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ORIGINAL RESEARCH

The Effect of Kinesio Tape in Chronic Neck Pain: Randomized Controlled Study

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Abstract
Objective: This study aimed to compare the effects of Kinesio tape and conventional physiotherapy in addition to home exercise in patients with chronic neck pain.
Material-Method: A total of 44 individuals were randomly divided into two groups. Conventional physiotherapy methods were applied to all subjects for 15 sessions. In addition to the study group, Kinesio tape application was performed each session. Pain, pressure pain threshold, range of motion, muscle strength, muscle endurance, pectoralis minor muscle length, disability level, quality of life, and depressive symptoms were evaluated. The first evaluation was conducted prior to the Kinesio tape application, the second was conducted 24 hours after the procedure, and the third was after 15 sessions.
Results: A significant improvement was obtained in depression scores, muscle endurance, and patient satisfaction in favor of the study group (respectively p = 0.021, p=0.029, p= 0.009).
Conclusion: Kinesio tape can be used to increase muscle endurance in the short term. Also, it can be said that Kinesio tape application provides additional benefits to the conventional physiotherapy method in terms of treatment satisfaction.
Keywords: Neck Pain, Kinesio Tape, Pain, Quality of Life

INTRODUCTION

The prevalence of chronic neck pain varies between 12.1% and 71.5%. Especially in developing countries, it is considered an essential public health problem as it causes socioeconomic issues such as loss of labor and disability[1].Chronic neck pain is in the fourth rank among diseases causing disability[2].
The main goal of treatment is to increase joint range of motion (ROM), muscle strength, endurance, and coordination, to ensure independence in activities of daily living, and to improve the quality of life in chronic neck pain. Many different methods have been defined in its treatment. Exercise therapy, which requires the patient's active participation, is the most effective treatment method preferred by physiotherapists[3].Electrotherapy, hot pack-cold pack applications, manual therapy techniques, cervical traction, and neck collar use, which are among passive treatment applications, are applied to reduce inflammation, pain, and muscle spasm secondary to nerve root irritation and to improve functions[4]. In addition to all these treatment options, Kinesio taping technique (KT) has become popular, especially in musculoskeletal problems Kenzo Kase developed the KT, but its use has become more prevalent in recent years[5]. The hypothesis proposed for the effects of KT can be listed as pain inhibition, stimulation of blood circulation, reduction of edema by increasing lymph circulation, correction of joint position by providing muscle relaxation, support, and stability to muscles and joints without limiting the ROM. KT application seems to be preferred in the literature for many musculoskeletal problems such as knee pain, chronic low back pain, neck pain, shoulder pain. Different results of studies conducted with individuals with low back and neck pain in order to reduce pain and increase functionality are included in the literature. While some studies discuss the benefits of KT, other studies show the opposite effects.The number and variety of studies in the literature are insufficient to establish clinical evidence for using KT in patients with neck pain.
Therefore,the aim of the study was to compare the effects of KT and conventional physiotherapy in addition to home exercise in patients with chronic neck pain.

MATERIALS AND METHODS

In our study designed with pretest-posttest control groups in randomized parallel groups, the allocation ratio is 1:1.

Fifty-two individuals who applied to the clinic with complaints of chronic neck pain and fulfilled the inclusion criteria participated in the study. The groups were divided into two groups with online computer randomization software[10]. The physical therapist who generated the random allocation sequence was blind to patients' clinical data. Oral and written information was given to each individual about the study, and their written consent was obtained.

Ethical permission was obtained from the Non-Interventional Research Ethics Committee of Pamukkale University. Also, this study was supported by Pamukkale University Scientific Research Projects Coordination Unit (Date: 03/05/2014/No: 60116787-020/14168). Written informed consent was obtained from each patient, and assessments were carried out according to the Declaration of Helsinki.

