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Effect of the Combined Therapy of the Muscle Energy Technique and Trigger Point Therapy on the Biophysical Parameters of the Trapezius Muscle: a Randomized Clinical Trial

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SUMMARY

Background. There is a lack of scientific literature assessing the impact of a combination of Muscle Energy Technique (MET) and Trigger Point Therapy (TPT) on biophysical parameters in a group of asymptomatic people with latent trigger point.
Methods. The research group consisted of 60 right-handed, asymptomatic students with a latent trigger point on the upper trapezius muscle, practising amateur symmetrical sports. The study used MyotonePRO to assess the tone, stiffness and elasticity of the upper trapezius muscle. Volunteers were randomly divided into three research groups, depending on the applied therapeutic method: 1) MET + TPT; 2) MET; 3) TPT. All patients underwent only one treatment of the selected therapeutic method. Measurements were made in three time intervals (before, after and on the second day after therapy).
Results. Each of the performed therapies resulted in a reduction of muscle tone and stiffness of both trapezius muscles and an increase in the elasticity of both muscles. However, a statistically significant change ($\alpha \leq 0.01$) in all myotonic features examined concerned only the right trapezius after the combination of MET and TPT.
Conclusions. The advantage of combined MET + TPT therapy may result from the benefits of combining methods with different therapeutic foundations.

KEY WORDS

Muscle Energy Technique; Trigger Point Therapy; combined therapy; myotonometry; muscle biophysical parameters.

INTRODUCTION

Muscle Energy Techniques (METs) can be defined as a group of soft tissue manipulation methods. All of them are characterized by cooperation on the part of the patient, precise management and control by the therapist as well as isometric contraction and/or isotonic movement (1). METs are multi-task techniques that can be performed to improve the function of the musculoskeletal system and reduce pain (2). They allow strengthening (3), relaxing and restoring the elasticity of specific muscles (4). They can affect the restoration of the range of motion in individual joints (5-7). They lead to the improvement of local soft tissue circulation and affect proprioceptive re-education (1). It is believed that neurological and biomechanical mechanisms, such as hypoalgesia, motor programming and control, reflex muscle relaxation, viscoelastic and plastic tissue property, autonomic-mediated change in extracellular fluid dynamics and fibroblast mechanotransduction, play a key role here (1). METs are used by clinicians who treat various myofascial and joint disorders, and also as a form of prevention against dysfunctions and as protection of the musculoskeletal system (1).

Trigger point therapy (TPT) uses manual techniques such as ischaemic compression (IC) (8), positional release (PR) (8), deep dry needling (DDN) (9) and soft tissue manipulations (8). Their main purpose is to reduce or eliminate the symptoms generated by myofascial trigger points (TrPs), which are defined as severely irritated areas within the hypertonic muscle fibre band or the fascia itself (10). They are characterized by specific soreness during palpation and can generate radiating pain (according to the muscle-specific pattern), a limitation of the range of motion, weakness of muscular strength and various vegetative reactions, which may have a negative impact on the performance of various motor activities (10). TrPs can lead to disorders related to proprioception and thus affect the kinematics of the cervical spine (11). A particularly sensitive indicator is the limitation of lateral flexion, which clearly correlates with neck pain (11). It is believed that the formation of TrPs is caused by a disturbed muscle blood supply, which in turn leads to a reduction in the supply of oxygen and nutrients (12). This happens due to various micro injuries and loads of the musculoskeletal system due to incorrect positions and movement patterns (12).

In the clinical classification, we distinguish active and passive (latent) trigger points (10). The first type can generate specific pain familiar to the patient. They have a characteristic pattern for each muscle. Latent TrPs are described as those that do not generate symptoms on their own. However, they can cause referred pain at the time of provocation, *i.e.* pressure at the place of their occurrence (13). Patients with latent TrPs may be unaware of their presence. They can lead to a decrease in muscle strength and an increase in muscle tone (13). Distinction between trigger point types is possible when performing various diagnostic procedures. In these types of cases, anamnesis and provocation tests may be useful in a clinical examination (14). It is believed that in the area of the shoulder girdle, TrPs most often occur on the upper trapezius muscle and may be closely related to various myofascial ailments of this area of the body (14).

The main objective of this study was to evaluate the effectiveness of a therapy that is a combination of Muscle Energy Technique (MET) and TPT, performed bilaterally on the upper trapezius muscle in a group of asymptomatic persons with latent TrPs. The study was carried out to examine whether a one-time therapy affects the soft tissue biophysical parameters (tone, elasticity and stiffness) in the area of upper trapesius muscle. In the scientific literature there are no reports on the assessment of the combination of MET with TPT. There are also no studies focused on changes in soft tissue biophysical parameters as a result of the proposed therapy. The experiment carried out has therefore an innovative character. Furthermore, an additional objective was to compare the efficacy of three therapies used – a combination of MET with TPT, MET alone, and TPT alone – which were made to both sides of the upper trapezius muscle in a group of asymptomatic students with latent TrPs.

MATERIALS AND METHODS

A randomized clinical tral consisted of assessing the effects of three different physiotherapeutic interventions. Randomly (sampling frame), participants were assigned to three different research groups (MET + TPT, MET and TPT). The study was of a parallel nature. The same person – a physiotherapist with 10 years of experience – was responsible for performing diagnostics and all types of therapeutic interventions. The blinded researcher did not know which experimental group the subjects belonged to. All measurements and interventions were carried out in the same place, the Department of Biology and Anatomy at the Poznan University of Physical Education.

Participants

The study involved 60 volunteers who were selected from first-year students at the Poznan University of Physical Education. They were right-handed people and practised amateur symmetrical sports (swimming, running, cycling, gym, roller skating). All subjects were asymptomatic (without pain symptoms of the cervical segment and shoulder girdle) and were characterized by a latent trigger point (TrP) on the upper trapezius muscle. The exact characteristics of the research material are presented in **table I**.

Disqualification criteria included: age above 21 years; no latent TrP on the upper trapezius muscle; pain in the cervical spine or shoulder girdle; any neurological symptoms in the upper limb; previous operations on the cervical spine or shoulder girdle; professional sports; practising asymmetrical sports. The exact flow of subjects through all stages of the study is shown in **figure 1**.

