has fully subsided [7].

Participants in group B were exposed to a single post-isometric muscle relaxation SMM treatment, belonging to the muscle energy technique introduced by Chaitow, consisting of: rotating the patient's head in the opposite direction and placing one hand on the sternum (the therapist placed their hand on the patient's head near the mastoid process, while the other hand placed on the patient's hand, which performed a head lift towards the ceiling with a small amount of force - the isometric contraction lasted 7-10 seconds; after this time, the patient slowly put their head back on the lounger, relieved the muscle tension and began to breathe; at this point, the therapist's hand resting on the patient's hand near the sternum performed an oblique pressure on the sternum in order to stretch the muscles. The performed SMM stretching during exhalation had to be carried out thrice for at least 30 seconds [8] (**Figure 4**).

Statistical analysis

Statistica 13 was used for statistical analysis, while Microsoft Excel was used to interpret the results graphically. In order to determine the distribution of analyzed variables, the Shapiro-Wilk test was applied. The Wilcoxon matched-pairs test or T-test were used to assess the significance of differences between groups for dependent samples. To assess the significance of differences for independent samples, the Mann-Whitney U test was used. A difference at $p<0.05$ was considered statistically significant.

Results

Group A results

In group A, after a single positional release technique of latent TP of SMM using the Jones method, the results showed a statistically significant increase in the mean TRM pain threshold ($p<0.05$).

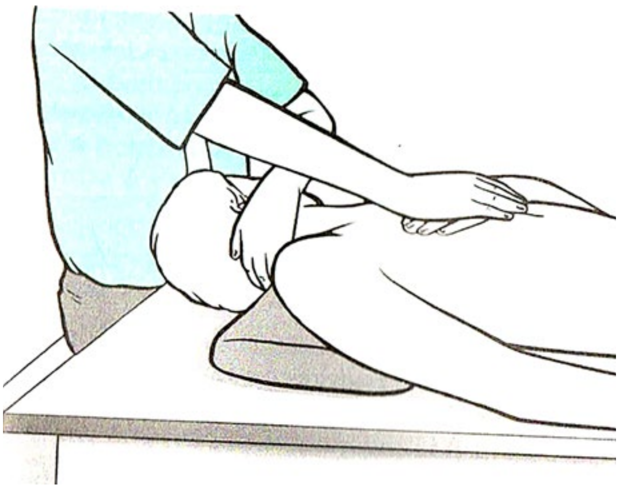

Figure 4. MET technique for right SMM [8].

Before the treatment, it was 6.85 Kgf, while after 9.48 Kgf, giving a change of 38.39%. The results indicated a decrease in mean resting TRM bioelectrical activity in group A after performing a single Jones positional release therapy on the SMM. This outcome was statistically significant (p<0.05). Before the treatment, the average was 4.88μV, while after, it was 3.33μV, representing a change of 31.76%. In group A, the results displayed a decrease in the mean value after treatment during the arm lift movement, but these results were not statistically significant (p>0.05). Before the treatment, the mean elevation value was 15.55μV, while after, it was 13.49μV, indicating a change of 13.25% (**Table 1**).

Group B results

In group B, after a single treatment with the muscle energy technique on the latent TP of SMM in accordance with Chaitow, the results demonstrated a statistically significant increase in the mean TRM pain threshold (p<0.05). It was 6.82Kgf before the therapy, and 8.47Kgf after, yielding a change of 24.19%. The mean values of bioelectrical activity of the TRM at rest after the single muscle energy technique, according to Chaitow, decreased, and this change was statistically significant (p<0.05). Before therapy, the average at rest was 3.73μV, while after, it was 3.07μV, resulting in a change of 17.69%. After treatment, the mean value for movement during elevation decreased. This change was statistically significant (p<0.05). Before therapy, it was 13.35μV, while after, it was 9.95μV, resulting in a change of 26.22% (**Table 2**).

Comparison of the results between groups

Prior to treatment, between groups A and B, the mean pain threshold showed no significant change. Post-treatment, group A and group B achieved a statistically significant increase in mean pain threshold scores at p<0.05, with no statistically significant differences between groups, indicating p>0.05. Groups A and B also showed no significant differences in mean resting values and during physical activity both before and after therapy (**Table 3**).

