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Original Article

Effects of Different Taping Techniques in Individuals with Myofascial Pain Syndrome with a Trigger Point in the Trapezius Muscle: A Sham-controlled Randomized Study

Trapezius Kasında Tetik Noktalı Miyofasyal Ağrı Sendromu Olan Bireylerde Farklı Bantlama Tekniklerinin Etkileri

Kubra KARDES[1,2], Pinar VAN DER VEER[1,2], Yunus Emre TUTUNEKEN[1,2], Hale Nur AYKAC[3], Esra ARSLAN[4], Aysenur AKSOY[1], Yasemin BURAN CIRAK[1]

[1]Istinye University Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Istanbul, Turkey
[2]Istanbul University-Cerrahpasa Institute of Graduate Studies, Department of Physiotherapy and Rehabilitation, Istanbul, Turkey
[3]Kocaeli Metropolitan Municipality Belde Inc, Kocaeli, Turkey
[4]Selen Er Wellness Center, Istanbul, Turkey

ABSTRACT

Objective: This study aimed to compare the effects of three different kinesio taping (KT) techniques in individuals with myofascial pain syndrome (MPS) who have a trigger point in the trapezius muscle.

Methods: The individuals included in our study were randomly divided into four groups: Group 1: Functional correlation technique, group 2: Fascia correlation technique, group 3: Star taping technique (STT), and group 4: Sham group. The visual analog scale was used to assess pain, cervical joint range of motion (ROM) with a universal goniometer, grip strength with a hand dynamometer, number of active trigger points by palpation, pressure-pain threshold with an algometer, quality of life with the Nottingham Health Profile and functional level with the Neck Disability index were evaluated before and after treatment.

Results: There was no difference between the groups in terms of demographic data and pre-treatment outcome measures ($p>0.05$). There was a significant difference in the pain score between the groups after treatment ($p<0.05$). A statistically significant difference was found in the cervical flexion ROM of all groups after treatment ($p<0.05$). In pairwise comparisons, these differences were found due to group 3 ($p<0.05$).

Conclusions: The three KT techniques are effective in reducing pain, increasing ROM, reducing the number of active trigger points, and increasing grip strength. Among these techniques, STT was found to be more effective in reducing pain and increasing cervical flexion ROM. KT is a method that can be used in the clinic for patients with MPS.

Keywords: Trapezius, functional correlation technique, fascia correlation technique, star taping technique

ÖZ

Amaç: Çalışma, trapezius kasında tetik noktası bulunan miyofasiyal ağrı sendromlu (MAS) bireylerde 3 farklı kinezyo bantlama (KB) tekniğinin etkilerini karşılaştırmayı amaçlamaktadır.

Yöntemler: Çalışmaya dahil edilen bireyler rastgele 4 gruba ayrıldı; grup 1: fonksiyonel korelasyon tekniği, grup 2: Fasya korelasyon tekniği, grup 3: Yıldız bantlama tekniği (YBT) ve grup 4: Sham grubu. Ağrı düzeyi vizüel analog skala ile, servikal eklem hareket açıklığını (EHA) gonyometre ile, kavrama kuvvetini el dinamometresi ile, palpasyonla aktif tetik nokta sayısını, basınç ağrı eşiğini algometre ile ölçüldü. Yaşam kalitesi Nottingham Sağlık Profili ve fonksiyonellik düzeyi Boyun Engellilik indeksi ile değerlendirildi.

Bulgular: Demografik veriler ve tedavi öncesi parametreler açısından gruplar arasında fark yoktur ($p>0,05$). Tedavi sonrasında gruplar arasında ağrı skorunda anlamlı farklılık olduğu görüldü ($p<0,05$). Tedavi sonrası tüm grupların servikal fleksiyon EHA'sında istatistiksel olarak anlamlı fark bulundu ($p<0,05$). İkili karşılaştırmalarda bu farklılıkların grup 3'e bağlı olduğu görüldü ($p<0,05$).

Sonuçlar: Üç farklı KB tekniği ağrının azaltılmasında, ROM'nin artırılmasında, aktif tetik nokta sayısının azaltılmasında ve kavrama kuvvetinin artırılmasında etkilidir. Bu tekniklerden YBT'nin ağrıyı azaltmada ve servikal fleksiyon hareket açıklığını artırmada daha etkili olduğu görüldü. KB tekniği MAS hastalarında klinikte kullanılabilecek bir yöntemdir.