The study was carried out between April 2014 and December 2015 at Şifa University Göztepe Hospital Physical Therapy and Rehabilitation department in İzmir. Criteria for inclusion in the study; between the ages of 30-55, neck pain lasting at least three months, pain between the superior nuchal line and spina scapula, a score of at least five on the Neck Disability Index, and being in the first two levels of the Neck Pain Task Force[11].Criteria not included in the study; the presence of conditions that will prevent evaluation or communication (such as cognitive problems), being illiterate, patients with discitis and/or spondylitis and/or spondylolisthesis, having undergone neck, back, or waist region physiotherapy within the previous six months; having undergone cervical region and spine surgery; having impingement or thoracic outlet syndrome; malignancy; having a fracture; having systemic autoimmune diseases; having neurological issues, and having been diagnosed with a mental illness that will prevent evaluation and treatment.

Materials

Age, sex, height, weight, Body mass index (BMI), education level, occupation, marital status, and smoking history of the participants were recorded before the treatment. Pain assessment was made with the evaluation of pain history, pain intensity, and pressure pain threshold. In the evaluation of the pain story, the type, duration, and activities that increase and decrease pain were questioned.

Visual Analogue Scale (VAS) was used to evaluate pain intensity. Pressure pain threshold was evaluated with an objective method, a digital algometer. Jtech Medical Commander Algometer device was used in the evaluation. The participants were asked to report the pressure sensation as soon as they returned to the feeling of pain and the compression applied after the patient notification was terminated. Two measurements were made a 30-second interval was taken between both measures.

Measurements were taken bilaterally from three regions in the prone position: the midpoint of the upper edge of the upper trapezius muscle (the lateral edge of the acromion and the midpoint of the region between the midline), the levator scapula muscle (2 cm above the lower medial edge of the scapula where the levator scapula muscle inserts), suboccipital region (2 cm lateral to the cervical line consisting of spinous processes, just below the occipital region). The results are recorded in Newton / cm^2[12]. Cervical range of motion (CROM) was evaluated with the CROM device. The CROM device measures CROM with three inclinometers and a magnetic amplifier placed on the neck[13,14]. The evaluation was made while the participants were sitting in the chair in an upright position with their arms adjacent to the body. The measurement results of actively performed movements were recorded in degrees[15]. Isometric muscle strengths of the cervical region were evaluated by Hand-Held Dynamometer (HHD). In the evaluation, Jtech Medical Commander Powertrack II Hand-Held Dynamometer device was used, and the result measurements were recorded in Newton. The pectoralis minor muscle shortness of the participants was evaluated with a standard bilateral ruler and the endurance of the deep neck flexor muscles with a chronometer; Muscle shortness was recorded in centimeters, and muscle endurance was recorded in seconds[16].Disability levels of the participants were assessed with the NDI[17,18], quality of life with Nottingham Health Profile (NHP)[19], emotional status with Beck Depression Inventory (BDI)[20,21], and treatment satisfaction with theVAS[22]. All evaluations except treatment satisfaction were conducted prior to the Kinesio tape application, the second was conducted 24 hours after the procedure, and the third was after 15

sessions by the same physiotherapist who was not blind to patients' treatment. Treatment satisfaction was evaluated on the second day of treatment and after treatment.

Methods

Conventional rehabilitation treatment

The standardized physical therapy methods and exercise programs were applied to all participants by the same physiotherapist. Unlike the control group, Kinesio tape was applied after each conventional treatment session.

Within the physical therapy methods, 20 minutes of the hot pack, 5 minutes of ultrasound (1.5 watts / cm^2), and 20 minutes of conventional transcutaneous electrical nerve stimulation (TENS) were applied. In the exercise program, active joint movement exercises, stretching exercises, isometric strengthening exercises, and posture exercises were used. All of the exercises were given to the participants in the form of brochures. In addition to the ones applied during the treatment session, the participants were asked to apply two more sets of home exercises on the same day.

On the first day of treatment, all participants were provided with patient education on the principles of pain control, proper posture, and ergonomics that should be considered in daily life to protect neck health.

Kinesio taping procedure

The inhibition technique was applied to the upper trapezius muscle to reduce pain and spasm and to support weak muscles. For this technique, 15-25% tension was achieved with I tape. The facilitation technique was applied to cervical paravertebral muscles. A tension of 15-35% was obtained with the Y band. The correction technique with 15-35% tension X-band was used in the rhomboideus major muscle. "Star application" was used in the area where the most pain and tenderness were felt during palpation. (Figure 1)[5].

