Original Article

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Comparison of the Effects of Kinesio Taping Versus Dry Needling on Pain Intensity, Shoulder range of Motion, and upper Limb Function in Patients with Myofascial Pain Syndrome in the Trapezius Muscle: A Randomized Controlled Trial

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Abstract

Aim: We hypothesized that both dry needling (DN) and Kinesio taping (KT) combined with exercise training would have short-term therapeutic effects. In this context, we aimed to compare the efficacy of DN versus KT combined with exercise training on pain intensity, shoulder range of motion (ROM), and upper limb function in patients with myofascial pain syndrome of the trapezius muscle.

Methods: Fifty participants with myofascial pain syndrome of the trapezius muscle were randomly assigned to three groups; KT combined with exercise training (KTG, n=17), DN combined with exercise training (DNG, n=16), and only exercise training (ExG, n=17). The training duration was for 3 weeks. The Visual Analogue Scale (VAS), universal goniometer, and the Disability of the Arm, Shoulder, and Hand (DASH) questionnaire were used at baseline and after training.

Results: Compared to DNG, VAS-activity (p=0.03; p=0.02) and DASH (p=0.01; p=0.03) scores were significantly decreased in favor of KTG and ExG. Shoulder flexion ROM increased significantly in KTG compared with DNG (p=0.008) and ExG (p=0.008).

Conclusion: Compared to DN, the adjunct of KT to exercise training and exercise training alone have significant effects on reducing pain intensity and improving shoulder ROM and upper extremity functionality in patients with myofascial pain syndrome of the trapezius muscle.

Keywords: Myofascial pain syndrome, range of motion, dry needling, trapezius, visual analog scale

Introduction

Pain in the shoulder area is the third most common reason for musculoskeletal evaluations worldwide (1). Signs and symptoms are usually seen in the shoulder and scapular regions and are characterized by shoulder stiffness and limited range of motion (ROM), often causing limitations in activities of daily living (2). Myofascial trigger points (MTrPs) are defined as hypersensitive points in a taut band of muscle and are characterized by referred pain and motor dysfunction in a taut band or fascia of the muscles (3). It has been shown that patients with pain in the shoulder area have a high number of active and latent MTrPs in their muscles (4). The active MTrP causes clinical complaints of pain, whereas the latent MTrP may have a taut band that increases muscle tension and limits ROM (3).

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Manual techniques (such as trigger point compression or other methods), trigger point stretching, and dry needling (DN) can inactivate MTrPs. However, MTrP inactivation can be combined with exercise training (5). DN and Kinesio taping (KT) are the two most common methods used recently for treating acute illnesses and musculoskeletal problems (6,7). KT is a fairly new technique that has been widely used for therapeutic purposes in various rehabilitation settings (8). It supports muscles, fascia, joints and improves blood circulation and lymphatic drainage by increasing the gap between the skin and soft tissue. As a result, KT increases muscle strength, tone, and ROM and reduces oedema and inflammation. It can also act with proprioceptive and nociceptive stimulations via cutaneous mechanoreceptors. However, DN is recognized as an effective intervention to directly inactivate MTrPs (9) and plays an important role in the treatment of muscle pain caused by MTrPs (10) by targeting trigger and non-trigger point structures (11). It has been shown that DN reduces pain by increasing pressure-pain threshold and increasing ROM, whereas no superiority to placebo was demonstrated in others (12). Choosing the most effective modality among the available treatment options will benefit the patients and shorten the treatment time. The effectiveness of KT and DN methods in MTrP has been investigated in many studies, but which one is superior to the others is still controversial (3,6,7). Given the high prevalence of MTrPs and the lack of consensus on the optimal treatment, we hypothesized that both DN and KT combined with exercise training would have short-term therapeutic effects. However, the expected benefit from DN combined with exercise training may be significantly higher.

Therefore, the current study compared the effects of KT or DN combined with exercise training on pain intensity, shoulder ROM, and upper limb function in patients with myofascial pain syndrome of the trapezius muscle.

Materials and Methods

Compliance with Ethical Standards

The 3-arm randomized controlled trials were conducted at Istanbul University, Department of Sports Medicine, between May 2016 and November 2017. The study was approved by the Clinical Ethics Committee of the University of Health Sciences Turkey, Bakirkoy Dr. Sadi Konuk Training and Research Hospital (decision no: 2014/17/06, date: 15.12.2014) and the study protocol was registered prospectively. Written informed consent was obtained from all participants, and the study was conducted in accordance with the Declaration of Helsinki.