Diagnosis of latent TrP was performed with the subject in the supine position. Using a pincer grip, the therapist performed palpation in the area of the entire upper trapezius. The test for the presence of TrP could be considered positive at the time when the following were noted: 1) the presence of a detectable strained band in the skeletal muscle; 2) the presence of an excessively sensitive area in the strained muscle band; 3) a local vibration response caused by compression of the strained band; 4) the occurrence of characteristic transferred symptoms (pain radiating to the posterior–lateral side of the neck, and/or mastoid process of the temporal bone, or/and the area of the temporal bone, and/or the angle of the jaw) as a result of compression of the hypersensitive muscle band. The examination was performed on both sides of this muscle. If during a palpation a given person felt the symptoms described above, but they were not known to them before (*i.e.* they did not feel them in everyday life), it was considered that there was a latency trigger point. The above criteria during palpation, conducted by an experienced clinician, guarantees high reproducibility of measurements (10).

Table I. Basic characteristics of the research groups.

Parameter	Category	Group MET+TPT		Group MET		Group TPT	
		N	%	N	%	N	%
Age [years]	19	4	20	2	10	2	10
	20	15	75	16	80	17	85
	21	1	5	2	10	1	5
Gender	men	10	50	12	60	14	70
	women	10	50	8	40	6	30
Weight [kg]	60-70	7	35	8	40	6	30
	71-80	7	35	8	40	7	35
	81-90	4	20	3	15	5	25
	91-100	2	10	1	5	2	10
Height [cm]	160-170	6	30	6	30	5	25
	171-180	9	45	11	55	10	50
	181-190	5	25	3	15	5	25
BMI [kg/m2]	17-18.5	0	0	0	0	0	0
	18.5-25	20	100	20	100	20	100
	25-30	0	0	0	0	0	0
Physical activity	1 x a week	5	25	2	10	6	30
	2 x a week	12	60	13	65	10	50
	3 x a week	3	15	5	25	4	20

MET + TPT-combination of Muscle Energy Technique and trigger point therapy; MET-single MET method; TPT-single TPT method.

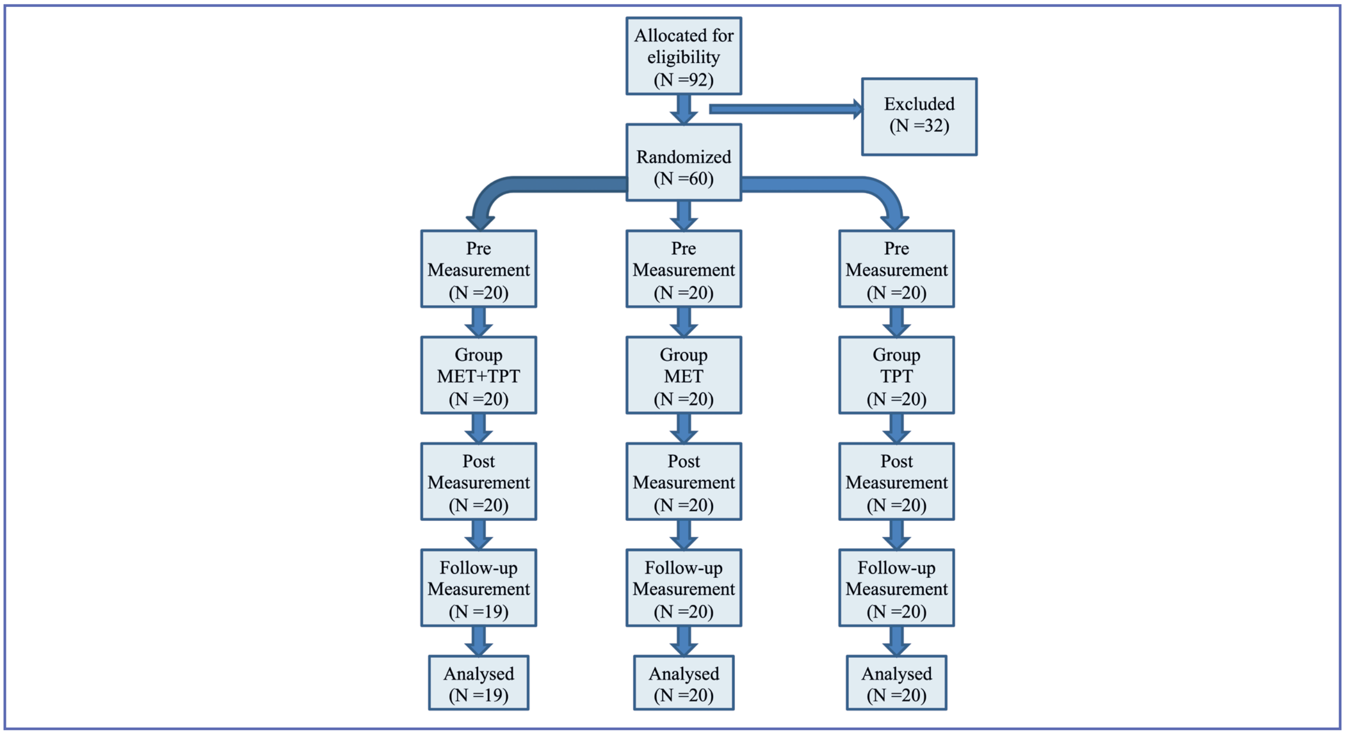

Figure 1. Diagram showing the flow of subjects through the various stages of the study.

Therapeutic interventions

Muscle Energy Technique (MET)

The contract-relax-agonist-contract (CRAC) technique was used on the upper trapezius muscle (on both sides). The participant was in the supine position. Then, the therapist set the cervical spine in the lateral flexion (opposite direction to the relaxant muscle) to the extent that slight soft tissue tension was felt (**figure 2**). In the case when the subject did not feel any symptoms of discomfort on the part of the engaged muscle, the therapist proceeded to perform the technique. It consisted of two stages. In the first (so-called 'tension phase'), the upper trapezius muscle was activated (shoulder girdle elevation) against the therapist's resistance. The duration of the contraction was 10 seconds. The therapist who performed the technique generated resistance of about 20-30% of the participant's maximum muscle strength. The resistance was acceptable to the subject (there could be no muscle vibration as this would indicate too much resistance). Then the participant took a deep breath in and out, which promoted relaxation and was followed by 10 seconds of antagonist group tension (lowering of the shoulder girdle). Then the therapist slightly moved the shoulder girdle of the subject towards the depression so that it did not cause any discomfort. Then followed the second stage (relaxation phase), during which the subjects were passively lying on their back for 30 seconds and the therapist maintained this new position of the shoulder girdle. Both phases: tension and relaxation made up the therapeutic cycle. During the proposed MET therapy, 5 cycles were performed on each side of the upper trapezius.