Anahtar kelimeler: Trapezius, fonksiyonel korelasyon tekniği, fasya korelasyon tekniği, yıldız bantlama tekniği

Address for Correspondence: K. Kardes, Istinye University Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation, Istanbul, Turkey
E-mail: kubra.koce@istinye.edu.tr **ORCID ID:** orcid.org/0000-0003-4166-085X

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INTRODUCTION

Myofascial pain syndrome (MPS) is a musculoskeletal pain condition that originates from localized, tense areas of the skeletal muscle and fascia, called trigger points. MPS is the most common cause of musculoskeletal pain, and its prevalence is reported to be 12-55% in the community[1]. Patients with MPS experience pain, stiffness, tenderness, burning, and squeezing sensation in the muscles. In addition to pain and somatic complaints, depression and anxiety complaints are observed, which negatively affect the patient's quality of life. Physical examinations may reveal trigger points in the muscles. MPS can be divided into acute and chronic forms. Acute MPS often resolves spontaneously or after simple treatments. However, chronic MPS usually has a worse prognosis, and symptoms may persist for 6 months or longer[2].

For treating MPS, trigger points should be inactivated, and normal body mechanics should be corrected as much as possible. Treatment of the trigger point may be the main goal of a rehabilitation program because it can rapidly reduce acute pain. However, it is necessary to determine the factors that cause the formation and persistence of MPS and plan the appropriate treatment. It is important to eliminate the causative factors to prevent the recurrence of trigger points after treatment. The goal is to control pain, restore a limited range of motion (ROM), and return the muscle to its optimal length and position. Preventing the reoccurrence of trigger points is only possible by controlling the causative factors, changing the lifestyle, and taking biopsychosocial approaches. One of the treatment methods used in MPS is kinesio taping (KT)[3].

KT is a frequently used therapeutic tool in numerous preventative and rehabilitation protocols because it is non-invasive, painless, takes less time, and has fewer side effects[4]. KT is a latex-free elastic-cotton adhesive tape that can be applied to any joint or muscle[5]. It differs from other stiff tapes because of its much greater stretch capacity (130-140% of its original length), which frees up mechanical movement restrictions and simulates the thickness and flexibility of the skin. It lowers local pressure, improves circulation, and lessens discomfort, thus gaining popularity among clinicians[6]. It has been demonstrated to be successful in lowering pain and muscular spasms, enhancing ROM, enhancing local blood and lymph circulation, lowering edema, strengthening weak muscles, managing joint instability, and maintaining postural alignment[7]. Although the precise mechanism of KT is unknown, the underlying mechanisms have been identified as sensorimotor, proprioceptive feedback mechanisms, inhibitory and excitatory nociceptive inputs, and mechanical constraints[8].

KT can be applied with different shapes and techniques depending on the shape and size of the application area and the purpose of the application[9]. Application techniques include muscle technique, functional correction technique, fascia correction technique, star technique (circulation/lymphatic correction technique), ligament/tendon correction (ligament) technique, mechanical correction technique, and neural technique[10]. The functional correction technique, which is a technique we used in the present study, lifts the skin, fascia, and soft tissue. In this way, it allows the pressure under the application area to decrease, and the decrease in pressure reduces the irritation in the chemical receptors and nociceptors. In addition, it increases lymphatic and blood circulation, allowing a more efficient exudate removal. Thus, this technique provides pain relief[10]. The fascia correction technique, which is another technique we used in our study, brings the fascial tissue to the desired position. The main goal here is to reduce tension and adhesions by making vibration (oscillation) movement between the fascia layers[9]. Another technique we will use in our study is the star technique. This technique is aimed at reducing the pressure on the lymphatic vessels and creating a gap that allows circulation in the tissue[10].

In the literature, there are inconsistent findings regarding the efficacy of KT, and high-quality studies are required to assess its efficacy. Because the trapezius muscle is a trigger point for MPS, the goal of our study was to compare the benefits of three distinct taping techniques [functional correlation technique (FUCT), fascia correlation technique (FACT), and star taping technique (STT)] in patients with MPS.

MATERIALS and METHODS

This prospective, randomized, and controlled study was conducted at the Istinye University Physiotherapy and Rehabilitation Application and Research Center between April 2023 and June 2023. The clinical trial number of our study is NCT05879016. Ethical approval was obtained from the Istinye University Human Research Ethics Committee on May 31, 2021, with a 21-38 protocol number and conducted according to the Declaration of Helsinki, the guidelines for Good Clinical Practice. All participants were informed about the study, and their informed consent was obtained.

