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Impact of acupuncture dry needle versus progressive pressure technique on pain severity and pressure pain threshold in patients with lower back myofascial pain syndrome: A randomized clinical trial

Wpływ suchego igłowania i progresywnego ucisku na nasilenie bólu i próg bólu uciskowego u pacjentów z zespołem bólu mięśniowo-powięziowego dolnej części pleców: randomizowane badanie kliniczne

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Abstract

Background. Chronic lower back pain contributes to the global disability burden, and continues to be a factor in the number of years spent disabled; Myofascial pain syndrome (MPS) is an inflammatory condition that may cause chronic localized pain and stiffness. Repetitive movements and incorrect posturing habits contribute to MPS advancement by formation of trigger points (TrPs) on the muscles.
Purpose. To investigate the impact of acupuncture dry needle versus progressive pressure technique on pain severity and pressure pain threshold (PPT) in patients with lower back MPS.
Methods. A randomized clinical trial. Thirty patients suffering from lower back MPS with the presence of TrPs on iliocostalis lumborum, quadratus lumborum, piriformis, and gluteus medius muscles were divided into two equal groups. Group (A) received acupuncture dry needle over TrPs followed by stretching exercise for 2 weeks (n = 15), and group (B) received progressive pressure technique over the same TrPs followed by stretching exercise for 2 weeks (n = 15). Pain severity and PPT at the TrPs were evaluated before and after treatment.
Results. There were statistically significant improvements in pain severity and PPT at the TrPs of the four muscles within both groups ($p < 0.05$), except the PPT at iliocostalis lumborum that showed a non-significant difference within group (A) ($p > 0.05$). Comparing both groups pre- and post-treatment showed statistically non-significant differences in all outcome measures ($p > 0.05$).
Conclusion. Both acupuncture dry needle and progressive pressure technique were effective in reducing pain severity and increasing PPT in patients with lower back MPS.

Keywords

acupuncture dry needle, progressive pressure technique, pain severity, pressure pain threshold, myofascial pain syndrome

Streszczenie

Informacje wprowadzające. Przewlekły ból dolnej części pleców przyczynia się do ogólnego obciążenia niepełnosprawnością i jest czynnikiem wpływającym na liczbę lat spędzonych z niepełnosprawnością; Zespół bólu mięśniowo-powięziowego (MPS) to stan zapalny, który może powodować przewlekły ból i sztywność. Powtarzające się ruchy i nieprawidłowe nawyki postawy przyczyniają się do postępu zespołu MPS poprzez powstawanie punktów spustowych (TrPs) na mięśniach.
Cel. Zbadanie wpływu suchego igłowania i progresywnego ucisku na nasilenie bólu i próg bólu uciskowego (PPT) u pacjentów z zespołem MPS w dolnej części pleców.
Metody. Randomizowane badanie kliniczne. Trzydziestu pacjentów cierpiących na MPS dolnej części pleców z wyczuwalnymi punktami spustowymi na mięśniu biodrowo-lędźwiowym, czworobocznym lędźwi, gruszkowatym i pośladkowym podzielono na dwie równe grupy. Grupa (A) była poddawana suchemu igłowaniu punktów spustowych, a następnie wykonywała ćwiczenia rozciągające przez 2 tygodnie (n=15), a grupa (B) była poddawana progresywnemu uciskowi tych samych punktów spustowych, a następnie wykonywała ćwiczenia rozciągające przez 2 tygodnie (n=15). Nasilenie bólu i PPT w punktach spustowych oceniano przed i po leczeniu.
Wyniki. Wystąpiła statystycznie istotna poprawa w zakresie nasilenia bólu i PPT w punktach spustowych czterech mięśni w obu grupach ($p < 0,05$), z wyjątkiem PPT na mięśniu biodrowo- lędźwiowym, który wykazał nieistotną różnicę w grupie (A) ($p > 0,05$). Porównanie obu grup przed i po leczeniu wykazało statystycznie nieistotne różnice we wszystkich pomiarach wyników ($p > 0,05$).
Wniosek. Zarówno suche igłowanie jak i progresywny ucisk były skuteczne w zmniejszaniu nasilenia bólu i zwiększaniu PPT u pacjentów z MPS w dolnej części pleców.