Trigger point therapy (TPT)

The positional release technique (PR) was used, which consisted of compressing the place of occurrence of the trigger point with the simultaneous shortening of muscle attachments (slight lateral flexion towards the relaxed muscle) (**figure 3**). The muscle on both sides underwent therapy. The pressure was acceptable to the patient. The duration of the technique was 2 minutes for each muscle.

Combination of MET and TPT

For this type of intervention, TPT was first performed on both sides of the upper trapezius, followed by MET, which was also performed bilaterally. The method of performing the therapeutic techniques used for the combined procedure was identical to the single methods (description above).

Measurement method - Myotonometry

In order to examine the biophysical parameters of soft tissues, *i.e.* muscle tone (F) [Hz], stiffness (S) [N/m] and elasticity (D) [no unit], a MyotonPRO was used. Measurements were made on the upper trapezius at the point located in the middle of the section between the C7 spinous

Figure 2. Method of applying MET on the left upper trapesius muscle (own material).

Figure 3. Method of applying TPT on the left upper trapesius muscle (own material).

process and the shoulder angle of the acromion. During the measurements, the subject was lying down. The pattern composer was programmed as follows: Tap time: 15 ms, Interval: 0.8 s, mode: multiscan (5 repetitions). The MyotonPRO is a reliable and repeatable tool for measuring biophysical parameters of superficial soft tissues (15-19).
All measurements were made at three time intervals: before therapy; after therapy; and on the second day after therapy.

STATISTICAL METHODS

The collected data were analysed in the statistical program Statistica version 13. In order to examine the impact of the studied therapeutic methods on the measured quantitative variables, an analysis of variance with repeated measurements was carried out, as well as a number of comparisons with the Student's-t mean test against a constant reference value. To counteract the problem of multiple comparisons, the Bonferroni correction was applied.

ETHICS

Participation in the study was voluntary, unpaid and fully anonymous. Participants could opt out of the study at any phase. To conduct the study, the permission of the Bioethics Committee in Poznan University of Medical Sciences (Approval Number: 232/20), informed consent of the participants and clinical trial registration number (NCT04360668) were obtained.. The research was conducted in accordance with international recommendations in clinical science and meets the ethical standards of the MLTJ journal (20).

RESULTS

In order to determine the impact of three compared therapeutic methods (MET + TPT, MET, TPT) on the values of biophysical parameters (muscle tone, stiffness, elasticity) of the soft tissues of the upper trapezius muscle, a measurement of these features was made immediately before each therapy (Pre), immediately after performed therapy (Post) and the next day (Follow-up). By following the results of the analysis of variance for repeated measurements (in which the therapy method and repeated measurements were a factor), a statistically significant difference was noted between the measurements made before, immediately after and one day after the therapy used for muscle tone, stiffness and elasticity of the right trapezius muscle and the muslce tone and stiffness of the left trapezius muscle (**table II**). On the other hand, no significant differences in the tested myotonometric parameters were noted, depending on the therapeutic method used and the interaction between the therapy method and repeated measurements (**table II**). The resulting eta-squared values indicate that the factor, measurement over time (Pre, Post, Follow-up), most strongly affects the muscle tone and soft tissue stiffness of the right trapezius muscle, explaining as much as 30% and 23% variability of these parameters (**table II**).
In addition, the size of the examined biophysical features of the upper trapezius muscle before therapy, immediately after the therapy and the next day, depending on the method of therapy used (MET + TPT, MET, TPT) (**figures 4-9**), is presented in graphical form. The figures show the impact of all the therapies used immediately after their performance on the biophysical features of the trapezius; however,

Table II. Summary of results of ANOVA variance analysis with repeated measurements for biophysical features (muscle tone - F; stiffness - S; elasticity - D) of soft tissues of the upper trapezius muscle on both sides.

Variable	Method (MET + TPT, MET, TPT)		R (Pre, Post, Follow-up)		R*Method	
	p	η^2	p	η^2	p	η^2
Right trapezius muscle						
F	0.9578	0.0015	0.0000**	0.2992	0.7146	0.0185
S	0.9781	0.0008	0.0000 **	0.2278	0.8485	0.0121
D	0.4235	0.0302	0.0054 *	0.0889	0.7159	0.0185
Left trapezius muscle						
F	0.7732	0.0091	0.0001**	0.1458	0.8441	0.0123
S	0.8918	0.0041	0.0181*	0.0691	0.9989	0.0009
D	0.5336	0.0222	0.0594	0.0492	0.7474	0.0170

R (Pre, Post, Follow-up) - measurement in time (immediately before, immediately after and 1 day after therapy); R*Method - interaction between measurements (Pre, Post, Follow-up) and factor therapy method (MET + TPT, MET, TPT); η^2 - eta-partial square; p - test probability; ** significant differences at the level $p \leq 0.01$.