Participants

Sixty-four participants who matched the inclusion criteria for our study and were between the ages of 18

and 30 formed the participant pool. The study inclusion criteria were pain in the trapezius region, a tension band in the area, at least one active trigger point in the tension band, and increased pain when the trigger point was compressed. Any musculoskeletal disorder, particularly those affecting the spine and upper extremities (cervical discopathy, cervical spondylosis, pathologies affecting the shoulder joint and surrounding soft tissues, scoliosis, kyphosis, leg length discrepancy, developmental hip dysplasia, etc.), major surgery or trauma, neuromuscular disease, active rheumatic disease, ischemic disease (diabetes, hypothyroidism, infection, malignancy, etc.), serious psychological issues (a score of 30 or more from the Beck Depression inventory), obesity (body mass index >30 kg/m^2), and patients with KT allergy were excluded from the study.

Participants were divided into 4 groups, group 1: FUCT, group 2: FACT, group 3: STT, and group 4: Sham group, using a computer-aided randomization program. Although one patient from the FACT group and two patients from the STT and Sham groups were invited to the study, they did not participate and were dropped from the trial (Figure 1).

Outcome Measurements

Demographic data were recorded in the sociodemographic form prepared by the researcher before the study. The outcome measurements were repeated by the same researcher before and 30 minutes (min) after the intervention for all individuals participating in the study. All outcome measurements were made before and 30 min after the application, in

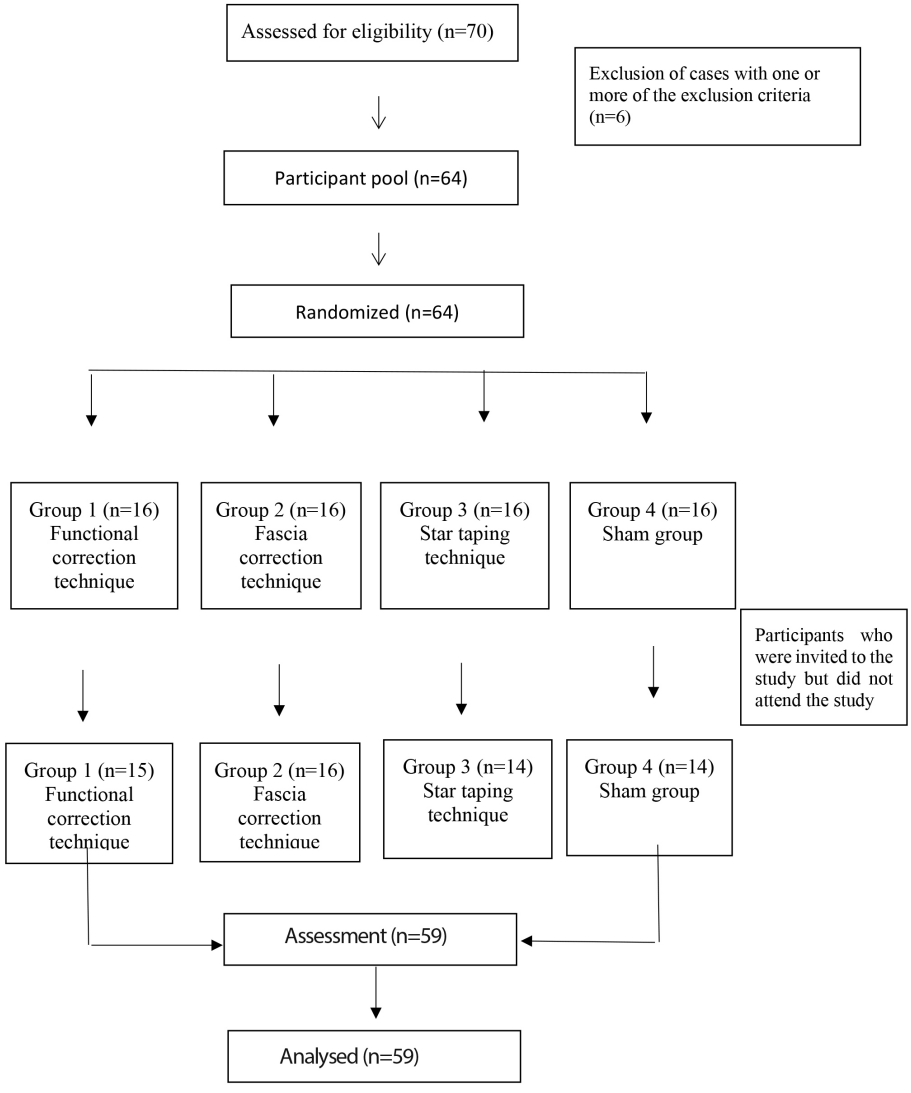

Figure 1. Flow diagram of study.

the same order, by a researcher who was experienced in using assessment tools and blinded to the intervention method.

Sociodemographic form: This form included demographic information such as age, height, weight, marital status, educational status, occupation, and working time. The duration, localization, type of pain, factors that reduce and increase pain, pharmacological and non-pharmacological treatment approaches for MPS, concomitant diseases, trauma and operation history, dominant hand, smoking, and alcohol habits were questioned.

