Turk J Phys Med Rehab 2020;66(3):252-261
DOI: 10.5606/tftrd.2020.3712
Available online at www.turkishjournalpmr.com

Original Article

Comparison of effectiveness of different kinesiological taping techniques in patients with chronic low back pain: A double-blind, randomized-controlled study

Alper Mengi[1], Şenay Özdolap[2], Tuğçe Köksal[2], Fürüzan Köktürk[3], Selda Sarıkaya[2]

[1]Department of Physical Medicine and Rehabilitation, Gaziosmanpaşa Taksim Training and Research Hospital, Istanbul, Turkey
[2]Department of Physical Medicine and Rehabilitation, Bülent Ecevit University Faculty of Medicine, Zonguldak, Turkey
[3]Department of Biostatistics, Bülent Ecevit University Faculty of Medicine, Zonguldak, Turkey

Received: January 30, 2018 **Accepted:** March 07, 2019 **Published online:** August 01, 2019

ABSTRACT

Objectives: This study aims to investigate the effects of kinesiological taping (KT) method combined with physiotherapy modalities and exercise therapy on the severity of pain, range of lumbar motion, and degree of disability.

Patients and methods: Between November 2015 and November 2016, a total of 125 patients (63 males, 62 females; mean age 45 years; range, 20 to 65 years) who were diagnosed with chronic non-specific low back pain were included in this double-blind, randomized, placebo-controlled study. The patients were randomly assigned to four groups. All groups received the same physiotherapy modalities and exercise therapy. Group 1 received physiotherapy modalities and exercise therapy alone; Group 2 received additional sham KT; Group 3 received additional KT with a space correction technique; and Group 4 received additional KT with a fascia correction technique. Kinesiological taping was applied for three weeks with five-day intervals and four times in total. The patients were evaluated at baseline (Day 0), at the end of the treatment (Day 21), and on Day 51. Pain severity using the Visual Analog Scale (VAS), ranges of lumbar motion using the fingertip-to-floor distances and modified lumbar Schober test, and the degree of disability using the Oswestry Disability Index (ODI) and Roland Morris Disability Questionnaire (RMDQ) were evaluated.

Results: We found a significant difference among the groups in terms of VAS motion T0-51 changes ($p<0.05$). There was also a significant difference among the groups in terms of T0-21 and T0-51 changes in the ODI and RMDQ ($p<0.05$).

Conclusion: Our study results suggest that KT ensures reduction in pain and disability, irrespective of the technique of taping, with sustainable short-term effects following the end of the treatment.

Keywords: Chronic pain, exercise therapy, kinesiotaping, lumbago, physiotherapy.

Low back pain (LBP) is a global health problem in all societies and its lifelong prevalence is reported to be 60 to 85%.[1] About 5.9 to 18.1% of all LBP cases suffer from pain lasting more than 12 weeks which becomes chronic.[2] Low back pain of non-specific origin lasting more than 12 weeks is defined as chronic non-specific LBP. There are many therapy methods to apply for chronic mechanical LBP treatment. Frequently applied options include exercise programs, medical treatments, behavioral treatments, physiotherapy modalities, and complementary medicine applications.[3] Exercise therapy is one of the most frequently used methods in patients with chronic LBP, which is often used along with the other therapy methods. The effectiveness of the exercise therapy has been shown in patients with chronic LBP.[4] Physiotherapy modalities such as hot, cold, low, medium, and high frequency currents are used in the daily practice in the treatment of patients

Corresponding author: Alper Mengi, MD. Gaziosmanpaşa Taksim Eğitim ve Araştırma Hastanesi Fiziksel Tıp ve Rehabilitasyon Kliniği, 34255 Gaziosmanpaşa, İstanbul, Turkey. e-mail: a_mengi22@hotmail.com

Cite this article as:
Mengi A, Özdolap Ş, Köksal T, Köktürk F, Sarıkaya S. Comparison of effectiveness of different kinesiological taping techniques in patients with chronic low back pain: A double-blind, randomized-controlled study. Turk J Phys Med Rehab 2020;66(3):252-261.

with LBP. However, there is no strong evidence for the effectiveness of physiotherapy modalities in chronic LBP.[5,6]

Kinesiological taping (KT) was first developed by the Dr. Kenzo Kase in 1970s.[7] It is a very popular therapy method for sports injuries[8] and can be also used for chronic non-specific LBP.[7,9] Kinesiological taping is a type of taping used for increasing function, supporting muscle, reducing pain, and facilitating recovery in joints, muscles, and other soft tissue problems. The tape's creators have developed different techniques of taping for different treatment purposes: mechanical correction, fascia correction, and space correction. To ensure KT is effective, the tape-cut-shapes and stretching tension must match the technique used.[10,11]

In the literature, there are few publications regarding the effectiveness of the KT in chronic non-specific LBP with controversial results. In a study, the effect of KT in reducing pain and disability was not found to be superior to the effect of placebo.[12] However, there are also studies reporting that KT may be useful for reducing pain or disability.[7,9] In the studies involving patients with chronic non-specific LBP, a control group where taping intervention was not applied and a group (placebo group) where KT was used, but applied without stretching were not evaluated together, and the superiorities of different KT techniques were not compared. Furthermore, in these studies, exercise therapy and physiotherapy modalities used frequently in the daily practice in LBP treatment were not combined with KT.