Słowa kluczowe

suche igłowanie, progresywny ucisk, nasilenie bólu, próg bólu uciskowego, zespół bólu mięśniowo-powięziowego

Introduction

Chronic pain is a major cause of morbidity and has a significant impact on quality of life [1]. Chronic lower back pain (LBP) contributes to the global disability burden and continues to be a factor in the number of years spent disabled [2, 3]. From a global standpoint, it is also regarded as a global public health problem [4].

Myofascial pain syndrome (MPS) is an inflammatory condition that causes recurrent chronic pain in muscles and fascia or associated soft tissues. It can be accompanied by obvious emotional disorders or dysfunction [5-7]. The muscular fascia is a connective tissue in which pathological changes appear under overload. That damage leads to the biomechanical change of muscle contraction force and flexibility [8]. Repetitive movements and incorrect posturing habits contribute to the advancement of MPS by the formation of TrPs on participating muscles [9].

A trigger point is a hypersensitive spot in a taut dense band of skeletal muscle. When stimulated, it causes referred pain and motor phenomena [10]. Depending on their clinical characteristics, TrPs are classified as active or latent. An active TrP causes spontaneous pain enhanced with palpation. The pain pattern is similar to the pain complaint of the patient. Unprompted pain that only appears in the presence of a local stimulus seems to be a latent TrP. It can, however, have repercussions such as limited range of motion (ROM) and muscle weakness [11]. Clinical symptoms related to myofascial TrPs (pain, limitation of ROM, paresthesia, and weakness) occur due to the shortening of muscle fibers and pressure on close-up nerves and adjacent tissues [12]. These symptoms may have a large impact on life quality, health status, and mood [13].

Quadrates lumborum (QL) is one of the many significant causes of LBP [14]. Poor posture and body positioning change the body mechanics that appear in muscle trigger points (MTrPs). There are four potential TrPs in the QL muscle, including upper, lower, middle, or deep. QL MTrPs were seen to be more common in the younger age group, with the highest prevalence, i.e., 48%, in patients 20–30 years of age [12].

The new secondary type of LBP is gluteal syndrome (GS), which was included in the 11th Revision of the International Classification. GS is a good example of nociplastic pain that can imitate sciatica or overlap with real sciatica. It is characterized as a local syndrome of the lower limbs that enhances myofascial pain from one of the three TrPs in gluteal muscles (i.e., gluteus maximus, medius, or minimus) [15].

The most important differential diagnosis of LBP is piriformis syndrome, and it should not be ruled out with proper examination and assessment. Clinicians must consider medical management and conservative management in the initial treatment plan. Conservative management includes physical therapy, steroid injections, botulinum toxin injections, and dry needling, which are all potentially effective [16].

Different therapeutic methods are advocated for TrPs management [17], Kinesio tape and dry needling have more positive effects in terms of pain and disability [18], with needling interventions being the most commonly used [17]. Extracorporeal shock wave therapy [19] and manual therapy interventions are effective for improving ROM in cases with myofascial TrPs. Massage, cupping, and ischemic compression are the most common conventional approaches for treating TrPs [20, 21]. Neuromusculoskeletal pain and movement impairments can be managed with needles that penetrate the skin and stimulate TrPs and muscular tissues [22]. Dry needling utilization by physical therapists in the United States has increased over the last five years. It has been certified by over 4,000 physiotherapists in the United States [23].

The TrPs progressive pressure technique is effective and safe for successfully reducing pain and tenderness [24]. The clinician applies direct digital pressure on each TrP until a state of relief tension is reached and inactivates the TrP [25]. As demonstrated by Holey and Cook [26], stretching complements myofascial TrP pressure release by effectively deactivating a TrP. Stretching is a beneficial intervention to treat chronic MPS. Stretching cervical muscles for 30 seconds was optimal in reducing the negative effects of MPS on the affected nerve roots and central nervous system [27].