Visual analogue scale (VAS): This is a straightforward, accurate, and repeatable technique used to assess pain intensity. A horizontal or vertical line that is 10 cm long, with the line's beginning and end points, stands for no discomfort and the worst possible suffering, respectively. The patient is asked to identify the place on the line where his pain is the most severe, and the point is measured in centimeters[11].

ROM: Cervical region flexion, extension, lateral flexion, and rotation ROM were evaluated using a universal goniometer.

Hand grip strength: The maximum isometric contraction strength of the hand and forearm muscles was measured bilaterally using a hand dynamometer.

Pressure pain threshold (PPT): The PPT felt by the individuals was measured using an algometer. Algometry is used in many musculoskeletal diseases to evaluate pain and determine therapeutic effects[12].

Number of active trigger points: Upper trapezius fibers were evaluated for the number of trigger points by manual palpation.

Nottingham Health Profile (NHP): The NHP, which has been translated into several languages, was created in England in 1985 to assess a person's health-related quality of life[13]. The NHP is a general quality of life questionnaire that evaluates a person's health issues and the degree to which those issues interfere with their day-to-day activities. Its Turkish validity and reliability were examined in 2000 in osteoarthritis patients by Kücükdeveci et al.[14] There are 38 items in total on the NHP with 6 subheadings. Energy (3 items), social isolation (5 items), pain (8 items), sleep (5 items), physical activity (8 items), and emotional reactions (9 items) were the subheadings that were categorized. Scores for each subsection range from 0 to 100. A high total score indicates poor health status[14].

Neck Disability index (NDI): To assess patients with neck pain's everyday activities, Vernon and Mior released the NDI, which was adapted from the Oswestry Low Back Pain Disability questionnaire. The NDI scale is the oldest, most used, and widely translated scale in the world to assess disability caused by non-specific mechanical neck pain. It consists of ten sections with a 6-point Likert scale ranging from 0 (no disability) to 5 (full disability) for each item. The Turkish validity and reliability of NDI were performed by Kesiktas et al.[15].

KT Application Procedure

KT applications were performed in a single session by a certified researcher with at least 2 years of experience in the techniques. At the end of the applications, it was questioned whether there were any adverse effects related to the techniques.

Group 1-FUCT: A single I-shaped tape was used for this technique. The patient was positioned to extend the upper trapezius muscle. Taping was performed by applying a moderate (25-35%) degree of stretching to the middle 1/3 of the tape, centered on the trigger point. The ends of the tape were adhered without tension (Figure 2)[16].

Group 2-FACT: I-shaped tape was applied to prevent fascial adhesions. The patient was asked to place the

Figure 2. Functional correction technique (I-shaped, 25-35% tension, extend position).

muscle in a resting position. Taping was performed by applying a moderate (25-35%) degree of stretching to the middle 1/3 of the tape, centered on the trigger point. No tension was applied to the ends of the tape (Figure 3)[16].

Group 3-STT: Four I-shaped tapes of the same length, between 15 and 20 cm, were taped on top of the trigger point. After the first I tape was adhered, the second I tape was adhered at 90 degrees. Then, the 3rd and 4th I bands were adhered at 45 degrees to obtain a star appearance. The tapes were adhered with the patient in the resting position without tension at the ends (Figure 4)[16].

Group 4-Sham group: The I-shaped tape adhered while the patient was in the resting position without applying any tension (Figure 5).

Sample Size Calculation

The sample size was calculated using G*Power (version 3.1) software, which analyzed at least 14 patients for each group, with effect size =0.4, power =80%, and error probability of 0.05. Considering the possibility of patient dropout, a pool of 64 participants, comprising 16 participants for each group, was included[17].

Statistical Analysis

The Windows-based SPSS 22 (Statistical Package for the Social Sciences) program was used for statistical analysis. Mean and standard deviation (X ± SD) for changes determined by measurement. The percentage (%) value was calculated for the values indicated by the count. Data distribution was evaluated using the Kolmogorov-Smirnov test. Because the data were normally distributed

Figure 4. Star taping technique (4 I-shaped, no tension, rest position).

Figure 3. Fascia correction technique (I-shaped, 25-35% tension, rest position).

Figure 5. Sham taping (I-shaped, no tension, rest position).

in the present study, a One-Way ANOVA test was used for the intergroup comparison, and the paired sample t-test was used for the within-group comparison. Results with a p-value of 0.05 were considered statistically significant.

RESULTS

There was no demographic or baseline difference between the groups (p>0.05) (Table 1, 2).