Sample Size

The study sample size was calculated based on the reported effect size of the Disability of the Arm, Shoulder, and Hand (DASH) questionnaire. The GPower software (G*Power version 3.1, Düsseldorf, Germany) was used to determine the sample size (13). Based on a priori power analysis, a power of 0.95, a 5% level of significance (a=0.05), and an effect size of 1.13 (14), a minimum of 14 patients per group were required to achieve significance. A total of 57 participants, by considering patient drop-out during follow-up, were enrolled in the current study.

Participants

Consecutive patients with trapezius myofascial pain syndrome were screened for the inclusion criteria. The inclusion criteria of the study are as follows: a) 18 years or above, b) pain in the shoulder area for at least two months, and c) presence of an active trigger point or area of mechanical hypersensitivity in at least one muscle (upper trapezius, middle trapezius, and supraspinatus) in the shoulder region. Patients who experienced problems such as previous surgery on the shoulder area, shoulder bone fractures, frozen shoulder, shoulder impingement syndrome, and those currently receiving other physiotherapy treatments for shoulder region pain were excluded.

According to the inclusion criteria, 68 patients were screened for the study. Of these, 11 participants didn't meet the study inclusion criteria. The remaining 57 patients were randomly divided into 3 groups, with 19 patients in each group. One patient left the study due to personal reasons, and one patient left due to an allergic reaction to the tape in KTG (n=17). In DNG, one patient was excluded due to needle phobia, and two for not completing the treatment due to personal reasons (DNG, n=16). Two patients in ExG were excluded from the study for not completing the treatment due to personal reasons (ExG, n=17) (Figure 1).

Randomization

Fifty-seven participants were randomly divided into one of three groups (1:1:1) using a validated web-based "Research Randomizer" (https://www.randomizer.org/): KT application combined with exercise (KTG, n=19), DN combined with exercise (DNG, n=19) and the exercise group received only exercise (ExG, n=19) (Figure 1).

Intervention Programs

Exercise Training Group

The exercise training program consisted of Codman exercises, stretching, and strengthening exercises (15). Stretching exercises were applied to the upper trapezius, supraspinatus, and pectoralis muscles for at least ten

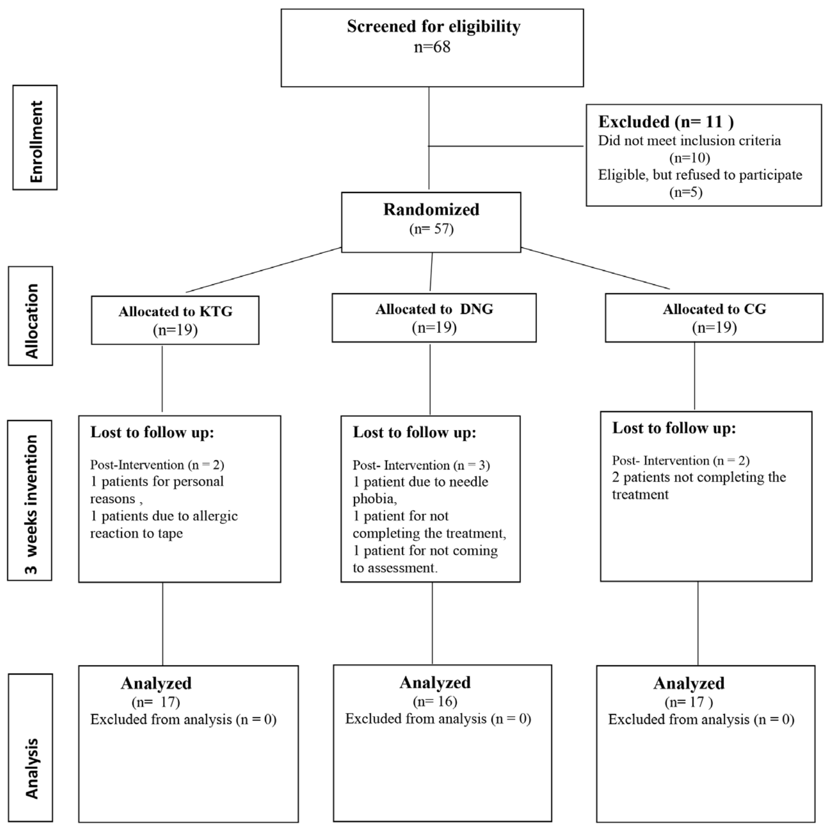

Figure 1. Design of the study.

seconds in a sitting position. Isometric strengthening exercises for the trapezius, supraspinatus, and serratus anterior muscles were applied. The exercise protocol consisted of 3 sets of each exercise, and each set consisted of 10 repetitions performed under the supervision of a physiotherapist. This program was applied to all groups for 45 minutes a day, 5 times a week for 3 weeks.