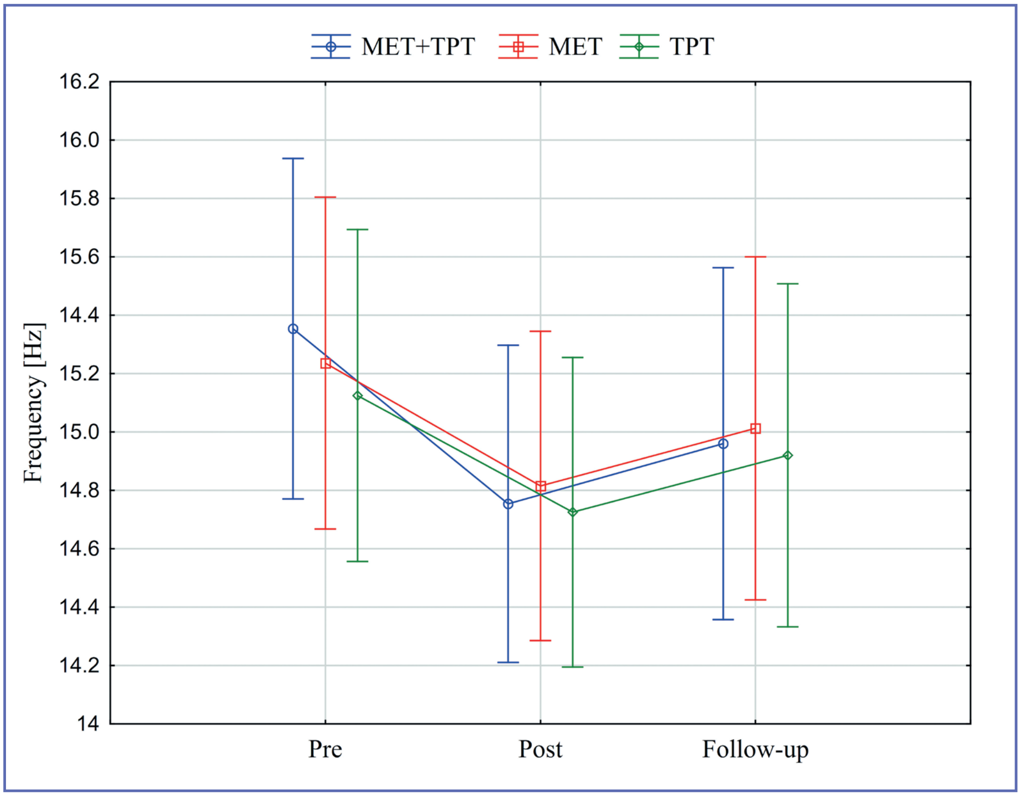

Figure 4. Mean muscle tone (F) values of the right upper trapezius muscle before the therapy (Pre); immediately after the therapy (Post); and the next day (Follow-up) for each of the performed therapies (MET + TPT, MET, TPT). The vertical bars indicate the 95% confidence interval for the mean.

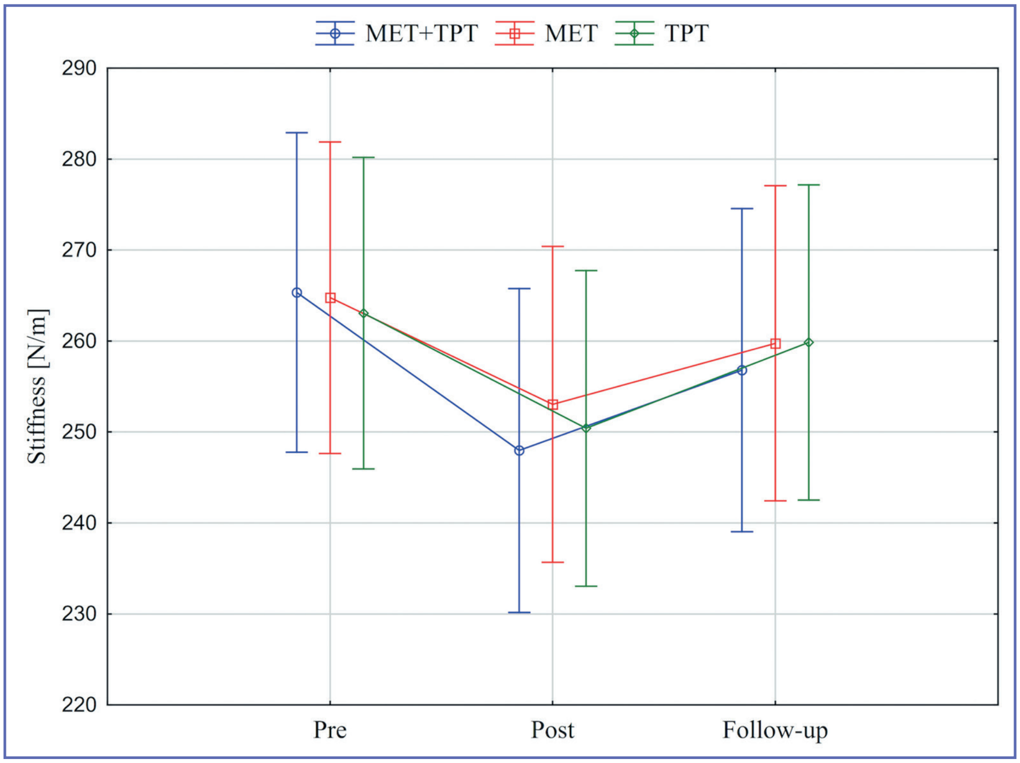

Figure 5. Mean stiffness (S) values of the right upper trapezius muscle before the therapy (Pre); immediately after the therapy (Post); and the next day (Follow-up) for each of the performed therapies (MET + TPT, MET, TPT). The vertical bars indicate the 95% confidence interval for the mean.