Table 1. Effects of single positional release technique treatment of latent TP of SMM using the Jones method on pain threshold and changes in TRM bioelectrical activity.

Group A						
Variable	**Mean**	**Min**	**Max**	**SD**	**N**	**p**
Pain before (Kgf)	6.85	2.4	14.8	3.37	36	0.00000002
Pain after (Kgf)	9.48	3.8	17.25	4.31	36	
Rest sEMG before (μV)	4.88	0.85	11.4	2.53	36	0.000176
Rest sEMG after (μV)	3.33	0.81	8.23	1.63	36	
Elevation sEMG before (μV)	15.55	3.34	63.2	16.97	36	0.081182
Elevation sEMG after(μV)	13.49	2.24	57.9	17.32	36	

Notes: Student's t-test, Wilcoxon paired rank order test, p<0.05 - statistically significant differences.

Abbreviations: Min – minimum value, Max – Maximum value; SD – standard deviation, N – number of participants, p – level of statistical significance, sEMG – surface electromyography.

Table 2. Effects of single treatment with the muscle energy technique on the latent TP of SMM in accordance with Chaitow on pain threshold and changes in TRM bioelectrical activity.

Group B						
Variable	**Mean**	**Min**	**Max**	**SD**	**N**	**p**
Pain before (Kgf)	6.82	2.3	14.1	2.74	36	0.000177
Pain after (Kgf)	8.47	3.6	17.1	3.24	36	
Rest sEMG before (μV)	3.73	1.02	9.92	2.13	36	0.044331
Rest sEMG after (μV)	3.07	1.38	6.09	1.31	36	
Elevation sEMG before (μV)	13.35	4.2	44.3	9.01	36	0.000047
Elevation sEMG after(μV)	9.85	2.75	39.9	8.03	36	

Notes: Wilcoxon paired rank order test, p<0.05 - statistically significant differences.

Abbreviations: Min – minimum value, Max – Maximum value; SD – standard deviation, N – number of participants, p – level of statistical significance, sEMG – surface electromyography.

Table 3. Intergroup comparison of analyzed variables.

Group A vs. B						
Variable	**Pain before** (Kgf)	**Pain after** (Kgf)	**Rest sEMG before** (μV)	**Rest sEMG after** (μV)	**Elevation sEMG before** (μV)	**Elevation sEMG after** (μV)
Group A (N)	36	36	36	36	36	36
Group B (N)	36	36	36	36	36	36
U	572.5	464.5	505.0	554.0	621.0	532.0
Z	0.037	0.995	1.605	1.053	0.298	1.301
p	0.96	0.32	0.11	0.29	0.77	0.19

Notes: Wilcoxon paired rank order test, p<0.05 - statistically significant differences.

Abbreviations: Min – minimum value, Max – Maximum value; SD – standard deviation, N – number of participants, p – level of statistical significance, sEMG – surface electromyography.

Discussion

Emerging pain is the most common reason for performing positional release therapy and MET in the area of the affected muscle strands. However, few people are aware that TPs occurring in one muscle cause an increase in tension in the antagonistic muscle. The current research is one of very few addressing this issue. There were 72 students divided into two equal groups in the present study. Group A received PRT therapy using the Jones method, while group B received a single MET treatment using the Chaitow method. The results demonstrated that MET and PRT of latent TPs of SMM reduce the pain threshold of TRM. The lack of statistically significant differences between the groups may indicate that either form of therapy in managing pain caused by latent TPs is comparably effective.

An important element for the diagnosis of myofascial pain is the measurement of muscle tenderness. It is measured by applying appropriate pressure to the muscle. The handheld dynamometer is one diagnostic tool designed to measure pain threshold and resistance to tenderness. In scientific research, many authors use the algometer, the effectiveness of which has been confirmed in numerous articles [11–13]. Ginszt et al. [14] used, in their study, a pressure algometer to assess the latent TP pain threshold. The authors evaluated, among other things, the effects of the latent TP compression technique on pressure pain threshold values. The pain threshold value was measured for the left and right masseter muscle, which was determined by three measurements using a standard digital algometer. The researchers demonstrated that using compression is an effective therapy in raising the pressure pain threshold. According to the authors, the algometer proved an effective research tool. Furthermore, research conducted by Jayaseelan et al. [15] supported that the handheld dynamometer is a valid and reliable tool that accurately measures pain thresholds.