Kinesio Taping Application Combined with Exercise Training

In addition to the abovementioned exercise program, KT (Ares Tape®) was applied to the upper trapezius, middle trapezius, and supraspinatus in this group. Taping was done by a professional physiotherapist who had received KT training. KT was applied to myofascial pain points in the supraspinatus muscle of 2 patients; the middle trapezius muscle of 3 patients; the supraspinatus and upper trapezius muscles of 8 patients; and the upper trapezius and supraspinatus muscles of 5 patients in the KT combined with the exercise training group (KTG). Before the application of KT, the patient's skin was shaved, wiped with alcohol, and dried. For trapezius muscle MTrPs, star-shaped KT was performed. As shown in Figure 2, four I-strips were cut and applied. Four stripes were fixed to the trapezius muscle, while MTrP was centered at the intersection of these strips. The inhibition technique was applied according to the Kenzo Kase method (stretching it 15-25% of the original length). KT treatment was applied twice a week for 3 weeks (Figure 2).

Dry Needling Combined with Exercise Training

The DN procedure used in this study was applied as specified by Hong (16). In this study, the physiotherapist applied DN to each MTrP in at least two muscles (upper trapezius, middle trapezius, and supraspinatus) in patients with shoulder pain (2,4). Seirin® B type needles with a length of 25-40 mm and a diameter of 0.25 mm were used. Each needle was used once or twice. The DN was applied to myofascial pain points in the supraspinatus muscle of 3 patients; the middle trapezius muscle of 2 patients, the supraspinatus and upper trapezius muscles of 7 patients, and the upper trapezius and supraspinatus muscles of 4 patients in the DN combined with exercise (DNG). The application of DN to each MTrP region took approximately 1-2 minutes (17). In this group, patients received DN in addition to the above-mentioned exercise program for 3 weeks (twice a week periodically).

Table 1. The demographic variables of participants

	KTG (n=17)	DNG (n=16)	ExG (n=17)	p-value
	Mean ± SD or n	Mean ± SD or n	Mean ± SD or n	
Age (years)	47.4±4.1	46.9±4.4	47.3±3.8	0.624[a]
Sex (female/male)	15/3	14/2	16/2	0.121[b]
Height (cm)	167.9±8.1	166.3±8.6	168.1±9.4	0.329[a]
Weight (kg)	75.8±8.9	76.4±9.2	75.3±9.1	0.423[a]
BMI (kg/m²)	25.5±4.2	26.1±3.7	25.9±5.1	0.256[a]

[a]One-Way ANOVA; significance level set at <0.05.
[b]Chi-squared test; significance level set at <0.05.
KTG: Kinesio taping application combined with exercise, DNG: Dry needling combined with exercise, ExG: Only exercise, SD: Standard deviation, BMI: Body mass index

Table 2. Comparison of pain intensity and functionality intra and intergroup

	KTG (n=17)		DNG (n=16)		ExG (n=17)		Intergroup	
	Mean ± SD		Mean ± SD		Mean ± SD		p-value	
	Baseline	End of the intervention	Baseline	End of the intervention	Baseline	End of the intervention	Baseline	End of the intervention
VAS-rest	4.5±2.1	2.9±2.2[a]	4.4±2.8	3.1±1.2[c]	4.8±2.3	3.0±2.4[e]	0.762	0.146
VAS-activity	6.9±2.3	3.2±2.1[a]	6.6±3.1	4.9±1.8[d]	6.5±3.3	3.1±2.2[e]	0.391	0.034*
VAS-night	5.1±3.2	3.9±2.1[a]	4.9±2.7	3.7±2.4[c]	4.9±3.6	3.8±2.5[e]	0.740	0.189
DASH	80.4±22.33	61.9±18.1[b]	82.2±19.3	72.3±13.2[d]	80.5±19.5	63.5±16.9[e]	0.868	0.008**