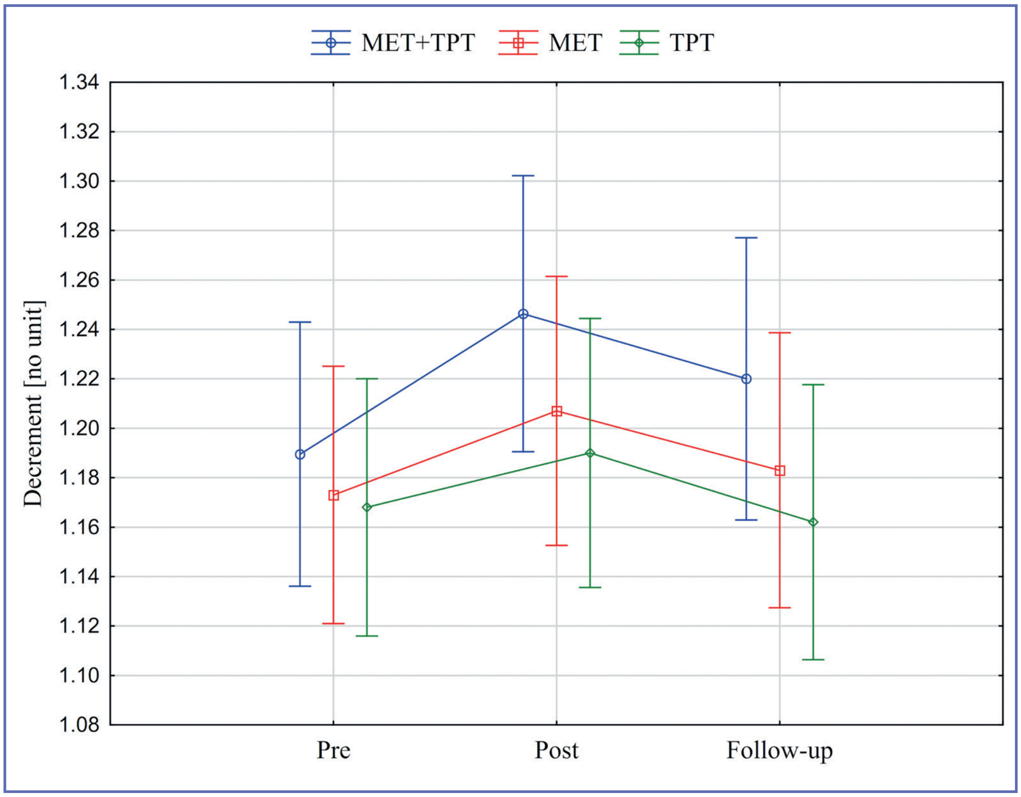

Figure 6. Mean elasticity (D) values of the right upper trapezius muscle before the therapy (Pre); immediately after the therapy (Post); and the next day (Follow-up) for each of the performed therapies (MET + TPT, MET, TPT). The vertical bars indicate the 95% confidence interval for the mean.

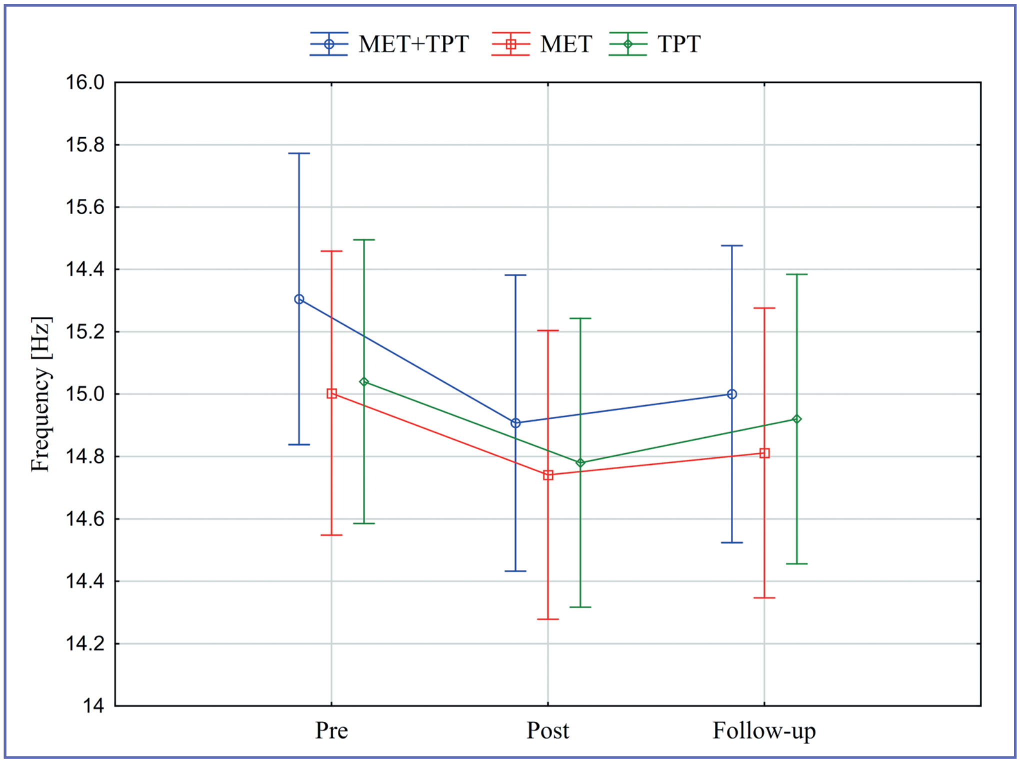

Figure 7. Mean muscle tone (F) values of the left upper trapezius muscle before the therapy (Pre); immediately after the therapy (Post); and the next day (Follow-up) for each of the performed therapies (MET + TPT, MET, TPT). The vertical bars indicate the 95% confidence interval for the mean.