Post-treatment pain scores of all groups decreased statistically significantly (p<0.05). Comparing the groups, there was a statistically significant difference in the pain score (p<0.05). Because of the post-hoc test, it was observed that the difference between the groups was due to the STT group (p<0.05). Statistically significant differences were found in the post-treatment grip strength (left), PPT (right), and active trigger point (right and left) values in the FUCT group compared with the other groups (p<0.05). A statistically significant difference was found in the post-treatment PPT (right and left) and active trigger points (right and left) values in the FACT group in the within-group comparison (p<0.05). A statistically significant difference was found in the post-treatment grip strength (right) and active trigger point (right and left) values in the STT group in the within-group comparison (p<0.05). In the sham group, a statistically significant difference was found only in the values of the active trigger point (right and left) after treatment in the within-group comparison (p<0.05) (Table 3).

A statistically significant difference was found in the cervical flexion ROM of all groups after treatment (p<0.05). In the comparison between the groups, there was a statistically significant difference in cervical flexion ROM (p<0.05). Because of the post-hoc test, it was observed that the difference between the groups was due to the STT group (p<0.05). A statistically significant difference was found in the post-treatment cervical extension, lateral flexion (right), and rotation (right and left) values in the FUCT and FACT groups in the within-group comparison (p<0.05). A statistically significant difference was found in the lateral flexion (right) and rotation (right) values after the treatment in the within-group comparison in the STT group (p<0.05). In the sham group, there was no significant difference after treatment in the within-group comparison (p<0.05) (Table 4).

DISCUSSION

In the present study, we found that different KT techniques applied to the trapezius muscle improve pain, PPT, grip strength, and ROM in patients with MPS.

However, few studies have focused on the impact of various KT procedures on MPS. Currently, KT is extensively used for treating a variety of painful illnesses, sports injuries, and postoperative problems. The basic goals of KT are to increase ROM, decrease discomfort by increasing the area under the skin and soft tissue, and speed up the healing process by enhancing circulation[18].

Table 1. The sociodemographic features of the participants.

		FUCT (n=15) mean ± SD	FACT (n=16) mean ± SD	STT (n=14) mean ± SD	Sham (n=14) mean ± SD	p-value
Age (years)		23.80±3.98	22.13±3.00	22.79±2.94	21.57±2.02	0.248$^{\beta}$
BMI (kg/m^2)		22.61±3.01	22.11±2.97	20.30±6.14	22.99±3.33	0.308$^{\beta}$
Diseases duration (week)		0.66±2.58	1.37±2.96	0.35±0.92	1.07±1.54	0.609$^{\beta}$
Sex, n (%)	Female	13 (86.7)	14 (87.5)	12 (85.7)	13 (92.9)	0.942$^{\beta}$
	Male	2 (13.3)	2 (12.5)	2 (14.3)	1 (7.1)	
Dominant side, n (%)	Left	1 (6.7)	5 (31.3)	2 (14.3)	0 (0.0)	0.069$^{\beta}$
	Right	14 (93.3)	11 (68.8)	12 (85.7)	14 (100.0)	
Education, n (%)	University	12 (80.0)	15 (93.8)	13 (92.9)	13 (92.9)	0.563$^{\beta}$
	Postgraduate	3 (20.0)	1 (6.3)	1 (7.1)	1 (7.1)	
Occupation, n (%)	Student	13 (86.7)	14 (87.5)	13 (92.9)	13 (92.9)	0.769$^{\beta}$
	Retired	1 (6.7)	1 (6.3)	0 (0.0)	0 (0.0)	
	Working	1 (6.7)	1 (6.3)	1 (7.1)	1 (7.1)	

BMI: Body mass index, SD: Standard deviation, FUCT: Functional correction technique, FACT: Fascia correction technique, STT: Star taping technique,*p<0.05, 95% confidence interval, α=0.05. $^{\beta}$ANOVA