[a,b]Paired-sample t-test; (p<0.05, p<0.01) indicating the difference between VAS and DASH scores before and after the treatment in KTG.
[c,d]Paired-sample t-test; (p<0.05, p<0.01) indicating the difference between VAS and DASH scores before and after the treatment in DNG.
[e]Paired-sample t-test; (p<0.01) indicating the difference between VAS and DASH scores before and after the treatment in ExG.
*One-Way ANOVA test, Bonferroni correction; indicating that after intervention pain during activity significantly decreased in KTG (p=0.007) and ExG (p=0.011) compared with DNG.
**One-Way ANOVA test, Bonferroni correction; indicating that after intervention DASH scores significantly decreased in KTG (p=0.004) and ExG (p=0.013) compared with DNG.
KT: Kinesio taping application combined with exercise, DN: Dry needling combined with exercise, ExG: Only exercise, VAS: Visual analog scale, DASH: Disabilities of the arm, shoulder and hand, SD: Standard deviation

Table 3. Comparison of shoulder range of motion

	KTG (n=17)		DNG (n=16)		ExG (n=17)		Intergroup	
	Mean ± SD		Mean ± SD		Mean ± SD		p-value	
	Baseline	End of the intervention	Baseline	End of the intervention	Baseline	End of the intervention	Baseline	End of the intervention
Shoulder Flex ROM	154.1±24.8	162.2±23.1[a]	159.5±22.3	165.5±23.1[b]	155.6±23.3	164.6±23.7[c]	0.662	**0.043[d]**
Shoulder Ext ROM	30.3±15.2	31.5±16.3	29.6±12.5	30.5±16.4	30.6±13.7	32.1±12.3	0.391	0.567
Shoulder Abd ROM	119.6±40.3	143.5±36.1[a]	123.4±37.6	131.3±35.1	122.5±32.1	141.8±30.3	0.340	**0.023[e]**
Shoulder Add ROM	45.7±10.1	47.4±13.4	43.4±13.9	44.3±13.5	44.8±11.1	45.9±12.9	0.879	0.567
Shoulder IR ROM	76.5±14.3	77.1±13.2	73.4±17.5	73.9±15.4	74.8±13.5	76.9±14.6	0.521	0.325
Shoulder ER ROMs	75.3±18.5	83.2±16.4[a]	75.2±22.1	77.1±21.5	74.2±19.8	81.4±21.1[c]	0.868	0.012[f]

[a]Paired-Sample t-test; (p<0.05) indicating the difference between before and after the treatment in KTG.
[b]Paired-Sample t-test; (p<0.05) indicating the difference between before and after the treatment in DNG.
[c]Paired-Sample t-test; (p<0.05) indicating the difference between before and after the treatment in ExG.
[d]One-Way ANOVA test, Bonferroni correction; indicating that after intervention, shoulder Flex ROM significantly increased in KTG compared with DNG (p=0.008) and ExG (p=0.008).
[e]One-Way ANOVA test, Bonferroni correction; indicating that after intervention, shoulder Abd ROM significantly increased in KTG (p=0.003) and ExG (p=0.007) compared with DNG.
[f]One-Way ANOVA test, Bonferroni correction; indicating that after intervention, shoulder ER ROM significantly increased in KTG (p=0.008) and ExG (p=0.012) compared with DNG.
KT: Kinesio taping application combined with exercise, DN: Dry needling combined with exercise, ExG: Only exercise, ROM: Range of motion, Flex: Flexion, Ext: Extension, Abd: Abduction, Add: Adduction, IR: Internal rotation, ER: External rotation, SD: Standard deviaiton

Figure 2. Kinesio Tape application

Outcome Measure

Pain Intensity

Patient's pain was evaluated using a visual analog scale (VAS). The patient was asked to describe the pain she/he felt at rest, at activity, and at night. According to VAS, motion, pain and 10-were rated the worst pain (18).

Range of Motion

Active ROM of the patient's shoulder was assessed by a goniometer (Saehan®) in a supine position as described by Clarkson and Gilwich. Measurements were repeated three times in all directions of the shoulder and the average value was recorded (19,20).

Upper Limb Functions

The DASH questionnaire is used to evaluate upper limb functions. The questionnaire consists of 30 items on the disability/symptom scale related to the patient's health status last week. All items have five responses, ranging from "no problem or no symptoms" (1 point score) to "severe symptoms" (5 point score) (21). The Turkish version of the DASH questionnaire was used in the study (22).