Figure 1. Application of Kinesio tape (KT)

KT was performed every day of conventional treatment immediately after the session ended. In case of complaints such as redness, burning, or itching in the area where the tapes were applied, the participants were told that the tapes should be removed using baby oil, etc. At the same time, individuals were advised that the tapes were water-resistant, but they should not be dried with a dryer. The participants who were treated five days a week were asked not to remove the tapes at the weekend.

Statistical analysis

The data were analyzed with SPSS 20.0 package program. Continuous variables are expressed as mean ± standard deviation, median (minimum and maximum values), and categorical variables as numbers and percentages. When parametric test assumptions are provided, independent groups t-test in comparison of differences; when parametric test assumptions are not provided, the Mann-Whitney U test was used to compare independent group differences. In the dependent group comparisons, Friedman Test and Wilcoxon paired-sample tests were used. The differences between categorical variables were examined by chi-square analysis. In all analyses, $p < 0.05$ was considered statistically significant.

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RESULTS

Fifty-two individuals with chronic neck pain participated in the study. One of the participants was excluded from the study because she was diagnosed with ankylosing spondylitis during the study period, two of them did not come to the last session of the treatment, and five of them did not attend the treatment regularly. When 44 people were included in the study (22 for each group), it was calculated that 80% of power would be obtained with 95% confidence. The study was completed with forty-four participants. Figure 2 shows the flow diagram for patient recruitment, reasons for exclusion, and drop-out cases.

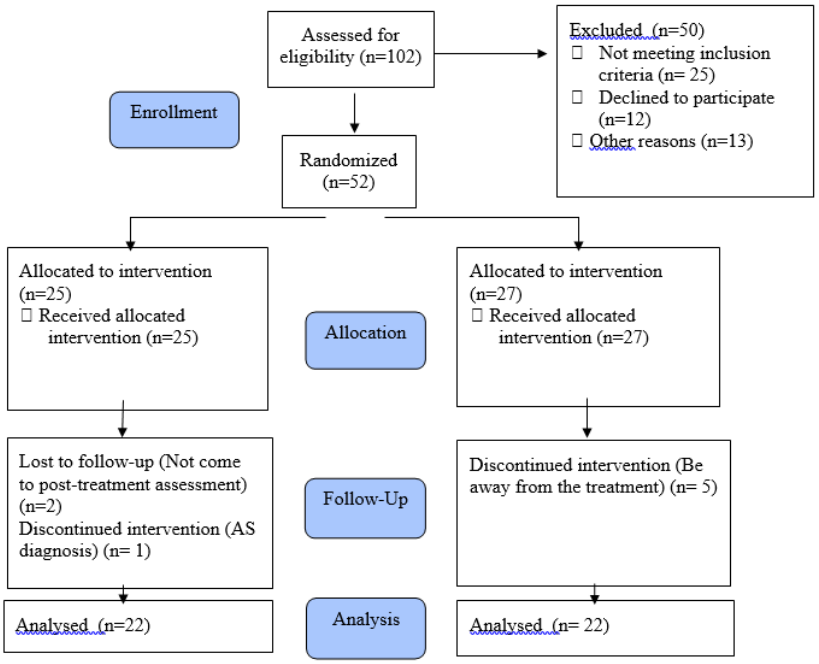

Figure 2. Flow diagram

The two groups were compared in demographic features, education level, properties of the neck pain, total pressure pain threshold, ROM, muscle endurance, muscle shortness, disability level, quality of life, and sex variables. In the pre-treatment evaluation, the muscle strength of the study group was found to be significantly higher than the control group (p=0.012) (Table 1). When the difference in BDI scores (delta values) after treatment and on the second day of treatment was compared, a significant decrease was obtained in favor of the study group (p = 0.021). The comparison was made in terms of muscle endurance differences before and on the second day of treatment, again in favor of the study group (p = 0.029). In the study group, patient satisfaction after treatment was significantly higher than on day 2 (p=0.009), but there was no significant difference in the control group (p=0.085) (Table 2).