In our study, we aimed to investigate the effects of KT method combined with physiotherapy modalities and exercise therapy on the severity of pain, range of lumbar motion, and degree of disability and to evaluate whether KT is effective without using any method using sham taping.

PATIENTS AND METHODS

This double-blind, randomized, placebo-controlled study included a total of 125 patients (63 males, 62 females; mean age 45 years; range, 20 to 65 years) who were diagnosed with chronic non-specific LBP at our Physical Medicine and Rehabilitation outpatient clinic between November 2015 and November 2016. *Inclusion criteria were as follows:* age between 18 and 65 years, having chronic non-specific LBP for at least three months without leg pain, and a Visual Analog Scale (VAS) score of ≥3. *Exclusion criteria were as follows:* patients with neurological deficit, lumbar stenosis, lumbar surgery history, spondylolisthesis, central or peripheral nervous system disorders, inflammatory LBP, fibromyalgia, severe osteoporosis or osteomalacia (lumbar T score <-2.5 SD or presence of one or more fragility fractures), and active psychiatric disease, infectious, malignancy history, pregnancy; patients who previously received KT for LBP in the lumbar region, but not other regions; presence of skin diseases; contraindication due to the use of tape; taking medicines for LBP during treatment and during the next one month after treatment, except for paracetamol. A written informed consent was obtained from each patient. The study protocol was approved by the institutional Ethics Committee (2015-91-21/10). The study was conducted in accordance with the principles of the Declaration of Helsinki.

A detailed clinical history of the patients was recorded and physical examination was undertaken by the single physician. Demographic data including sex, age, body mass index (BMI), education status, and occupation, LBP duration, and low back trauma history were recorded.

All patients were randomized to four groups using block randomization method with random numbers table (Figure 1). All groups received the same physiotherapy modalities and exercise therapy. Group 1 received physiotherapy modalities and exercise therapy alone; Group 2 received additional sham KT; Group 3 received additional KT with a space correction technique; and Group 4 received additional KT with a fascia correction technique.

Physiotherapy modalities and exercise therapy

All patients were applied the same physiotherapy modalities, superficial heating (Chattanooga, 60 cm moist heat pack), and transcutaneous electrical nerve stimulation (TENS) for five sessions a week for a total of three weeks. The moist heat pack was applied to the patient's lower back for 20 min, while in the prone position, with the heat pack touching the patient's lower back. The TENS (frequency of 100 Hz, pulse duration of 100 μs, sensory-level amplitude) was applied for 25 min with EMS 2000 electrical neuromuscular stimulator (BioMedical Life Systems, California, USA). During application, four electrodes were placed over the painful area. In groups with taping, the electrodes were placed and they did not come above the tape. It was around the tape on four electrodes.

All patients were given the same exercise program, consisting of flexion, extension, stretching and mobilization, and posture exercises. The patients did the same exercises individually under supervision of