In practice, palpation is mainly used to locate TPs, but there are other effective ways of detecting them. One such method includes superficial electromyography (sEMG), which was also used in our own study. The sEMG test is painless and does not directly interfere with the subject's body. The effectiveness of the use of sEMG for TP localization is proven by numerous research [16–18]. A large study testing the efficacy of using sEMG was conducted by Yu and Kim [19]. The authors compared the differences in electrophysiological characteristics of normal muscles with muscles in which latent or active TPs were present. A total of 90 individuals in their 20s participated in the study. The subjects were divided into three equal groups - a group with active TPs, a group with latent TPs, and a control group. Maximum isometric contraction, median frequency, endurance, and muscle fatigue index were measured in each patient. Studies have revealed that muscles with active TP have an increased median frequency and experience fatigue more quicker. According to the researchers, sEMG is an effective diagnostic tool that can be used to analyze muscle bioelectrical activity in physiotherapy.

A number of therapies are currently available for TPs, with PRT and MET therapies being among the most common. MET is widely used and described by numerous researchers [20,21]. The second therapy method used in the study was positional release therapy. Positional release is a method in which pressure is applied to the TP, and the area under examination is successively guided to a position of freedom [7]. The positional release has also been used in research conducted by other authors [22,23].

Our study showed equal effectiveness in reducing pain between MET and RP. Similar observations were made by Sadria et al. [24]; their study involved 64 individuals between the ages of 18 and 50 years who were diagnosed with latent TPs in the superior TRM. The tests examined the extent of active lateral flexion in the neck, the pain threshold measurement through the VAS scale, and the thickness of affected muscles. These measurements were taken before and after treatment. Both treatments had a direct effect on decreasing the thickness of the descending TRM muscle ($p<0.01$), increasing active lateral cervical flexion ($p<0.001$), and reducing pain in accordance with the VAS scale ($p<0.05$). The researchers revealed that both PRT and MET had the same effect on reducing the pain symptoms generated by latent TPs in the superior part of the TRM.

Another valuable research comparing PRT and MET therapy during the active release of gastrocnemius and soleus muscle TPs was conducted by Jain et al. [25]. The study comprised 30 runners who were randomly divided into two groups. Group A received a single active release treatment, while Group B received a single positional release treatment. Dorsiflexion range of motion and numeric pain rating scale (NRS) score were assessed. Statistical analysis demonstrated that there was a significant increase in the range of motion and reduction in pain in both groups after TP treatments. A comparison between groups showed that the changes were significantly more effective in group B. The research concluded that therapy using the positional release of TPs was a better intervention, as it showed a greater reduction in pain and a greater increase in dorsiflexion range of motion at the ankle joint.

Authors Joshi and Rathi [26] evaluated the effect of MET in comparison to positional release in patients with TRM inflammation and non-specific neck pain. They enrolled 30 individuals between the ages of 20 and 50 and divided them into two groups. Group A received RP therapy, while group B received MET. All participants enrolled in the study were evaluated for pain before and after therapy using the numerical pain rating scale (NPRS), cervical spine range of motion, and the neck disability index (NDI). The researchers found that MET was more effective than the positional release technique in their study subjects.

In our study, a comparable positive effect of both forms of therapy was observed; however, studies confirming these results on a greater sample, also employing control groups, are required. Subsequent research should also evaluate the efficacy of PRT and MET therapy not only immediately afterward, but also at a later stage by examining the therapeutic effects over an interval of time. In the future, researchers should consider whether it would be advantageous to use both techniques on the same TP to create the most beneficial treatment for TPs.

Conclusions

The results of the study demonstrated the comparability of both MET and PRT techniques in increasing the compressive pain threshold, as well as decreasing resting TRM tension after therapy on SMM. Both MET and PRT are comparatively useful in the treatment of pain occurring through myofascial TPs.

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