Until now, no study compared the effects of acupuncture dry needle versus progressive pressure technique on pain severity and pressure pain threshold in patients with lower back MPS. Thus, this study was conducted to investigate which treatment protocol is more effective.

Subjects and methods

Study Design

The study was designed as an experimental randomized clinical trial. It based on the Helsinki Declaration principles for human research. It was carried out between October 2017 and March 2022.

Participants

Thirty patients (male & female), with an age ranging from 18 to 43 years, were recruited from the out clinic of the Faculty of Physical Therapy, Cairo University, Egypt. They had lower back MPS for 3 months, and MTrPs in iliocostalis lumborum, quadratus lumborum, piriformis, and gluteus medius muscles on any side, with a pain level of 3 cm to 7 cm on visual analog scale (VAS). The diagnosis of MPS was confirmed through both proper history taking and clinical examination. The history identified the areas affected by pain and helped in finding the predisposing factors that led to MPS. In clinical examination, muscles whose TrPs could refer pain in the affected areas were examined; muscles were palpated searching for taut bands, using either flat palpation or pincer palpation; fingers were moved along the taut band to find the hardest and most tender spot (TrP); TrPs were compressed manually and the patient was asked if the spot was tender or painful, and if so the pain resembled his/her usual pain; TrPs were compressed for 5–10 seconds and the patient was asked if there was pain radiating from the TrP. Exclusion criteria were history of previous back surgery, neurologic deficit, current lower extremity symptoms, a cardiopulmonary disease with decreased activity tolerance, rheumatologic conditions, polyarticular osteoarthritis, rheumatoid arthritis, and advanced lumbar degenerative disease, as well as participants taking other treatment, whether physical therapy or medication that might interfere with the results of our study.