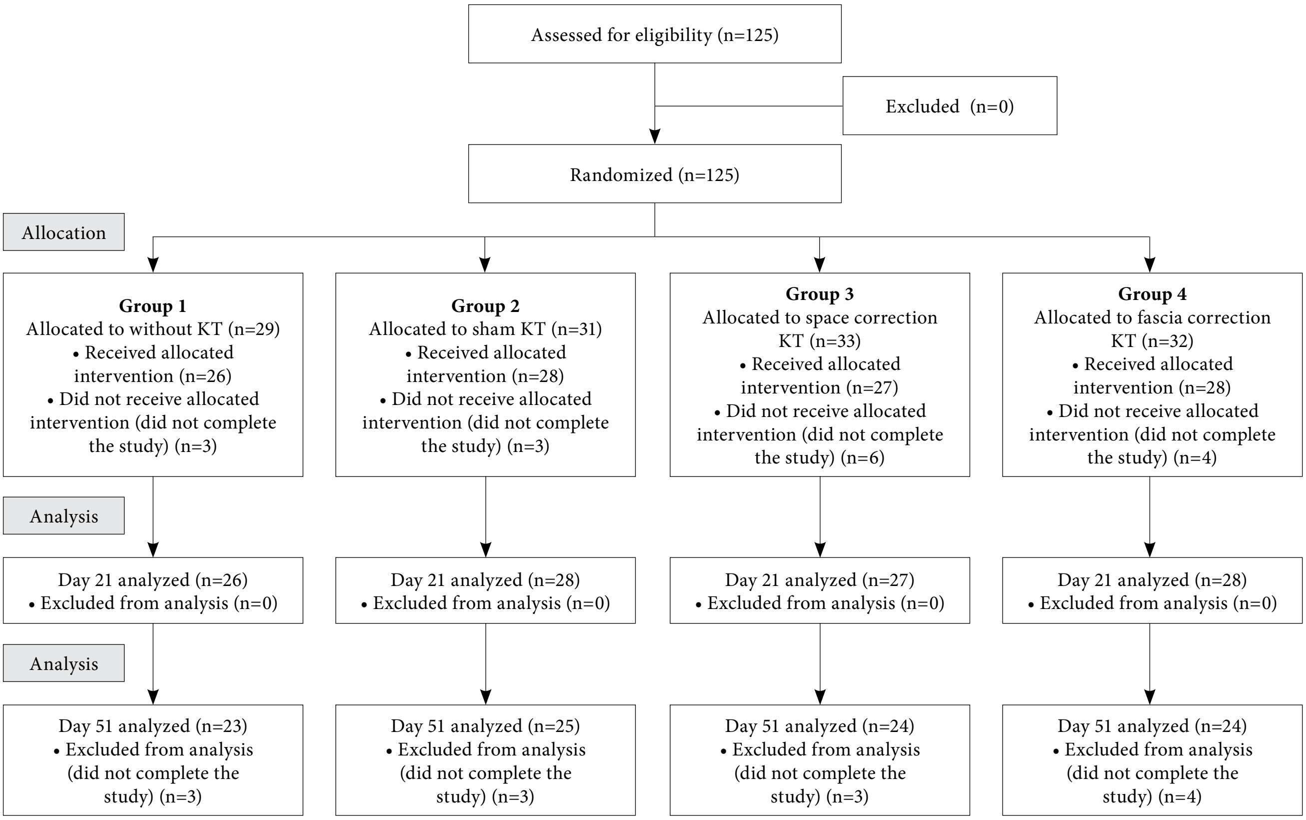

Figure 1. Flow diagram.

physiotherapists during the treatment for five sessions a week for a total of three weeks. The patients were instructed to do the exercise program two times a day and to continue the exercise program after the treatment.

KT intervention

Kinesiological taping was applied for three weeks with five-day intervals for a total of four times, being left on the body after the application. The KT was applied by an operator having KT application certificate. Sham KT was applied horizontally on the defined region of pain, without tension, using I-strip 5 cm in width and 20 cm in length (Figure 2a).[7]

During the application of the KT with a space correction technique, four pieces of I-strip 5 cm in width and 20 cm in length were used. Horizontal tape was placed at an upright position on the point where the patient felt the pain at the highest level with 25 to 35% tension in the center of the tape, and this was finished without tension on the ends. Vertical tape was applied in maximum forward flexion position in the same manner. Oblique tapes were applied to the patient in a position with rotation and flexion toward the contralateral of the application region in the same manner (Figure 2b).[7,10,11]

During the application of KT with a fascia correction technique, two pieces of I-strip 5 cm in width and 35 cm in length were used. The starting tip of I-strip was applied on the sacral paravertebral region without tension to the patient in an upright position. Then, the rest of the tape was applied on the lumbar paravertebral region with 10-50% tension using an oscillating motion, while the patient was in a maximum forward flexion position. The endpoint was completed without tension. Then, the same application was exercised on the other side to be parallel with the first tape (Figure 2c).[10,11,13]

Evaluation of patients

The patients were evaluated at baseline (Day 0), at the end of the treatment (Day 21), and on Day 51 after baseline (one month after the end of treatment). With the evaluation on Day 51, we aimed to identify whether the effect continued one month after the end of the treatment. Pain severities, ranges of lumbar motion, and levels of disability of the patients were measured at each evaluation.

Figure 2. The applications of the KT; **(a)** Sham KT, **(b)** KT with space correction technique, **(c)** KT with fascia correction technique.
KT: Kinesiological taping.

The pain severity was evaluated using a 10 cm VAS, where 0 indicates no pain, while 10 indicate unbearable pain. At each evaluation, the averages of pain in activity (VASactivity), in rest (VASresting), and during the night (VASnight) for the last one week were inquired.

The lumbar ranges of motion were assessed by two methods including The modified lumbar Schober test and fingertip-to-floor (FTF) distances (as anterior, right lateral and left lateral) measurements which were explained in detail elsewhere.[14]

The disability degree of the patients was evaluated using the Oswestry Disability Index (ODI)[15] and Roland Morris Disability Questionnaire (RMDQ)[16] with proven Turkish validation.

The study was performed in double-blind. The patients did not know in which group they belonged to. The one of the researchers, AM, performed kinesio taping, and the another researcher, TK, evaluated them. The researcher who evaluated the patients, TK, did not know in which group the patients belonged to.