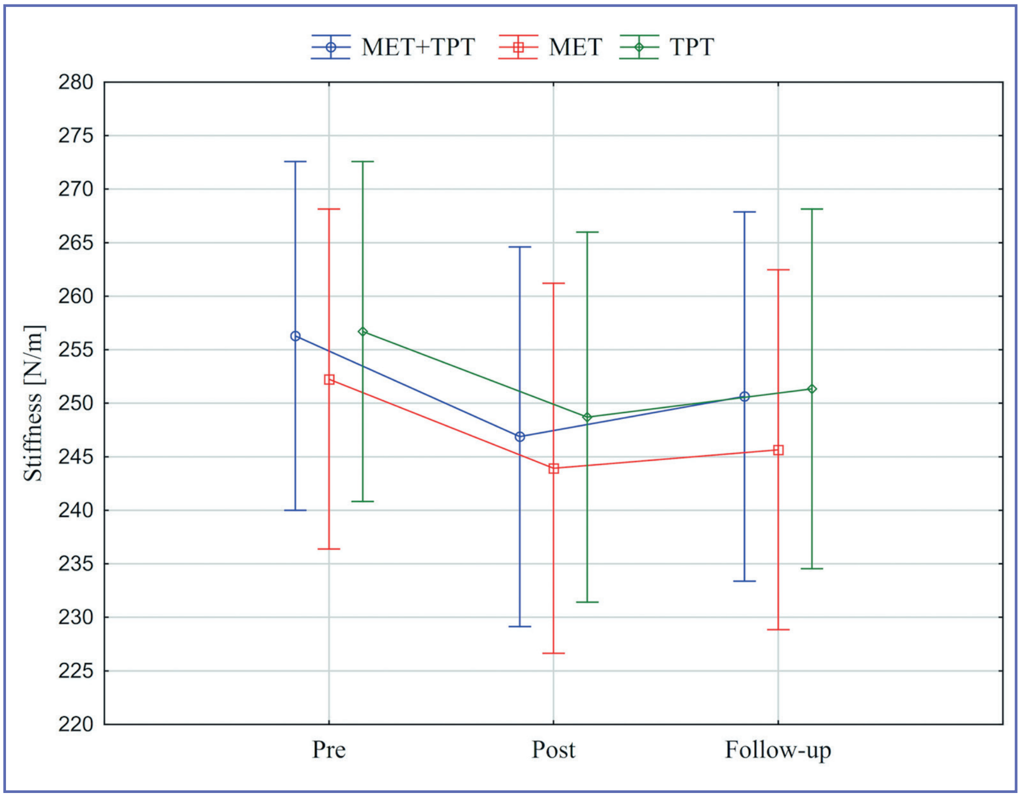

Figure 8. Mean stiffness (S) values of the left upper trapezius muscle before the therapy (Pre); immediately after the therapy (Post); and the next day (Follow-up) for each of the performed therapies (MET + TPT, MET, TPT). The vertical bars indicate the 95% confidence interval for the mean.

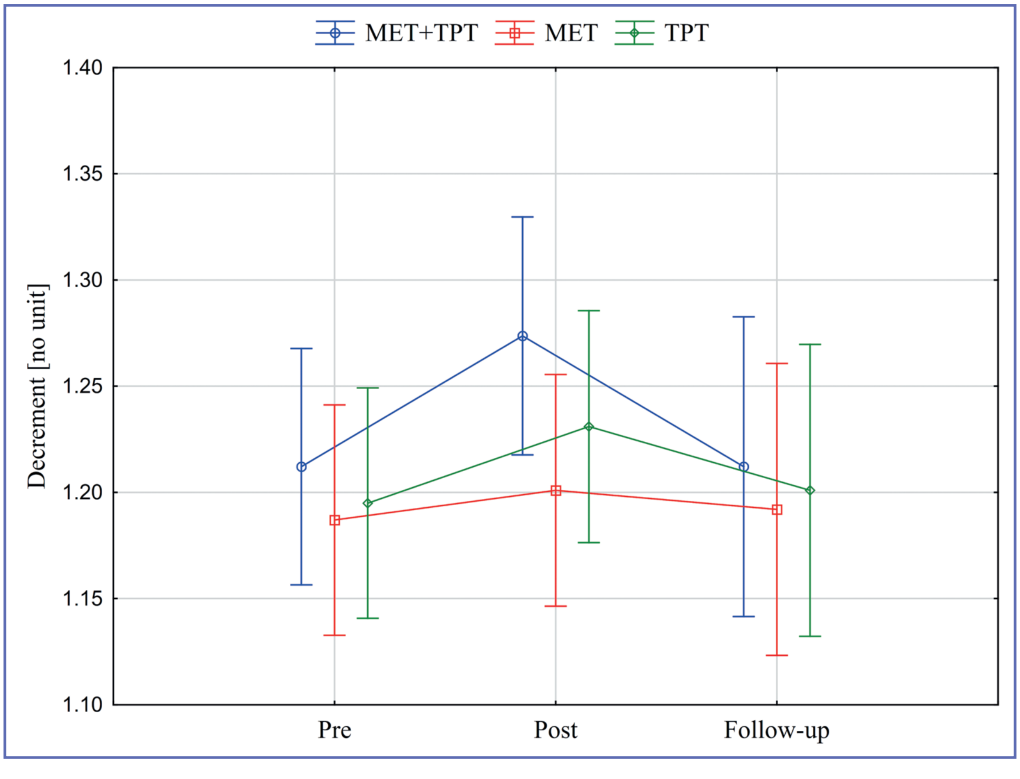

Figure 9. Mean elasticity (D) values of the left upper trapezius muscle before the therapy (Pre); immediately after the therapy (Post); and the next day (Follow-up) for each of the performed therapies (MET + TPT, MET, TPT). The vertical bars indicate the 95% confidence interval for the mean.

the effect caused by the following day therapies was diminishing. The analysis of the presented graphic images indicates that among the methods used, the combination of the MET + TPT therapy had the greatest impact on the changes in myotonometric parameters (**figures 4-7, 9**).
In order to determine the effectiveness of the applied therapeutic methods, the differences between the measurements were compared: (Post–Pre), (Follow-up–Pre) and (Follow-u–Post) within each of the performed therapies. These differences were determined using the mean test against a constant reference value (**table III**). To counteract the problem of multiple comparisons, the Bonferroni correction was applied, which reduced the nominal level of significance of each set of related tests in direct proportion to their overall number. Taking into account the Bonferroni correction, the nominal significance level α of each of the related tests had to be divided by 3. And so: for the level of 0.01, $p < 0.003333$ is required, for the level of significance 0.05 – $p < 0.016667$, and $p < 0.03333$ refers to the significance level of 0.1.
Each of the performed therapies resulted in a reduction of muscle tone and stiffness of both the right and left trapezius muscles and an increase in the elasticity of both muscles. However, a statistically significant change at the significance level $\alpha \leq 0.01$ in all myotonic features examined concerned only the right trapezius after the combination of MET and TPT. Other therapies significantly affected only the muscle tone and stiffness of the right trapezius, TPT therapy at $\alpha \leq 0.01$, and MET therapy at $\alpha \leq 0.05$. On the left, changes in the biophysical parameters of the trapezius muscle were smaller (**table III**). In the case of combined therapy, significant changes at the $\alpha \leq 0.05$ level concerned the stiffness and elasticity of the upper left trapezius, and TPT therapy at the $\alpha \leq 0.01$ level significantly reduced the muscle tone (**table III**).