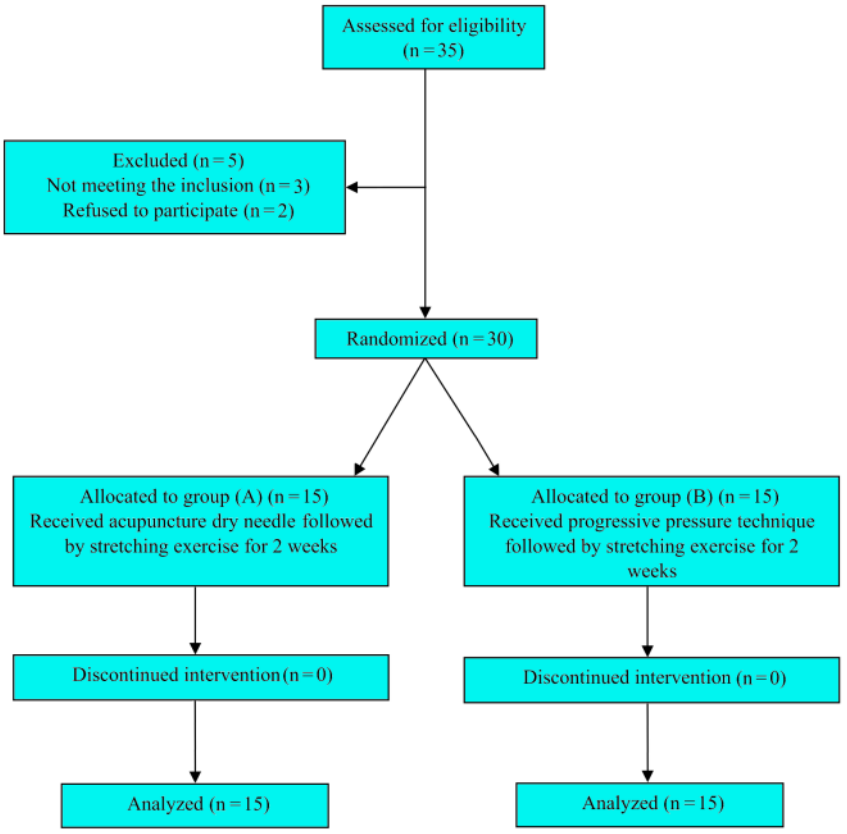

Figure 1. Participant flow diagram

Randomization

Each participant was notified of the nature, purpose, and value of the study, as well as the right to withdraw from it at any time and the confidentiality of all data acquired. After all baseline criteria had been met, the random permuted block method was the way to randomize the participants. They were randomized in our study to ensure that the treatment groups were balanced at the end of every block. Participants were registered in blocks using random number generator software (figure 1). All patients were asked to sign a consent form for ethical issues.

Interventions

Group (A) consisted of 15 patients receiving acupuncture dry needle over TrPs of iliocostalis lumborum, quadratus lumborum, gluteus medius, and piriformis muscles followed by stretching exercise for 2 weeks. Group (B) consisted of 15 patients receiving progressive pressure technique over the same muscles followed by stretching exercise for 2 weeks.

Acupuncture dry needle

Each participant in group (A) received acupuncture dry needle over TrPs in iliocostalis lumborum, quadratus lumborum, gluteus medius, and piriformis muscles, 2 treatment sessions per week, for 2 weeks. Before the application of acupuncture dry needle, a detailed explanation of the procedure to the patient was performed. Possible fear of needling and pain associated with dry needle were in our consideration. The pain associated with needling could be inhibited by activating patients' conditioned pain modulation system, as demonstrated by research [28]. Initially, the TrPs were determined by palpating taut bands in the belly of the iliocostalis lumborum, quadratus lumborum, gluteus medius, and piriformis muscles. Then, dry needling was performed with a solid filiform needle in a tube, 0.30 mm in diameter, 50 and 70 mm long. The filiform needle in its tube was steady with the non-needling hand against the targeted area by using a pincer grip or flat palpation depending on the muscle orientation, location, and direction of needle penetration. In order to draw the needle out, the needling hand gently pulled it from the tube. In order for the needle to penetrate the skin, the top of the needle was tapped or flicked. To achieve deep needling, the needle was directed in the direction of the TrP. Once the needle felt resistance against the TrP, a local twitch response (LTR) was provoked and that was considered fundamental in obtaining a desirable therapeutic effect [29, 30]. The needle was inserted deep enough to fully penetrate the taut band region and then pulled back to the subcutaneous tissue layer but not out of the skin, then the needle was kept in the TrP for seven to ten minutes [31]. Generally, numerous LTRs could be elicited. Discontinuation of a given dry needling procedure might happen as a result of prominent decreased frequency or removal of LTRs, decreased resistance to palpation of the underlying tissue, or patient lack of tolerance of continued needling at that site. Once the needle had come out completely from the skin, pressure (hemostasis) was applied directly to the skin over the insertion site of the needle with an alcohol swab to prevent possible swelling or soreness. The muscle was reassessed by palpation of taut bands and TrPs [32].

Regarding iliocostalis lumborum, TrP was identified via flat palpation from a side-lying position. A needle of 5cm in length was inserted slightly superior to the TrP, perpendicular to the skin, and directed anteromedially for about 30°. Care was taken to avoid penetration of the lung. Regarding quadratus lumborum, the patient was placed in a lying position, with the arm in extension to elevate the rib cage and the leg in extension and adduction to lower the iliac crest. Using a pillow under the sound side to make the space wider where TrPs were identified was easier. Caudal to the 12th rib and anterior to the paraspinal muscle mass, the 7-cm needle was inserted in a parallel direction to the back's plane (in the frontal plane) toward the transverse processes of L2 and L3. Regarding gluteus medius, the patient was in a side-lying position. A needle of 5cm in length was used along the contour of the iliac crest. The muscle was needled perpendicularly with flat palpation. The strong dropping of the subcutaneous tissue was required to minimize the distance from the skin to the muscle. It was common if the needle contacted the periosteum. Precautions were taken to avoid needling the nerves (sciatica- superior gluteal) and deep branch of the superior gluteal vessels. The amount of adipose tissue determined the depth of penetration. Regarding piriformis, the patient was in a side-lying position. The bony landmarks for the greater trochanter and sacrum at S2, S3, and S4 were detected. Then, the needle 5 cm length was inserted perpendicular to the muscle surface directly into the TrP taut band from the sciatic notch toward the pubic symphysis, with taking care to avoid nerve needling [31].