DISCUSSION

As a result of our study, in addition to conventional physiotherapy methods in chronic neck pain, KT was found to have positive effects on BDI scores and patient satisfaction. Also, it was observed that muscle endurance increased after 24 hours after KT application in chronic neck pain.Controlling pain in the presence of chronic pain is important for symptomatic treatment. There are fewstudies in the literature evaluating the short-term effect of KT application on pain severity in neck pain. Ay et al.[23] divided the participants into two groups in their study on cervical myofascial pain. The first group received KT and exercise, and the second group received placebo taping and exercise, repeated every three days for a total of 5 sessions over three weeks. Improvement was observed in both groups, while a reduction in pain intensity was reported in the KT and exercise groups. However, there was no significant difference between the three treatment modalities. According to our results, a significant decrease in pain intensity was detected at the end of both treatments applied during 15 sessions. However, there was no significant difference between the two groups.

Another common clinical picture of chronic neck pain is pressure-sensitive painful points[24]. Tender

points in the cervical region are due to excessive muscle activity, poor posture, and psychological factors. Tender points can be palpated by hand or detected by an algometer[25]. Since the low-pressure pain threshold and pain are directly related to each other, treatment methods used to reduce pain can also be used to increase the pressure pain threshold[26,27]. Ay et al.[23] in their study, compared KT application and placebo taping in subjects with cervical myofascial pain and observed an increase in pressure pain threshold in both groups at the end of 15 days of treatment and reported that this increase was higher in the KT-treated group. In our study, the pressure pain threshold after treatment was significantly higher in both groups than before treatment. When the treatment groups were compared, there was no significant difference between the two groups.

Table 1. Demographic characteristics education status and neck pain variables.

Variables	Studygroup (n = 22)		Control group (n = 22)		p
	Mean±SD	Median (Min-Max)	Mean±SD	Median (Min-Max)	
Age (years)	41.9±6.9	41 (30- 55)	39.6±7.4	38.5 (30- 55)	0.154*
Height (cm)	167.9±12	163.5 (150-198)	169.0±10	168.5 (150-190)	0.755**
Weight (kg)	69.8±16.2	67.5 (47-117)	66.5±11.9	66 (50-86)	0.442**
BMI (kg/m^2)	24.6±3.6	24.9 (19.3-32.4)	23.2±2.7	22.9 (18.6-28.7)	0.139**
Education status (years)	13.4±2.9	15 (5 – 20)	14.2±3.2	15 (8 – 22)	0.445*
First pain time (months)	62.4±3.7	30 (3-240)	41.7±44.8	24 (3-168)	0.268**
Last neck pain duration (months)	6.4±3.5	4 (3-12)	9.3±9.3	4 (3-36)	0.144**
Neck pain intensity (0-10)	6.3±2.3	6.6 (1-10)	5.6±2.4	5.9 (2-10)	0.334**
Total of pressure pain threshold (N/cm^2)	213.7±72.0	201 (108.8-350)	172.4±71.0	166.8 (47.7-366.3)	0.062*
ROM (^{0})	312.5±39.3	316 (211-370)	324.6±42.5	326 (220 - 396)	0.335**
Muscle strength (N)	308.1±98.2	283.8 (162.8-491)	230.1±98.8	218.4 (103.4-59.2)	0.012**
Muscle endurance (sn)	18.9±10.6	17.5 (3 - 40)	22.6±16.0	22 (3 - 75)	0.557*
Muscle tightness (cm)	18.9±2.5	20 (14 - 24)	18.2±2.5	18 (12 - 22)	0.423*
Disability level	13.9±6.4	14 (5 - 28)	16.9±6.6	16(6 - 30)	0.125**
Quality of life (0-600)	133.0±82.4	117.5 (0-329.9)	145.6±102.0	111.7 (10.5-55.9)	0.655**
	n (%)		n (%)		
Sex					
Female	14 (63.6)		18 (81.8)		0.176***
Male	8 (34.4)		4 (18.2)		

BMI body massindex; ROM range of motion; Mean±SD mean±standard deviation; *Mann-Whitney U Test; ** Independent T-Test; *** Pearson's Chi-squared test

Gonzalez-Iglesias et al.[8]reported that the increase in ROM was significantly higher in patients with acute whiplash injury than in the placebo taping group immediately after and in a 24-hour follow-up Erdoğanoğlu and Bayraklı[28] reported the measurement results before elastic adhesive tape application and after 24-hour follow-up, and a significant difference was found between ROM values. In our study, ROM evaluation was performed with the CROM device, which is an objective and reliable method[14,29]. Our results showed that ROM in both groups was increased after treatment and the treatment methods were effective on ROM.