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 19.0 software (IBM Corp., Armonk, NY, USA). Distribution of data was analyzed using the Shapiro-Wilk test. Continuous variables were expressed in mean ± standard deviation (SD) or median (min-max), while categorical variables were expressed in number and frequency. Categorical variables were compared using the Pearson's chi-square test and Fisher-Freeman-Halton exact test (Fisher-Freeman-Halton exact test was used when 20% of expected frequencies were less than 5). Analysis of variance (ANOVA) or Kruskal-Wallis test was used to examine statistically significant differences among the groups. The Tukey's method was used for *post-hoc* analysis after ANOVA. The Dunn's test was used for *post-hoc* analysis after the Kruskal-Wallis test. A two-way mixed ANOVA was used to measure the time, group and time X group interaction effect (simultaneous effect of two or more independent variables on at least one dependent variable) followed by the Bonferroni *post-hoc* test. Levene's test of homogeneity of variances and Box's M test of homogeneity of covariances were used. The sphericity assumption was analyzed by the Mauchly's test. The Greenhouse-Geisser correction was used for epsilon <0.75, while the Huynh-Feldt correction was used for less severe asphericity. The analysis of the results was carried out per protocol (PP) and by intention-to-treat (ITT) for all variables. The last observation carried forward method was used in the ITT analysis for the missing values.

After the study was completed, the *post-hoc* power analysis was performed using the G*Power version 3.1.9.2 software (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). For the repeated measures within-between interaction ANOVA from F-test family, the *post-hoc* power was calculated as 0.99 in the power analysis using the Schober score measure for four groups and three repeats. A p value of <0.05 was considered statistically significant.

RESULTS

Of 125 patients included in the study, 109 completed the evaluation on Day 21 and 96 patients completed the evaluation on Day 51 (Figure 1). Demographic and clinical characteristics of all patients are shown in Table 1. There was no significant difference in the age, sex, BMI, education status, occupation, and, low back trauma history (p>0.05). However, there was a significant difference in pain duration among the groups (p<0.05). This was due to the fact that pain duration in Group 1 was significantly longer than Group 4.

TABLE 1
Demographic and clinical characteristics of patients

	Group 1 (n=29)					Group 2 (n=31)					Group 3 (n=33)					Group 4 (n=32)					
	n	%	Mean±SD	Median	Min-Max	n	%	Mean±SD	Median	Min-Max	n	%	Mean±SD	Median	Min-Max	n	%	Mean±SD	Median	Min-Max	*p*
Age (year)			45.7±9.8					44.8±13.2					45.8±11.1					43.7±12.4			0.970
Body mass index			28.7±4.1					27.0±5.1					28.8±5.1					27.5±4.7			0.360
Duration of pain (month)				120.0	3.0-240.0				60.0	3.0-360.0				60.0	3.0-420.0				60.0	3.0-300.0	0.041
Sex																					0.928
Male	15	51.7				15	48.4				18	54.5				15	46.9				
Female	14	48.3				16	51.6				15	45.5				17	53.1				
Educational level																					0.311
Not literate	3	10.3				2	6.5				3	9.1				2	6.3				
Primary school	13	44.8				11	35.5				12	36.4				8	25.0				
Secondary school	1	3.4				5	16.1				4	12.1				5	15.6				
High school	4	13.8				11	35.5				6	18.2				10	31.3				
University	8	27.6				2	6.5				8	24.2				7	21.9				
Job																					0.700
Unemployed	0	0.0				4	12.9				3	9.1				2	6.3				
Housewife	10	34.5				10	32.3				12	36.4				8	25.0				
Office worker	5	17.2				5	16.1				6	18.2				9	28.1				
Heavy duty worker	14	48.3				12	38.7				12	36.4				13	40.6				
Low back trauma history																					1.000
Available	1	3.4				2	6.5				2	6.1				2	6.3				
Not available	28	96.6				29	93.5				31	93.9				30	93.8				

SD: Standard deviation; Min: Minimum; Max: Maximum; *p* value of <0.05 is considered statistically significant.

Group and time showed a statistically significant interaction effect on the VASactivity, ODI, and RMDQ scores in PP ($p<0.05$). In all groups except for Group 1, baseline measurement was significantly higher than the measurement on Days 21 and 51 ($p<0.05$). Baseline and on Day 51 measurements were similar in Group 1 for VASactivity, ODI, and RMDQ (Figures 3-5). These results indicated that there was no significant main effect of the treatment groups in these scales ($p>0.05$). However, the effect of time was significant ($p<0.001$). A significant interaction effect was found in the left lateral FTF ($p<0.05$). In Group 1, measurement on Day 21 was found to be significantly lower than the other two time points, while the baseline measurement

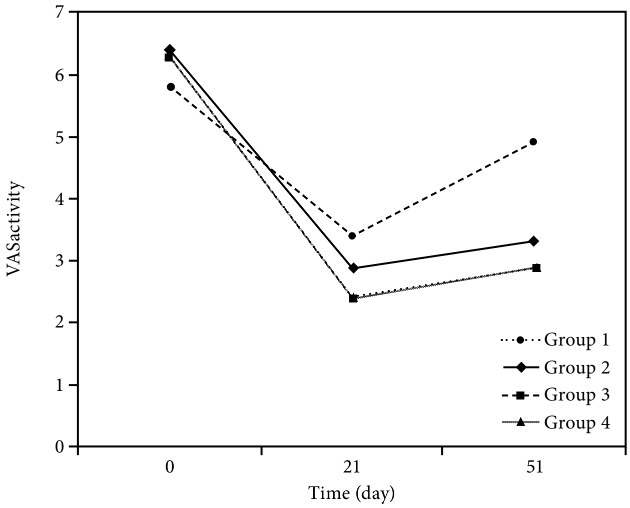

Figure 3. Estimated marginal means of VASactivity.
VAS: Visual Analog Scale.