Table 2. Comparison of all outcomes taken before treatment between groups.					
	FUCT (n=15) mean ± SD	**FACT (n=16) mean ± SD**	**STT (n=14) mean ± SD**	**Sham (n=14) mean ± SD**	**p-value**
VAS	4.93±1.98	3.62±2.18	5.42±1.45	4.57±1.50	0.058[β]
ROM					
Flex	57.33±5.04	55.31±5.90	57.35±5.04	58.43±5.33	0.533[β]
Ext	45.60±6.13	48.12±3.09	47.64±3.52	49.28±1.81	0.101[β]
ROM-lat. flex					
Right	38.66±2.82	38.18±3.37	37.71±3.72	38.92±2.89	0.779[β]
Left	37.80±3.44	38.50±2.47	37.85±2.82	38.50±3.00	0.848[β]
ROM-rotation					
Right	53.64±2.43	52.50±5.47	53.92±2.89	51.46±4.40	0.465[β]
Left	53.46±2.97	54.06±2.01	53.42±3.03	52.85±3.77	0.688[β]
Grip strength					
Right	23.23±9.15	21.44±9.43	19.68±12.00	20.44±11.77	0.820[β]
Left	17.70±9.48	21.69±9.45	18.82±11.30	30.50±40.50	0.400[β]
PPT					
Right	8.40±2.91	8.18±3.41	8.17±1.74	21.69±52.26	0.418[β]
Left	8.82±2.62	7.33±1.58	8.10±1.53	7.82±1.54	0.189[β]
Active trigger points					
Right	4.00±2.03	3.75±2.54	5.17±1.86	4.45±1.59	0.269[β]
Left	3.53±2.55	4.31±2.79	4.71±2.84	4.85±1.87	0.505[β]
NDI	9.35±5.25	10.68±4.88	10.92±5.59	9.28±4.64	0.745[β]
NHP					
1st part	119.86±63.01	139.38±93.43	148.98±112.55	153.44±118.63	0.800[β]
2nd part	1.93±2.81	1.18±1.51	0.92±1.07	1.35±1.73	0.535[β]

FUCT: Functional correction technique, FACT: Fascia correction technique, STT: Star taping technique, VAS: Visual analog scale, ROM: Range of motion, PPT: Pressure pain threshold, NDI: Neck Disability index, NHP: Nottingham Health Profile, Flex: Flexion, Ex: Extension, Lat.Flex: Lateral flexion, SD: Standard deviation, *p<0.05, 95% confidence interval, α=0.05. [β]ANOVA

By lowering the chemical variables at the trigger site, MPS treatment for KT can reduce pain[18]. A statistically significant decrease in pain was attained immediately following the treatment, according to Wang et al.[19], who examined the acute effect of KT from the origin in MPS to the insertion of the upper trapezius muscle. The control group, however, showed no improvement[19]. A patient with myofascial shoulder discomfort who received KT in a case study by García-Muro et al.[20] with an active ROM noticed a significant improvement in pain, algometry, and functional ratings[20]. Halski et al.[21] examined the effects of cross-taping and KT applied to the latent trigger points of the upper trapezius muscle in a randomized, placebo-controlled research. According to research, KT treatment decreases the subjective perception of pain[21]. Patients were randomly assigned to one of two groups in a trial that included patients with active myofascial trigger points (MTrPs) and taut bands in the upper trapezius. A functional correction approach was used to apply KT to the first group, whereas no tension was administered to the second group receiving sham KT. Because of the study, there was a significant improvement in VAS and algometer levels and trapezius muscle strength even after one month[22]. The results obtained in these studies support our study results.

In a different study, star taping was applied just above the MTrPs in the active intervention group and a few centimeters away from the MTrPs in the control group to assess the immediate and short-term effects of KT application on MTrPs and PPT in the upper trapezius and gastrocnemius muscles. The study's findings suggested that applying KT directly to MTrPs could delay additional sensitization until 24 h after application and avoid a drop in PPT immediately[23]. Similarly, our study found that KT increased the pain threshold for pressure.

Table 3. Comparison of outcomes taken after treatment between groups.