Progressive pressure technique

Each participant in group (B) received progressive pressure technique over TrPs in iliocostalis lumborum, quadratus lumborum, gluteus medius, and piriformis muscles, 2 treatment sessions per week, for 2 weeks. The patient position was side lying for the application of progressive pressure technique over the TrPs in the four muscles. A sustained gentle pressure was applied using the thumb or four fingers for 90-120 seconds moving inward toward the center of the MTrp. Once tissue resistance was felt, pressure was maintained until resistance dissipated (melting away). This cycle was repeated 3 times with a 90-second resting period between each compression. By the end of treatment, relaxation of the tissue was felt or no benefit was achieved [33].

Stretching exercise

Groups (A) received stretching exercise for iliocostalis lumborum, quadratus lumborum, gluteus medius, and piriformis muscles following acupuncture dry needle, while group (B) received the same stretching exercise following progressive pressure technique, 2 sessions per week, for 2 weeks. Concerning iliocostalis lumborum stretching, it was achieved through reaching with the arm to the opposite side from long sitting and trunk flexion. Concerning quadratus lumborum stretching, the patient was in a semi-prone position with one leg in adduction and extension, and the therapist supported the lower thoracic cage and iliac crest while spreading the hands. The therapist could also support the lower thoracic cage and iliac crest with his hands while spreading the hands apart in semi-supine with the leg in adduction and flexion. Concerning gluteus medius stretching, the patient was supine with the treated side in hip flexion and adduction. The patient eased movement using one hand to help hip flexion and the other to assist hip adduction. Concerning piriformis stretching, the patient was supine with the treated side in hip flexion above 90 degrees, adduction, and external rotation. Assurance was on external rotation. The patient eased movement using the hands and the other leg to help hip flexion, adduction and external rotation [34, 35].

Outcome measures

Pain severity assessment

For pain assessment, the VAS was used to evaluate pain severity pre- and post-treatment for both groups (A) and (B). The VAS is a valid, responsive, and frequently used pain outcome measure [36]. The validated subjective measure of chronic and acute pain is the visual analog scale (VAS). The scores were recorded by putting a handwritten mark on a 10-cm line between “no pain” and “worst pain” [37].

Pressure pain threshold (PPT) measurement

The PPT at the TrPs of the iliocostalis lumborum, quadratus lumborum, gluteus medius, and piriformis muscles were measured pre- and post-treatment for both groups (A) and (B), using a pressure algometer (Baseline® Pressure algometer Fabrication Enterprises, Inc. PO Box 1500 White Plains, NY 10602). The pressure algometer has a high degree of validity and reliability in measuring PPT for the diagnosis of MPS in back and trunk muscles [38]. The tip of the algometer was placed precisely on the MTrP region to avoid any difference in readings, the pressure was increased by 1 kg/cm^2 steady and perpendicular to the identified TrPs [39]. Patients were instructed to say "now" when they first began to feel a change of pressure to either discomfort or pain [40]. Pressure thresholds lower than 3 kg were considered to be abnormally low [41].