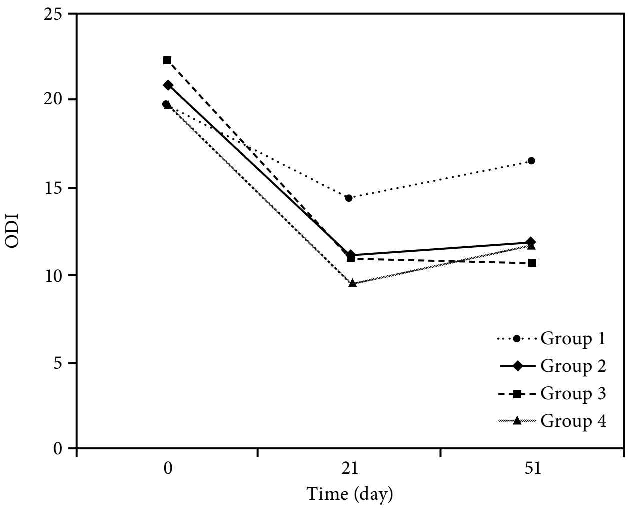

Figure 4. Estimated marginal means of ODI.
ODI: Oswestry Disability Index.

in Group 4 was significantly higher than the other two time points (p<0.05). The measurements were similar in Group 2 at all time points, while the baseline measurement in Group 3 was significantly higher than Day 21 (Figure 6). There was no significant main effect of treatment groups (p>0.05), although the main effect of time was significant (p<0.001). The analysis showed that there was no significant interaction effect of VASresting, VASnight, Schober, anterior FTF, and right lateral FTF (p>0.05). The results are summarized in Tables 2 and 3.

In addition, we found a significant interaction effect only on ODI and RMDQ in the ITT (p<0.05). Using ODI, the baseline measurements were significantly higher than the other two time points for all groups, while there was no significant difference between the measurements on Days 21 and 51. Using the RMQI, Day 21 measurement in Group 1 was found to be significantly lower than the other two time points. Baseline measurements for RMDQ were significantly higher than the other two time points in all groups, except for Group 1. In the ITT, as in the PP, there was no significant main effect of treatment groups in all scales (p>0.05), although the main effect of time was significant (p<0.05) (Table 4).

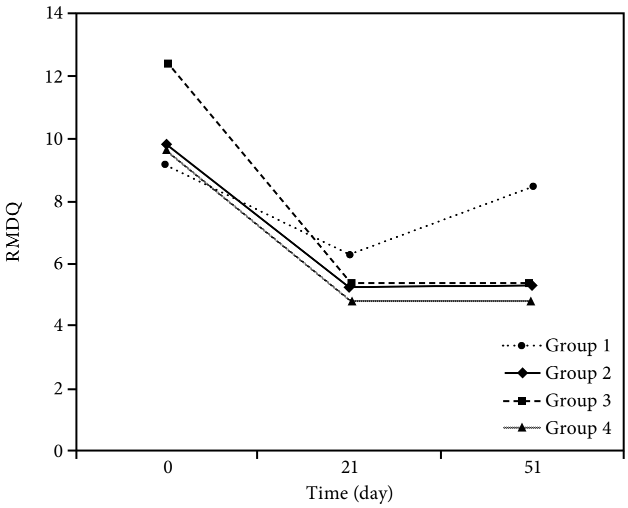

Figure 5. Estimated marginal means of RMDQ.
RMDQ: Roland Morris Disability Questionnaire.

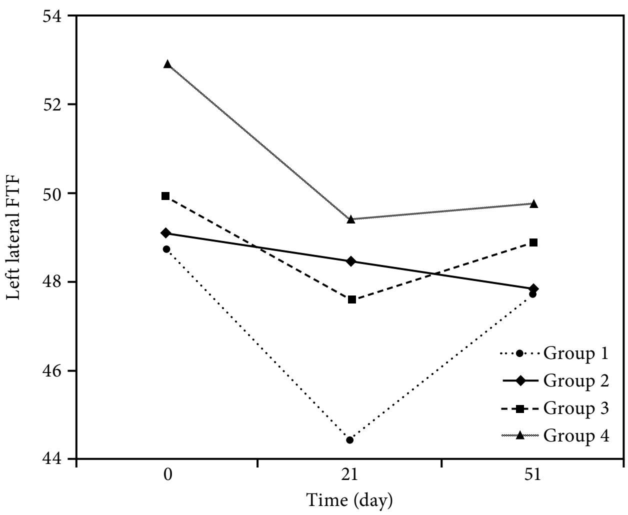

Figure 6. Estimated marginal means of left lateral FTF.
FTF: Fingertip-to-floor distance.