DISCUSSION

In the scientific literature there is a small amount of work focused on assessing the impact of MET and TPT on the biophysical parameters of soft tissues. It should be emphasized that there are several types of therapeutic methods listed above. In the case of MET, the agonist-contract (AC) technique is most often tested. Undoubtedly fewer articles relate to the contract-relax-agonist-contract (CRAC) technique (used in the present study) which, in addition to activating agonist muscle, also uses the work of the antagonistic muscle group. This type of technique uses both postisometric relaxation, as in the case of the AC technique, and in addition the mechanism of reciprocal inhibition. There are no scientific papers that would assess the impact of CRAC on soft tissue biophysical parameters. Research related to assessing the effectiveness of trigger point therapy most often concerns the technique of ischaemic compression (IC). Undoubtedly, less research focuses on positional release (PR), where, in addition to the pressure of the trigger point occurrence area, the shortening of the muscle undergoing therapy is applied by bringing its attachments closer together. There are no scientific papers describing the impact of PR technique on the biophysical parameters of the trapezius muscle. There are also no reports in the scientific literature on the impact of the combination of MET and TPT in the context of changes in the biophysical parameters (muscle tone, stiffness and elasticity) of the trapezius muscle in the group of young asymptomatic people diagnosed with occurrence of a latent trigger point.
The study showed clear changes in biophysical parameters of soft tissues due to the use of MET + TPT combined therapy. A significant reduction in muscle tone (F) was noted for the upper right trapezius ($p < 0.001$). The stiffness (S) of the soft tissues examined significantly decreased in the right muscle area ($p < 0.001$). Elasticity (D) increased in the right ($p < 0.001$) and left ($p < 0.05$) upper trapezius. In the case of the other two research groups (MET, TPT), significant changes in the biophysical parameters of the upper trapezius were also noted mainly on the right side. The intergroup analysis showed no differences between all the therapies studied. Nakamura *et al*. (21) believe that stretching techniques that reduce the soft tissue stiffness parameter also increase the range of motion in an adjacent joint. The MET affects the stretching of soft tissue myofascial anatomical structures. It is believed that neurological and biomechanical mechanisms, such as hypoalgesia, motor programming and control, reflex muscle relaxation, viscoelastic and plastic tissue property, autonomic-mediated change in extracellular fluid dynamics and fibroblast mechanotransduction, play a key role here (1). Subject experts believe that the occurrence of trigger points may increase the stiffness of adjacent soft tissues (22). The effect of TPT on the biophysical parameters of the upper trapezius is probably possible due to the lengthening of the sarcomeres of muscle fibres subjected to the compression technique and the improvement of local tissue circulation, which may be disturbed due to the trigger point (1). The largest statistical changes in the intra-group analysis were recorded in the group that received the combined therapy. This effect may result from the benefits given by these two (completely different from each other) methods carried out together. In the scientific literature there are only a few research papers assessing the impact of the therapies we have studied on the biophysical parameters of soft tissues. No scientific work has been found investigating the effects of the proposed combined

Table III. Significance of differences between measurements before (Pre), after (Post) and 1 day after therapy (Follow-up) of biophysical features of soft tissues of the upper trapezius muscle (muscle tone-F; stiffness-S; elasticity-D) calculated by Student's t-test averages against a constant reference value.

Variable	MET+TP				MET				TP			
	N	X	SD	p	N	X	SD	p	N	X	SD	p
Muscle tone (F) - right trapezius muscle												
Post – Pre	20	- 0.58	0.49	0.0000**	20	- 0.42	0.68	0.0119*	20	- 0.40	0.24	0.0000 **
Follow-up – Pre	19	- 0.39	0.84	0.0555	20	- 0.22	0.43	0.0295	20	- 0.21	0.18	0.0001 **
Follow-up – Post	19	0.21	0.69	0.2107	20	0.20	0.57	0.1395	20	0.20	0.24	0.0016 **
Stiffness (S) - right trapezius muscle												
Post – Pre	20	- 16.91	16.43	0.0002**	20	-11.74	19.26	0.0134 *	20	- 12.65	8.20	0.0000 **
Follow-up – Pre	19	- 8.54	15.97	0.0317	20	- 5.03	21.45	0.3076	20	- 3.20	18.89	0.4580
Follow-up – Post	19	8.84	16.71	0.0333	20	6.72	25.85	0.2598	20	9.45	20.09	0.0490
Elasticity (D) - right trapezius muscle												
Post – Pre	20	0.05	0.04	0.0000**	20	0.03	0.07	0.0391	20	0.02	0.08	0.2057
Follow-up – Pre	19	0.03	0.11	0.2446	20	0.01	0.09	0.6264	20	- 0.01	0.11	0.8082
Follow-up – Post	19	-0.03	0.11	0.3046	20	- 0.02	0.09	0.2441	20	- 0.03	0.09	0.1877
Muscle tone (F) - left trapezius muscle												
Post – Pre	20	- 0.34	0.64	0.0285	20	- 0.26	0.68	0.0997	20	- 0.26	0.31	0.0014 **
Follow-up – Pre	19	- 0.31	0.56	0.0290	20	- 0.19	0.76	0.2746	20	- 0.12	0.29	0.0828
Follow-up – Post	19	0.09	0.46	0.3961	20	0.07	0.70	0.6608	20	0.14	0.30	0.0480
Stiffness (S) - left trapezius muscle												
Post – Pre	20	- 9.85	15.89	0.0121*	20	- 8.33	22.77	0.1184	20	- 8.00	19.22	0.0783
Follow-up – Pre	19	- 5.66	7.78	0.0053*	20	- 6.60	23.39	0.2224	20	- 5.35	32.39	0.4691
Follow-up – Post	19	3.77	15.28	0.2970	20	1.73	24.94	0.7599	20	2.65	34.57	0.7355
Elasticity (D) - left trapezius muscle												
Post – Pre	20	0.06	0.09	0.0075*	20	0.01	0.13	0.6257	20	0.04	0.11	0.1478
Follow-up – Pre	19	0.00	0.05	1.0000	20	0.01	0.09	0.8036	20	0.01	0.21	0.8977
Follow-up – Post	19	- 0.06	0.10	0.0098*	20	- 0.01	0.12	0.7332	20	- 0.03	0.21	0.5322

(Post – Pre)- difference in the values of soft tissue features (muscle tone-F; stiffness-S; elasticity-D) between the measurements taken immediately after the therapy (Post) and the measurements made before the therapy (Pre); (Follow-up–Pre)-difference in the values of soft tissue features (muscle tone-F; stiffness-S; elasticity-D) between the measurement taken 1 day after therapy (Follow-up) and the measurement performed before the therapy (Pre); (Follow-up–Post)-difference in the values of soft tissue features (tonus-F; stiffness-S; elasticity-D) between the measurement taken 1 day after therapy (Post) and the measurement taken immediately after therapy (Post); X-mean difference of two measurements; SD-standard deviation of this difference; p-test probability; ** significant differences at $p \leq 0.01$ after the Bonferroni correction; *significant differences at $p \leq 0.05$ after the Bonferroni correction.