Statistical analysis

Statistical Package for Social Sciences (SPSS) for Windows, version 20 (SPSS, Inc., Chicago, IL) was used to analyze the data. Prior to final analysis, data were screened for normality assumption, homogeneity of variance, and presence of extreme scores. This exploration was done as a pre-requisite for parametric calculations of the analysis of difference. Results were expressed as mean and standard deviation for baseline and demographic data as well as PPT at the TrPs of the iliocostalis lumborum, quadratus lumborum, gluteus medius, and piriformis muscles, while they were expressed as median for pain severity. In normally distributed data, unpaired t test was used for comparison of different variables between groups, while paired t test was used for comparing "pre" and "post" treatment within the same group for different variables. In non-normally distributed data, unpaired Mann-Whitney test was used for comparison of different variables between groups, while Wilcoxon test was used for comparing "pre" and "post" treatment within the same group. The alpha level was set at 0.05.

Results

There were no statistically significant differences ($p > 0.05$) between subjects in both groups concerning age, body mass, height and all outcome measures at baseline (Tables 1–3).

The pain severity showed a statistically significant reduction ($p < 0.05$) within the two groups (A) and (B). The post-treatment comparison of both groups showed a statistically non-significant difference ($p > 0.05$) (Table 2).

The PPT showed statistically significant increases at the TrPs of the four muscles ($p < 0.05$) within both groups, except the PPT at iliocostalis lumborum that showed a non-significant difference within group (A) ($p > 0.05$). The post-treatment comparison of both groups showed statistically non-significant differences at the TrPs of the four muscles ($p > 0.05$) (Table 3).

Table 1. Physical characteristics of patients in both groups

	Group (A) (n = 15)	Group (B) (n = 15)	P value
Age [years]	29 ± 6.17	25.26 ± 6.30	0.113^{NS}
Body mass [kg]	84.8 ± 11.43	79.2 ± 10.94	0.181^{NS}
Height [cm]	174.06 ± 8.48	172.36 ± 8.39	0.585^{NS}

NS, p > 0.05 = non-significant, p = probability

Table 2. Pain severity for both groups

		Group (A) (n = 15)	Group (B) (n = 15)	P value*
Pain severity	Pre-treatment	6	6	0.964^{NS}
	Post-treatment	3	4	0.549^{NS}
	P value**	0.001^{S}	0.001^{S}	

Data were expressed as median
** Inter-group comparison; ** intra-group comparison of the results pre- and post-treatment*
NS, p > 0.05 = non-significant; S, p < 0.05 = significant; p = probability

Table 3. The PPT at the TrPs of iliocostalis lumborum, quadratus lumborum, gluteus medius, and piriformis muscles for both groups

		Group (A) (n = 15)	Group (B) (n = 15)	P value*
PPT at iliocostalis lumborum [kg/cm^2]	Pre-treatment	3.58 ± 1.68	3.14 ± 1.37	0.521^{NS}
	Post-treatment	4.76 ± 1.58	4.94 ± 1.63	0.804^{NS}
	Improvement%	32.96%	57.32%	
	p value**	0.071^{NS}	0.006^{S}	
PPT at quadratus lumborum [kg/cm^2]	Pre-treatment	2.47 ± 0.75	3.14 ± 1.37	0.866^{NS}
	Post-treatment	4.35 ± 2.3	4.94 ± 1.63	0.687^{NS}
	Improvement%	76.11%	57.32%	
	p value**	0.004^{S}	0.006^{S}	
PPT at gluteus medius [kg/cm^2]	Pre-treatment	3.59 ± 1.13	3.09 ± 0.88	0.253^{NS}
	Post-treatment	5.39 ± 2.42	4.8 ± 1.97	0.531^{NS}
	Improvement%	50.1%	55.3%	
	p value**	0.029^{S}	0.012^{S}	
PPT at piriformis [kg/cm^2]	Pre-treatment	3.15 ± 1.4	2.68 ± 1.2	0.387^{NS}
	Post-treatment	5.56 ± 2.15	4.13 ± 1.9	0.086^{NS}
	Improvement%	76.5%	54.1%	
	p value**	0.002^{S}	0.011^{S}	

Data were expressed as mean and standard deviation
** Inter-group comparison; ** intra-group comparison of the results pre- and post-treatment*

Discussion

To our knowledge, this is the first randomized trial demonstrating the impact of acupuncture dry needling versus progressive pressure technique on pain severity and PPT in patients with lower back MPS.