Temporal change (TC) was calculated considering the difference between the evaluations performed at baseline (Day 0), at the end of the treatment (Day 21), and on Day 51 after baseline in all groups. The changes were compared among the groups, and the changes in the time were evaluated. There was a significant difference in terms of TC (0-51) VASactivity among the groups (p=0.010). The changes between Group 1 and other groups were significant (p=0.046, p=0.021, and p=0.024, respectively). Although there was a reduction in the pain score in VASactivity TC (0-51) in all four groups, the reduction in the VAS scores in Group 1 was significantly lower, compared to the other groups. In addition, there was a significant difference in terms of TC (0-21) ODI and TC (0-51) ODI among the groups (p=0.040 and p=0.002, respectively). There was also a significant difference between Group 1 and other groups in terms of TC (0-21) (p=0.029, p=0.007, and p=0.044, respectively) and TC (0-51) changes (p=0.006, p<0.001, and p=0.020, respectively). Also, there was a reduction in disability in TC (0-21) and TC (0-51) in all four groups in terms of the ODI; however, the improvement of disability in Group 1 was lower, compared to the other groups. We also found a significant difference among the groups in terms of TC (0-21) and TC (0-51) changes in the RMDQ (p=0.012 and p=0.001, respectively). The differences between Group 1 and Group 3 for TC (0-21) changes (p=0.006) and the differences between Group 1 and Group 2 and Group 1 and Group 3 in TC (0-51) changes were significant (p=0.044 and p<0.001, respectively). Although there was a reduction in disability in both TC (0-21) and TC (0-51) in all groups in the RMDQ scores, the recovery of disability in only Group 1 was found to be significantly lower, compared to Group 3 in terms of TC (0-21). Besides, in terms of TC (0-51), the recovery of disability in Group 1 was significantly lower, compared to Groups 2 and 3. However, there was no significant difference in the TC of the modified lumbar Schober

TABLE 2
The evaluation results at each visit

	Group 1		Group 2		Group 3		Group 4	
	Mean±SD	Min-max	Mean±SD	Min-max	Mean±SD	Min-max	Mean±SD	Min-max
VASactivity								
D0	6.0±1.6	3.0-10.0	6.1±1.9	3.0-10.0	6.1±1.5	3.0-10.0	6.1±1.6	3.0-10.0
D21	3.1±2.2	0.0-8.0	2.9±2.5	0.0-8.0	2.5±1.2	0.0-5.0	2.7±2.3	0.0-8.0
D51	4.9±2.8	0.0-10.0	3.4±2.9	0.0-10.0	2.9±2.0	0.0-7.0	2.9±2.6	0.0-7.0
VASresting								
D0	2.8±2.3	0.0-7.0	2.7±1.9	0.0-7.0	2.2±1.8	0.0-7.0	2.0±2.3	0.0-10.0
D21	0.8±1.8	0.0-7.0	1.5±2.3	0.0-8.0	0.5±0.8	0.0-3.0	0.7±1.4	0.0-5.0
D51	1.8±2.0	0.0-6.0	1.9±2.3	0.0-7.0	0.8±1.6	0.0-7.0	1.0±1.9	0.0-7.0
VASnight								
D0	2.1±2.2	0.0-7.0	2.5±2.6	0.0-9.0	1.5±1.5	0.0-5.0	1.8±2.2	0.0-10.0
D21	0.8±1.6	0.0-7.0	1.2±2.1	0.0-7.0	0.5±1.2	0.0-5.0	0.3±1.0	0.0-5.0
D51	1.0±1.8	0.0-6.0	1.2±2.2	0.0-8.0	0.5±0.9	0.0-3.0	0.9±2.0	0.0-8.0
Schober								
D0	7.4±1.1	5.0-9.0	7.0±1.3	4.0-9.0	7.3±2.1	2.0-11.0	7.1±1.2	5.0-10.0
D21	7.8±1.5	4.0-10.5	7.1±0.9	5.0-9.0	7.7±1.7	4.0-10.0	7.6±1.6	5.0-11.0
D51	7.3±1.4	5.0-10.0	7.1±1.1	5.0-9.0	7.7±1.6	4.0-10.0	7.4±1.3	5.0-10.0
FTF anterior								
D0	7.9±9.6	0.0-33.0	10.6±11.4	0.0-44.0	12.1±12.2	0.0-47.0	9.8±11.6	0.0-36.0
D21	7.2±8.8	0.0-28.0	8.1±8.8	0.0-26.0	10.9±11.8	0.0-39.0	7.5±10.2	0.0-31.0
D51	7.6±8.1	0.0-24.0	7.8±9.8	0.0-35.0	11.5±11.8	0.0-37.0	5.9±8.4	0.0-32.0
FTF right lateral								
D0	48.3±6.0	35.0-61.0	49.5±6.0	40.0-62.0	49.0±5.4	41.0-69.0	50.6±5.9	39.0-65.0
D21	44.7±8.1	19.0-56.0	48.1±6.4	34.0-60.0	46.9±4.0	34.0-55.0	48.3±6.9	34.0-63.0
D51	46.5±6.7	36.0-60.0	47.2±6.5	38.0-63.0	48.3±3.6	40.0-54.0	49.8±4.8	40.0-61.0
FTF left lateral								
D0	49.9±6.2	38.0-64.0	49.0±5.4	40.0-64.0	49.9±5.3	41.0-67.0	51.0±6.3	39.0-66.0
D21	45.1±8.2	17.0-56.0	48.1±6.2	36.0-59.0	47.2±4.9	30.0-56.0	48.8±5.8	37.0-59.0
D51	47.7±6.9	38.0-64.0	47.8±5.7	38.0-62.0	48.7±4.2	37.0-56.0	49.7±4.9	40.0-60.0
ODI								
D0	19.2±5.6	10.0-32.0	20.1±6.1	10.0-35.0	21.8±5.7	7.0-32.0	19.9±6.3	10.0-33.0
D21	13.3±7.2	1.0-27.0	10.6±8.3	1.0-31.0	11.3±5.6	2.0-22.0	10.3±7.2	1.0-30.0
D51	16.7±7.6	4.0-28.0	11.8±8.3	2.0-29.0	10.8±7.8	1.0-27.0	11.6±8.5	1.0-30.0
RMDQ								
D0	9.0±5.7	1.0-20.0	9.0±5.4	2.0-19.0	11.6±5.1	1.0-20.0	9.8±5.5	2.0-19.0
D21	6.0±5.2	0.0-18.0	4.9±5.2	0.0-18.0	5.3±4.1	0.0-15.0	4.9±4.5	0.0-19.0
D51	8.4±6.4	1.0-20.0	5.2±5.3	0.0-20.0	5.5±4.4	0.0-14.0	4.8±5.2	0.0-18.0