Statistical Analysis

The analysis of the study data was performed using SPSS version 24.0. Data are presented as mean ± standard deviation, and frequencies. One-Way ANOVA and chi-square tests were used for intergroup comparisons of demographic and baseline clinical variables. A paired-sample t-test was used to determine the improvement within the groups, whereas a One-Way ANOVA was applied to compare the improvements between the groups. Pairwise post-hoc comparisons were made using Bonferroni's test and the level of significance was determined to be $p<0.017$ (23).

Results

Participants were similar in baseline demographic and clinical variables (Table 1). After the 3-week intervention, patients' VAS and DASH scores significantly reduced within all three groups. The VAS-activity pain score was significantly decreased in favor of KTG (p=0.007) and ExG (p=0.011) compared with DNG (Table 2). The DASH scores significantly decreased in KTG (p=0.004) and ExG (p=0.013) compared with DNG (Table 2).

After the 3-weeks of intervention, shoulder flexion (p=0.02), shoulder abduction (p=0.02), and shoulder external rotation ROM (p=0.04) were significantly improved in the KTG, whereas DNG showed improvement in shoulder flexion ROM only (p=0.02), and ExG showed improvement in shoulder flexion (p=0.03), and shoulder external rotation ROM (p=0.04) compared to baseline. The inter-group comparison revealed that shoulder flexion ROM increased significantly in KTG compared with DNG (p=0.008) and ExG (p=0.008). Whereas shoulder abduction and shoulder external rotation ROM significantly increased in both KTG (shoulder abduction: p=0.003; shoulder external rotation: p=0.008) and ExG (shoulder abduction: p=0.007; shoulder external rotation: p=0.012) compared with DNG (Table 3).

Discussion

The findings of the current study demonstrated that after 3 weeks of intervention, pain intensity and DASH scores decreased significantly in all patients. However, pain intensity during activity and DASH scores were significantly decreased in favor of KTG and ExG compared with DNG. Considering ROM, KTG showed significant improvement in shoulder flexion, external rotation, and abduction ROM, whereas the DNG group showed improvement in shoulder flexion ROM only, and ExG showed improvement in shoulder flexion and external rotation ROM. The shoulder flexion ROM increased significantly in KTG compared to other groups, and shoulder external rotation and abduction ROM significantly increased in KTG and ExG compared to DNG.

Previous studies reported different and sometimes conflicting results due to differences in interventions used (taping technique, target muscle, etc.) and/or methodological differences in study designs. In this study, KT combined with exercise training resulted in an important decrease in pain intensity during activity compared to

DN application, which is consistent with the findings of Shakeri et al. (24). They demonstrated that KT application immediately reduced pain during physical activity and night pain intensity in participants with impingement syndrome compared with placebo KT application. Similarly, Öztürk et al. (25) reported that KT application to the trapezius muscle provided an important progression in pain intensity levels after KT. Delkhoush (26) reported that the use of the DN or inhibitory KT method in subjects with MTrPs of the upper trapezius muscle provided an immediate improvement in pain intensity and functional disability. Similarly, Doğan et al. (27) reported significant progress in resting and cervical motion pain intensity, tenderness pain threshold, cervical ROM, and function in both KT and DN groups, with no relative superiority. The authors suggested that KT could be an option for trigger point inactivation in patients who are afraid of injections or have contraindications for treatments other than KT. In another study, they reported that KT and DN combined with posture and stretching exercises were efficient in improving both VAS pain and tenderness thresholds at the end of the intervention, and the improvements were sustained even two months after the intervention (28). There are several theories that can explain the effect of KT on pain reduction. The most accepted theory is the Gate Control Theory. KT is believed to stimulate the neuromuscular pathway by increasing afferent feedback. Increasing afferent stimulation of large-diameter nerve fibers can reduce the effect of small-diameter nerve fibers that transmit pain (29). The applied KT reduces pain by stimulating the pain relief mechanism descending from the upper centers of the brain (30). One of the other proposed mechanisms is based on the reduction of the pressure on the subcutaneous nociceptors because of the lifting of the skin with KT application (31).