Table 2.Comparison of the differences in outcome measures total values between the groups and treatment satisfaction within and between groups.

Variables		Baseline-2nd day Mean±SD	Baseline –After treatment Mean±SD	2nd day –After treatment Mean±SD
Disability level	Study	2.73±3.71	7.18±5.91	4.45±4.24
	Control	2.86±5.79	7±6.44	4.14±5.29
	p^1	0.926*	0.923*	0.827**
Pressure pain threshold (N/cm^2)	Study	-11.59±34.44	-45.06±52.82	-33.48±40.68
	Control	-17.32±42.97	-32.96±46.59	-15.64±39.74
	p^1	0.628*	0.656*	0.149**
ROM (^{0})	Study	-16.82±25.69	-42.27±24.14	-25.45±22.51
	Control	-16.5±32.83	-36.23±49.86	-19.73±24.88
	p^1	0.411*	0.385*	0.428*
Muscle tightness (cm)	Study	0.45±1.06	1.36±1.79	0.91±1.6
	Control	0.82±1.59	1.27±1.58	0.45±1.95
	p^1	0.451**	0.889**	0.807*
Muscle strength (N)	Study	-16.86±42.76	-52.8±62.19	-35.95±43.28
	Control	-12.85±35.46	-39.89±52.33	-27.04±40.04
	p^1	0.467**	0.46*	0.483**
Neck pain intensity (0-10)	Study	1.02±1.73	4.17±2.41	3±2.62
	Control	0.37±0.89	3.08±2.36	2.7±2.2
	p^1	0.126*	0.142*	0.688**
Muscle endurance (sn)	Study	-6.07±8.5	-12.5±11.04	-6.43±7.66
	Control	-0.82±11.55	-10.77±17.45	-9.95±11.55
	p^1	**0.029****	0.323**	0.24**
Quality of life (0-600)	Study	32.88±48.01	81.25±61.21	48.37±44.8
	Control	15.47±54.2	66.93±85.14	51.46±86.34
	p^1	0.324*	0.241**	0.296**
Beck Depression Inventory (0-21)	Study	1.23±3.15	3.95±5.46	6.2±5.5
	Control	1.32±2.83	1.64±3.65	8.3±6.0
	p^1	0.92*	0.105*	**0.021****
		2nd day Mean±SD	Aftertreatment Mean±SD	p^2
Treatment satisfaction	Study	9.3±1.1	9.9±0.2	**0.009******
	Control	9.1±1.4	9.3±1.0	0.085******
	p^1	0.751***	0.148***	

ROM range of motion; Mean±SD mean±standard deviation; *Independent T-Test; **Mann-Whitney U Test; ***Friedman'stwoway ANOVA; **** Wilcoxonsigned-rank test; p^1intergroup; p^2intragroup.

Exercise is an effective treatment method for muscle strengthening in chronic neck pain[16].The muscle strength values before treatment were compared in both groups, and the total muscle strength was found to be high in favor of the study group. After the treatment, an increase in muscle strength was detected in both groups, but there was no difference between the groups. In other words, KT application is helpful for muscle strength but does not provide any additional benefit compared

to conventional treatment. Similar to our study, Copurgensli et al.[30]applied conventional therapy with exercise, Mulligan mobilization, and KT in cervical spondylosis and found no significant difference in muscle strength between the groups at the end of the treatment.

In individuals with chronic neck pain, cervical flexor muscle activity decreases, causing the head to go to the anterior tilt position. It causes muscle spasms and pain[31]. Researchers have noted that Alvarez-Alvarez et al.[32]recorded a significant increase in the endurance of the back extensor muscles in healthy individuals as a result of the evaluation made immediately after the application of KT to the back extensor muscles. Differently, Stedge et al.[33]evaluated the effects of KT applied to the gastrocnemius muscle on muscle endurance at the 24th and 72nd hours and concluded that it did not affect. In our study, in which we evaluated the cervical flexor muscle endurance, our results show thatmuscle endurance was increased after treatmentin both groups. However, the results of our study showed that KT increased muscle endurance over 24 hours and provided additional benefits to conventional treatment.