SD: Standard deviation; Min: Minimum; Max: Maximum; VAS: Visual Analog Scale; DO: Day 1; D21: Day 21; D51: Day 51; Schober: The Modified Lumbar Schober Test; FTF: Fingertip-to-floor distance; RMDQ: Roland Morris Disability Questionnaire.

Table 3
Evaluation of the interaction effects of group and time on parameters for PP analysis

	Time		Group		Time/group interaction	
	F	*p*	F	*p*	F	*p*
VASactivity	109.3	<0.001	1.3	0.249	2.4	0.027
VASresting	25.9	<0.001	1.4	0.221	0.7	0.624
VASnight	17.5	<0.001	1.0	0.371	0.8	0.560
Schober	5.3	0.006	0.9	0.434	1.1	0.336
FTF anterior	7.2	0.002	1.3	0.267	1.9	0.085
FTF right lateral	9.3	<0.001	2.2	0.091	1.6	0.146
FTF left lateral	15.4	<0.001	2.0	0.108	2.3	0.036
ODI	98.7	<0.001	1.1	0.321	3.6	0.003
RMDQ	58.3	<0.001	0.7	0.550	3.5	0.003

PP: Per-protocol; VAS: Visual Analog Scale; Schober: The Modified Lumbar Schober Test; FTF: Fingertip-to-floor distance; ODI: Oswestry Disability Index; RMDQ: Roland Morris Disability Questionnaire; F: Test statistics (analysis of variance with repeated measurements); p: Two way mixed Anova, *p* value of <0.05 is considered statistically significant.

Table 4
Evaluation of the interaction effects of group and time on parameters for ITT analysis

	Time		Group		Time/group interaction	
	F	*p*	F	*p*	F	*p*
VASactivity	100.7	<0.001	0.7	0.506	1.1	0.329
VASresting	31.3	<0.001	1.8	0.149	0.3	0.897
VASnight	25.0	<0.001	1.4	0.223	0.4	0.826
Schober	6.2	0.003	0.9	0.433	0.9	0.487
FTF anterior	7.8	0.001	0.6	0.566	2.0	0.071
FTF right lateral	12.7	<0.001	0.8	0.475	1.4	0.188
FTF left lateral	18.2	<0.001	0.2	0.847	1.8	0.093
ODI	98.0	<0.001	0.6	0.567	2.2	0.042
RMDQ	63.8	<0.001	0.9	0.441	3.0	0.009

ITT: Intention-to-treat; VAS: Visual Analog Scale; Schober: The Modified Lumbar Schober Test; FTF: Fingertip-to-floor distance; ODI: Oswestry Disability Index; RMDQ: Roland Morris Disability Questionnaire; F: Test statistics (analysis of variance with repeated measurements); p: Two way mixed Anova, *p* value of <0.05 is considered statistically significant.

test and FTF distances (as anterior, right lateral and left lateral) among the groups (p>0.05).

In the PP, group and time showed a statistically significant interaction effect on the VASactivity, FTF left lateral, ODI, and RMDQ, it had on the ODI and RMDQ in the ITT. The evaluation of VASactivity, ODI, and RMDQ was clinically significant and supported by TC. However, the evaluation of FTF left lateral was not compatible with other the lumbar ranges of motion measurements and not supported by TC.