	FUCT (n=15)		Within group	FACT (n=16)		Within group	STT (n=14)		Within group	Sham (n=14)		Within group	Group difference
	Pre	Post	p	Pre	Post	p	Pre	Post	p	Pre	Post	p	p
VAS	4.93±1.98	2.93±1.62	**0.000**$^{\gamma}$	3.62±2.18	2.56±1.54	**0.003**$^{\gamma}$	5.42±1.45	3.35±1.49	**0.000**$^{\gamma}$	4.57±1.50	2.64±1.59	**0.000**$^{\gamma}$	**0.024**$^{\beta}$
Grip strength													
Right	23.23±9.15	23.41±10.16	0.848$^{\gamma}$	21.44±9.43	22.72±10.88	0.212$^{\gamma}$	19.68±12.00	20.85±12.22	0.240$^{\gamma}$	20.44±11.77	22.06±12.72	0.091$^{\gamma}$	0.942$^{\beta}$
Left	17.70±9.48	19.39±10.08	**0.016**$^{\gamma}$	21.69±9.45	22.49±9.00	0.237$^{\gamma}$	18.82±11.30	20.66±11.78	**0.028**$^{\gamma}$	30.50±40.50	23.76±14.44	0.564$^{\gamma}$	0.745$^{\beta}$
PPT													
Right	8.40±2.91	9.37±3.39	**0.011**$^{\gamma}$	8.18±3.41	9.17±4.06	**0.002**$^{\gamma}$	8.17±1.74	8.43±1.85	0.451$^{\gamma}$	21.69±52.26	8.91±1.92	0.358$^{\gamma}$	0.853$^{\beta}$
Left	8.82±2.62	8.98±1.92	0.654$^{\gamma}$	7.33±1.58	8.26±2.29	**0.005**$^{\gamma}$	8.10±1.53	8.88±1.76	0.118$^{\gamma}$	7.82±1.54	11.00±7.92	0.126$^{\gamma}$	0.341$^{\beta}$
ATP													
Right	4.00±2.03	2.00±1.25	**0.000**$^{\gamma}$	3.75±2.54	2.00±1.67	**0.002**$^{\gamma}$	5.17±1.86	2.67±1.55	**0.000**$^{\gamma}$	4.45±1.59	2.14±1.35	**0.000**$^{\gamma}$	0.507$^{\beta}$
Left	3.53±2.55	1.86±1.40	**0.007**$^{\gamma}$	4.31±2.79	2.25±1.65	**0.001**$^{\gamma}$	4.71±2.84	2.85±1.79	**0.006**$^{\gamma}$	4.85±1.87	2.28±1.38	**0.000**$^{\gamma}$	0.670$^{\beta}$
NDI	9.35±5.25	9.28±5.31	0.336$^{\gamma}$	10.68±4.88	10.37±4.80	0.173$^{\gamma}$	10.92±5.59	10.71±5.75	0.189$^{\gamma}$	9.28±4.64	9.07±4.32	0.336$^{\gamma}$	0.782$^{\beta}$
NHP													
1st part	119.86±63.01	107.69±98±72	0.336$^{\gamma}$	139.38±93.43	135.88±94.48	0.078$^{\gamma}$	148.98±112.55	145.18±113.33	0.097$^{\gamma}$	153.44±118.63	145.18±113.33	0.336$^{\gamma}$	0.488$^{\beta}$
2nd part	1.93±2.81	1.86±1.81	0.506$^{\gamma}$	1.18±1.51	0.55±0.51	0.165$^{\gamma}$	1.92±1.07	0.89±1.00	0.723$^{\gamma}$	1.35±1.73	0.92±1.07	0.623$^{\gamma}$	0.535$^{\beta}$

FUCT: Functional correction technique, FACT: Fascia correction technique, STT: Star taping technique, VAS: Visual analog scale, PPT: Pressure pain threshold, ATP: Active trigger points, NDI: Neck Disability ındex, NHP: Nottingham Health Profile, R: Right, L: Left, SD: Standard deviation, *p<0.05, 95% confidence interval, α=0.05. $^{\beta}$ANOVA. $^{\gamma}$Paired sample t-test

Table 4. Comparison of range of motion taken after treatment between groups.

	Group 1: FUCT (n=15)		Within group	Group 2: FACT (n=16)		Within group	Group 3: STT (n=14)		Within group	Group 4: Sham (n=14)		Within group	Group difference
	Pre	Post	p	Pre	Post	p	Pre	Post	p	Pre	Post	p	p
ROM (Flex)	57.33±5.04	59.80±5.19	**0.000**$^{\gamma}$	55.31±5.90	58.75±5.62	**0.023**$^{\gamma}$	57.35±5.04	59.21±4.31	**0.000**$^{\gamma}$	58.43±5.33	58.92±4.87	**0.000**$^{\gamma}$	0.945$^{\beta}$
ROM (Ext)	45.60±6.13	47.66±5.30	**0.000**$^{\gamma}$	48.12±3.09	49.68±1.25	**0.003**$^{\gamma}$	47.64±3.52	49.64±1.33	0.097$^{\gamma}$	49.28±1.81	50.28±1.26	0.224$^{\gamma}$	0.211$^{\beta}$
ROM (R lat. flex)	38.66±2.82	39.66±2.28	**0.001**$^{\gamma}$	38.18±3.37	39.68±1.25	**0.000**$^{\gamma}$	37.71±3.72	39.14±1.83	**0.030**$^{\gamma}$	38.92±2.89	40.00±0.00	0.143$^{\gamma}$	0.908$^{\beta}$
ROM (L lat. flex)	37.80±3.44	39.66±1.29	0.421$^{\gamma\gamma}$	38.50±2.47	40.25±2.08	0.309$^{\gamma}$	37.85±2.82	39.78±0.57	0.365$^{\gamma}$	38.50±3.00	39.57±1.60	0.124$^{\gamma}$	0.381$^{\beta}$
ROM (R rot)	53.64±2.43	54.28±1.81	**0.015**$^{\gamma}$	52.50±5.47	53.75±3.87	**0.000**$^{\gamma}$	53.92±2.89	54.28±3.31	**0.000**$^{\gamma}$	51.46±4.40	53.00±2.80	0.123$^{\gamma}$	0.651$^{\beta}$
ROM (L rot)	53.46±2.97	54.33±2.58	**0.000**$^{\gamma}$	54.06±2.01	54.68±1.25	**0.032**$^{\gamma}$	53.42±3.03	55.00±1.96	0.259$^{\gamma}$	52.85±3.77	54.28±1.81	0.264$^{\gamma}$	0.956$^{\beta}$