Another consequence of postural changes caused by chronic neck pain is the shortness of the pectoralis minor muscle[16]. In our study, it was found that there was a significant decrease in pectoralis minor muscle shortening at the end of treatment in both groups, but there was no difference between the groups. Our results showed that KT and conventional treatment methods effectively reduce muscle shortness, but KT application does not provide any additional benefit.

In our study, disability caused by neck pain was evaluated with the NDI[18]. Saavedra-Hernandez et al. [34] divided individuals with mechanical neck pain into two groups, cervical manipulation in one group and KT in the other group. In our study, the evaluation made at the end of the 24-hour follow-upand after treatment, the decrease in the level of disability was similar in both groups.

Neck pain adversely affects the quality of life with parameters such as ROM, muscle strength, and muscle endurance[35]. Cuesta-Vargas et al.[36]reported that a multimodal physiotherapy program, which includes therapeutic exercise, patient education, and swimming, increases the quality of life in individuals with chronic nonspecific neck pain. Our results showed that there was an improvement in the quality of life after treatment in both groups, but there was no significant difference between the groups. However, no study evaluating the effect of KT application on quality of life in neck pain has been found.

Emotional status, as well as the quality of life, is an essential indicator of health and has an important place in chronic pain[37]. Benlidayi et al.[38]have two groups in their study of temporomandibular joint disorders; the first group received KT, exercise, and patient education, and the second group received only exercise and patient education. After the treatment, it was observed that the emotional status improved in favor of KT group. In our study when the difference in BDI scores after treatment and on the second day of treatment was compared, a significant decrease was obtained in favor of the KT group. However, when the scores obtained from the BDI before treatment, on the second day, and after the treatment are analyzed, it is seen that all the values are below the limit value of 17 points, which indicates severe depressive symptoms that require treatment. This result shows that individuals do not have severe emotional problems during the treatment process.

According to Hills and Kitchen[39], the results obtained from the treatment are related to the expectations and satisfaction of the individuals. In the literature, no study evaluating the satisfaction of individuals with chronic neck pain from KT application has been found. In the KT group, while patient satisfaction showed a significant increase after treatment compared with the second day, there was no significant change in the only conventional treatment group.

Many authors evaluated the effectiveness of KT in chronic neck pain, but changes in the application area, applied tension, and duration of application affected the outcome of the studies[40]. Gonzalez et al. [8], in their study on changes in applied tension, found that the tension between 15-25% was more effective than KT applied without tension. In our study, KT was applied using 15-25% tension for inhibition and 15-35% for facilitation. We think that the way KT is applied is also valuable for the compliance of our results with the literature.

The strength of our study was to examine the effect of KT, which is applied together with conventional physiotherapy methods, on many parameters in chronic neck pain, where there are not enough studies in the literature yet. The limitations in our study's lack of a sham KT group are that the placebo effect could not be investigated, and lack of long-

term follow-up of the patients.

In the literature, studies comparing the effectiveness of KT and conventional physiotherapy in chronic neck pain are controversial and, number of studies is few. Our results show that KT can be used to increase muscle endurance in the short term. Also, it can be said that KT application provides additional benefits to the conventional physiotherapy method in terms of treatment satisfaction. The study's main findings can be attributed to the effects of KT to increase local circulation, reduce local edema fasting the target muscle, provide positional stimulation to the skin-muscle or facial structures, and provide suitable afferent inputs for the central nervous system.

Disclosure statement: The authors have no conflicts of interest to declare.

Authors contributions: Methodology: [HD, EAT]; Formal analysis and investigation: [HD, EAT, MPK]; Writing - original draft preparation: [HD, MPK, EAT]; Writing - review and editing: [MPK, HD, EAT]; Funding acquisition: [HD, EAT]; Supervision: [EAT].

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