MET + TPT therapy in the context of muscle tone, stiffness and elasticity changes within the upper part of the trapezius muscle.

Kisilewicz *et al*. (23) in 2018 examined the effectiveness of ischaemic compression treatment on the biophysical parameters of the trapezius muscle in a group of 12 professional basketball players. There was a significant ($p < 0.05$) decrease in stiffness parameter by 11, 8% in the area of the upper trapezius muscle, due to the application of one treatment. This indicator did not change in the area of the transverse and lower parts of this muscle. The authors conclude that this could be due to the sport being trained, which forces excessive activation of the upper muscle, combined with a reduced motor control of the lower parts (23). In our study, we noted a stiffness reduction in the upper right trapezius by 6.4% ($p < 0.001$) and the left by 3.8% ($p < 0.05$), as a result of combined MET + TPT therapy. In the case of groups that received single TPT or single MET methods, the change in this indicator was smaller, but also statistically significant on the right side. The differences between the described studies may result from different research groups. Kisilewicz *et al*. (23) examined a group of professional athletes who were subjected to specific loads during sports training. In our study, the research group was made up of young, sports-active people, but they were not professional athletes. It should also be noted that Kisilewicz *et al*. (23) used TPT in the form of ischaemic compression, while in our study we used another variation – positional release. These important facts may have affected the differences in results obtained. Kisilewicz *et al*. (23) did not investigate the other biophysical parameters of the trapezius muscle, such as muscle tone and elasticity.

Kisilewicz *et al*. (24) in 2018 published another paper describing changes in the stiffness parameter as a result of MET application (AC technique). The research group consisted of 18 athletes practising various sports. The study aimed to assess changes in calf-muscle stiffness after eccentric exercise, followed by one MET treatment. As a result of the eccentric effort applied, the calf muscle stiffness in the right ($p < 0.001$) and left limb ($p < 0.05$) increased significantly. MET application caused a significant decrease ($p < 0.001$) in this variable (24). In the study we conducted, there was a significant reduction ($p < 0.001$) in stiffness due to the application of combined therapy in the area of the right side of the upper trapezius. In the case of the left side of the muscle, this indicator also decreased, but at the significance level $p < 0.05$. A similar but slightly smaller effect was noticed in the group to which single MET therapy was applied. Kisilewicz *et al*. (24) performed MET only on the right calf of all subjects. We do not know whether their effect would be identical on the other leg. The results of our study suggest that there may be differences in changes in stiffness due to the application of the described therapeutic methods, depending on the dominant side. Kisilewicz *et al*. (24) applied MET after the previous eccentric training. In our experiment, the tested persons were not subjected to any additional loads. Despite these differences, both studies support the use of MET to reduce muscle stiffness. The results of our study suggest that MET can be combined with other methods to improve muscle biophysical parameters, such as muscle tone, stiffness and elasticity.

There are reports in the scientific literature on combining therapeutic methods (25, 26). Yeganeh Lari *et al*. (25), in their work on the effectiveness of the combination of MET with dry needling, concluded that the best therapeutic effect occurred with combined therapy. There has been an increase in the range of motion towards contralateral lateral flexion and a decrease in the level of perceived pain. The authors of the study emphasize the benefits of combining therapies with separate therapeutic foundations (25).

Ellythy (26) reports similar conclusions in the article on the assessment of two types of combinations of therapeutic methods. The first of these is a combination of MET with a special physiotherapy programme. The second is a combination of myofascial release together with a special physiotherapy programme. Based on the results obtained, Ellythy concludes that the functional integration of specific manipulation techniques effectively reduces pain and functional disability in patients with chronic low back pain (26).

The main limitations of this research include the duration of the therapy itself. The aim of the study was to assess whether one treatment of combined therapy will change the biophysical parameters of the upper trapezius muscle and to compare the effects of three applied therapies (MET + TPT, MET, TPT). Performing only one treatment could make small changes in the tested parameters impossible to capture. The use of several treatments would probably give a more significant effect and allow for the differentiation of the methods used. The addition of a control group (*e.g.*, placebo or sham therapy) could also provide important data, although it would not be easy to do. When designing a future study, researchers should carefully consider what the therapy should look like in this type of control group, so that it does not affect the parameters studied and at the same time gives the impression of reliability for the participants. The authors of this manuscript suggest that future studies should be performed on groups of patients with dysfunctions of the musculoskeletal system and take into account the longer duration of therapy.

CONCLUSIONS

The results of the conducted research allow the following conclusions to be formulated:

Each of the performed therapies resulted in a reduction of muscle tone and stiffness of both the right and left trapezius muscles and an increase in the elasticity of both muscles. However, a significant change in all studied myotonometric variables concerned only the right trapezius after the combination of MET and TPT. The effect of the conducted therapies on changes in biophysical parameters of the trapezius muscle depended on the lateralization of the upper body of the subjects. Right-handed changes in these parameters were greater, which probably resulted from more frequent activation of the right side of the shoulder girdle in these people. No significant differences were found between the compared therapeutic methods for the studied soft tissue biophysical parameters of the upper trapezius muscle.

Among the compared therapeutic methods, the one-time combined method MET + TPT proved to be the most effective, as it caused changes in all tested biophysical parameters that persisted until the next day. The advantage of combined MET+TPT therapy may result from the benefits of combining methods with different therapeutic foundations.

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CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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