FUCT: Functional correction technique, FACT: Fascia correction technique, STT: Star taping technique, Flex: Flexion, Ex: Extension, Lat. flex: Lateral flexion, Rot: Rotation, SD: Standard deviation, *p<0.05, 95% confidence interval, α=0.05. $^{\beta}$ANOVA. $^{\gamma}$Paired sample t-test

In our study, bilateral cervical ROMs were measured using a goniometer. A meta-analysis study with the primary outcomes being pain intensity, PPT, and ROM; secondary outcomes being muscular strength and injury status showed that KT can be advised to lessen pain intensity and increase joint ROM[24]. González-Iglesias et al.[8] found an increase in cervical ROM, immediately and 24 h after KT application. Another study compared KT and sham KT groups with additional neck exercises and found that both groups' reductions in PPT, ROM, and limitation showed statistically significant improvements. These findings demonstrate that KT can be employed as a different approach to treating patients with MPS[25].

A hand dynamometer was used in our study to measure the participants' hand grip strength, and it was shown that both the FUCT and STT groups showed a substantial improvement in grip strength. PPT and grip strength were measured in a study comparing the short-term effects of KT (space correction technique) and friction massage on latent trigger points in the upper trapezius muscle. There was no significant difference between the two groups after treatment in terms of PPT or grip strength. Latent trigger points in the upper trapezius respond similarly to friction massage and KT in the near term[26].

Participants' discomfort, physical level, quality of life, and depression levels were assessed in a study contrasting dry needling with KT in MPS. This study concludes that KT is a useful, non-invasive, and painless therapeutic substitute for dry needling for patients with needle fear[27]. A study that treated 71 MPS patients with trigger points in the upper trapezius muscle using two different KT techniques (space correction technique and muscle inhibition technique) assessed patients' NDI, pain, and quality of life with the Short Form-36 at the end of the first, second, and sixth weeks. In the second week, there was an improvement in functional status and quality of life, whereas pain reduced from the first week[28].

A different study demonstrated that KT administered to the trigger point by both skilled and untrained physiotherapists can enhance MPS patients' quality of life, pain, muscular spasms, neck function, and patient satisfaction. However, because there was no sham or placebo group in this trial, the difference could not be analyzed. The placebo effect was underlined in the study on KT restriction[29]. In our study, comparisons with the sham control group were performed in addition to comparisons between various KT procedures. The sham group is applied without tension in the form of an I band, as described in the literature. The sham group used in our study was compatible with the literature[4,30-32].

Although it has been documented in the literature that KT can reduce pain and increase grip strength, ROM, and PPT over the short term, different KT methods cannot be directly compared. The comparison of various KT procedures is the key benefit of our study. Another advantage of our study is the use of objective tools to measure grip strength and PPT.

There are certain limitations of this study. The researchers were not blinded; therefore, the measurements may have been unintentionally biased. In addition, psychological factors and sensory feedback by raising their consciousness may have contributed to the improvement in the sham control group. In addition, the absence of long-term assessments was another limitation of the presented study.

CONCLUSION

The present study results show that all three KT techniques can alleviate pain, PPT, grip strength, and ROM in patients with MPS. Among these techniques, the star technique was found to be more effective in reducing pain and increasing cervical flexion ROM. The KT technique can be used clinically for patients with MPS.

Ethics

Ethics Committee Approval: The clinical trial number of our study is NCT05879016. Ethical approval was taken from the Istinye University Human Research Ethics Committee on May 31, 2021, with a 21-38 protocol number.

Informed Consent: Informed consent was obtained.

Author Contributions

Concept: K.K., Y.B.C., Design: K.K., P.V.D.V., Y.B.C., Data Collection and/or Processing: K.K., Y.E.T., H.N.A., E.A., A.A., Analysis and/or Interpretation: K.K., P.V.D.V., Literature Search: K.K., P.V.D.V., Y.E.T., H.N.A., E.A., A.A., Writing: K.K., P.V.D.V., Y.E.T.

Conflict of Interest: The authors have no conflict of interest to declare.

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