Additionally, applications of DN to shoulder girdle muscles have been increasing recently. Currently, little is known about the mechanism of action of DN. Stimulating the MTrP with a needle can result in increased blood flow and a decrease in nociceptive substances. DN can also stimulate ad fibers and activate inhibitory pain systems (32). De Meulemeester et al. (33) compared the short and long-term therapeutic effects of DN and manual pressure techniques and reported that both DN and manual pressure techniques resulted in similar short- and long-term treatment effects. The possible reason for this might be that all the muscles treated were superficial muscles, and they may not be suitable for either technique. Similar to this study, the DN application was not as effective as KT in our study. The possible reason is that we also applied DN superficial muscles only. Besides, recent studies conducted by Calvo-Lobo et al. (34) showed that the effects of DN on shoulder pain and function differ. We think that the difference in pain and function score results of our study from the similar outcome measurements of these studies is because our patients were relatively young, the number of DN sessions applied in the studies, and the difference in the muscles applied. However, differences between studies may be due to differences in study design, such as taking activated or latent trigger points, and differences in the KT technique. Therefore, KT needs to be performed more frequently compared with DN, which might increase the work load of clinicians. However, it is safer and not as time-consuming as DN.

Previous studies have examined the effect of KT use on outcome measures, and the findings of different studies are conflicting. Kaya et al. (35), reported that DASH scores were significantly lower in the KT group compared to the traditional physiotherapy group. Similarly, Thelen et al. (29) reported that there were no differences between KT and sham taping groups in terms of SPADI scores. According to Yasar et al. (36), KT and DN methods had more positive effects for treating MTrPs in terms of pain and disability than the control group. In another study, KT and DN applied with conventional physical therapy improved VAS pain and daily living activity scores in as little as 4 weeks, providing health benefits to MTrP patients (37). In our study, comparing three different methods, we detected significant differences in DASH scores after all applications, although the difference between groups was significantly decreased in favor of KT and Ex compared to DN. In this regard, we conclude that both KT and Ex applications may provide beneficial effects on upper extremity functions. Unlike DN application, we think this result is due to the tape being available to assist muscles, fascia, and joints in addition to unrestricted ROM.

Previous studies in the literature have reported that KT increases ROM (29,38,39). Thelen et al. (29) reported that the KT group demonstrated progress in pain-free shoulder abduction. In terms of facilitating the movement of the shoulder throughout its ROM, the KT-induced stretching of the skin over the area guides the shoulder in an arc. Improving the movement of the shoulder joint will ease the KT effect. This will reduce mechanical irritation to the soft tissue surrounding the shoulder joint. Şimşek et al. (39) reported that pain during the night and activities was decreased, and shoulder external rotation and abduction ROM were increased after 12 days of KT application. They also emphasized that the KT application was more effective when combined with an exercise program than exercise alone. Another study documented that KT decreased different types of pain, increased ROM, and sense of proprioception more than placebo taping when applied to the quadriceps muscle for patients with knee osteoarthritis

(40). In our study, KT application improved shoulder flexion ROM compared with DN and Ex, and shoulder abduction and shoulder external rotation ROM importantly increased with KT and Ex application compared to DN. As understood from these results, KT combined with exercise is superior to only exercise training and DN application, in addition to exercise, in improving the shoulder ROM. Previous authors reported that a reduction in pain intensity with KT resulted in improvement in shoulder ROM (41).

Study Limitations

The current study has some limitations. Firstly, researchers who performed KT and DN applications and performed measurements were not blind to treatment allocation. Secondly, the duration of treatment applied in our study was only 3 weeks, which was shorter than similar studies in the literature, and there were no long-term results. Another limitation is that no meaningful clinical difference was calculated in the shoulder ROM. The fact that the measurements were made by the same physiotherapist to avoid possible personal measurement differences can be considered the study's strength.

Conclusion

In patients with myofascial pain syndrome of the trapezius muscle, the use of kinesio tape in addition to exercise training and exercise training alone had more effects on decreasing pain severity and improving shoulder ROM and upper extremity functionality compared to dry needling.

Acknowledgments

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Ethics

Ethics Committee Approval: The study was approved by the Clinical Ethics Committee of the University of Health Sciences Turkey, Bakirkoy Dr. Sadi Konuk Training and Research Hospital (decision no: 2014/17/06, date: 15.12.2014).

Informed Consent: Written informed consent was obtained from all participants, and the study was conducted in accordance with the Declaration of Helsinki.

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Authorship Contributions

Surgical and Medical Practices: S.D., O.B.G., G.M., Concept: A.Y., R.M., G.M., Design: A.Y., R.M., S.D., G.M., Data Collection or Processing: A.Y., S.D., O.B.G., Analysis or Interpretation: R.M., S.D., Literature Search: A.Y., R.M., S.D., Writing: A.Y., R.M., S.D., O.B.G., G.M.

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