In the present study, we observed that both acupuncture dry needle and progressive pressure technique followed by stretching exercise were effective in reducing pain severity and increasing PPT in patients with lower back MPS and resulted in similar outcomes after treatment.

Regarding the positive effect of acupuncture dry needle followed by stretching exercise on reducing pain severity and increasing PPT, the results of this study are consistent with a systematic review by Hu et al. [42] that revealed the effects of dry needling for reducing pain and disability for treating LBP. Another meta-analysis included 45 articles by Sánchez-Infante et al. [43] analyzed the effect of dry needling in the short, medium, and long term and the results suggest that dry needling is effective in reducing pain in the short (immediately to 72 hours), medium (1–12 weeks), and long (13–24 weeks) terms. In addition to the effectiveness of dry needling in reducing pain better than other modalities such as transcutaneous electrical nerve stimulation, compression technique, superficial dry needling, conventional rehabilitation, massage, stretching.

The dry needling chemical effect in some studies has demonstrated that enhanced levels of bradykinin, calcitonin gene-related peptide, substance P, and other TrP chemicals are directly corrected by eliciting LTR after dry needling [44].

Regarding the beneficial influence of progressive pressure technique followed by stretching exercise on lowering pain severity and improving PPT, the findings of the current study come in agreement with other studies showing the effects of trigger point release in patients with MPS. Kostopoulos et al. [45] compared the efficacy of ischemic compression, passive stretching, and the combination of ischemic compression and passive stretching for the first time and reported that the combination was the most effective for pain relief. In addition, Lake et al. [46] investigated the efficacy of ischemic compression on 13 patients with 40 myofascial TrPs and observed that ischemic compression was significantly efficient for treatment in comparison with the control group, but the optimal level of ischemic compression was not defined. Moreover, Hanten et al. [47] experimented with the efficacy of the combination of ischemic compression and stretching for patients with MPS on the neck and upper back for 5 days and then the duration of pain sensations in 24 hours. PPT and VAS measured 3 days after treatment were compared with those measured for pre-treatment. Results revealed that a home program, consisting of ischemic pressure and sustained stretching, is effective in reducing TrPs sensitivity and pain intensity in neck and upper back pain. Furthermore, Hou et al. [48] examined various combinations of physiotherapy treatment methods for active upper trapezius trigger points and found that ischemic compression with specific pressure and duration provided immediate pain relief and decreased TrP sensitivity.

Shortened sarcomeres are the main cause of TrP formation and local ischemia at the site of TrPs. Therefore, by the use of progressive pressure technique and stretching in group (B), the shortened sarcomeres will flatten and lengthen. This local stretch reduces the overlapping of actin and myosin and also causes a flush of blood at the area of compression after the pressure is removed. This improves the local circulation and thus reduces the release of noxious, painful substances. All of this leads to inhibiting the TrP activity and reduces the sensitivity of myofascial TrPs [40].

The current study has some limitations. The first limitation is its short duration. As a result, future studies are needed to evaluate the long-term impact of acupuncture dry needling versus progressive pressure technique in patients with lower back MPS. Another limitation is the lack of control group. So, it would be useful for future trials to include a control or placebo group. The third limitation is the lack of the underling mechanisms attributing to these findings. Thus, further research is needed to investigate the effect of acupuncture dry needling versus progressive pressure technique on various TrP chemicals in individuals suffering from lower back MPS. At last, the management of MTrPs is not limited to MTrP inhibition, but it requires correction of aggravation factors that lead to the activate it.

Conclusion

The results of the current study showed significant improvements in pain severity and pressure pain threshold in patients with lower back myofascial pain syndrome. No differences were found between the improvements in both groups. Acupuncture dry needle and progressive pressure technique were equally effective in reducing pain level and increasing pressure pain threshold in the treatment of patients with myofascial back pain.

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