In the first application of KT, a reaction of the skin in the form of mild flushing and itching developed in one patient and the patient withdrew from the study before Day 21.

DISCUSSION

This study was carried out to compare the effectiveness of different KT techniques in combination with the physiotherapy modalities and an exercise therapy on the severity of pain, range of lumbar motion, and disability in patients with chronic LBP. To the best of our knowledge, this is the first study in the literature examining two different KT techniques (space correction and fascia correction techniques) as well as combining these KT techniques with physiotherapy and exercise therapy for chronic LBP. Our study showed that KT, irrespective of the type of KT, reduced pain and disability with sustainable short-term effects following the treatment. However, using these KT applications, we observed no improvement in the range of lumbar motion.

In a research by Castro-Sánchez et al.,[7] 60 patients with chronic, non-specific LBP were divided into two groups and one of the groups was applied I-strip sham KT, while the other group was applied star-shaped KT for seven days. Both groups were compared in terms of any improvement on pain reduction, range of lumbar flexion, degree of disability, and muscle endurance. It was found that the star-shaped KT slightly decreased LBP and its effect continued for four weeks after the treatment. In another study by Paoloni et al.,[9] 39 patients with chronic LBP were divided into three groups, and the groups were applied only KT, only exercise, and KT combined with exercise. The KT was applied between the vertebrae T12-L5 without stretching and replaced at intervals of three days for four weeks. The patients were evaluated in terms of pain, disability, and lumbar muscle activity before and after the treatment. It was found that there was a reduction in the pain scores of all groups and it was concluded that KT treatment in patients with chronic LBP was effective in short-term for reducing pain.

In our study, the VAS scores of all groups decreased after the treatment. When the VASactivity scores were evaluated, there was a higher reduction in the pain scores of all KT applied groups (including sham group). This finding suggests that there is no significant difference between the KT techniques on the pain reduction, and KT, including sham taping, reduces pain and this effect may sustain in short-term. This finding is also consistent with the results reported by Castro-Sanchez and Paoloni.[7,9] Castro-Sanchez also suggested that sustainable effects of KT on pain reduction even four weeks after the treatment could be attributed to the fact that KT ensures the patients to remain active in spite of pain in their daily lives or increases awareness of the patient on not to perform movements which may harm the lumbar tissue. Similarly, we also believe that KT increases awareness of the patient on lumbar region to avoid movements which are detrimental to the healing of the affected low back tissues.

It has been reported that exercise therapy in patients with chronic LBP increases the lumbar range of motion during the exercise of treatment, but this effect is not long-lasting.[17] The effect of superficial heating and TENS therapy on the lumbar range of motion in patients with chronic LBP is still not clear. In a study by Kim et al.,[18] exercise therapy with superficial heating and TENS therapy was applied to the patients with chronic LBP. There was no change in the lumbar range of motion in the group where only superficial heating and TENS therapy were applied. In the aforementioned study, an improvement was observed in the group where the exercise therapy was applied with superficial heating and TENS therapy. Considering the range of lumbar motion, our study showed no improvement by KT application. In another study, KT application on the lower trunk increased active lower trunk flexion range of motion in healthy individuals.[7] In addition, Castro-Sánchez et al.[7] reported that there was a borderline statistical significance in the improvement in trunk flexion range of motion, although this effect could not be sustained for four weeks. Therefore, the authors concluded that KT might increase the lumbar range of motion, when it was placed on the patient's body. We cannot argue with this result, as the lumbar ranges of motion measurements were performed after the tapes were removed from the patient's body in our study. Therefore, the results of our study suggest that KT does not affect the lumbar range of motion, after it is removed from the patient's body.

In our study, the improvement in disability on both Days 21 and 51 was higher in all taping applied groups according to the ODI. Comparing RMDQ scores, a greater improvement was observed in the group undergoing space correction KT technique on Day 21 and in the sham taping and space correction KT technique group on Day 51. In the study by Paoloni et al.,[9] the patients were evaluated with RMDQ before and after the treatment, and it was observed that only the exercise-alone group had reduced disability. In the aforementioned study, KT did not have any effect in terms of reducing disability. On the other hand, in the study by Castro-Sánchez et al.,[7] both the RMDQ and ODI were used to evaluate the degree of disability, and taping applied with the space correction technique ensured more reduction in disability, compared to sham taping at the end of the first week; however, reduction was unable to be sustained four weeks after the treatment. Unlike these studies, we showed that the space correction and fascia correction techniques, including sham KT, ensured reduction in disability at the end of the treatment, and the effect of such reduction continued for four weeks after the treatment. We, therefore consider that KT has an important effect on the increase in daily functions and such effect is independent from the technique of taping when applied with physiotherapy modalities and exercise therapy.

The main limitation of our study is that, although the patients were recommended to continue exercise therapy at the end of the treatment, it was not possible to follow the patients whether they continued exercises. The main strength of our study, on the other hand, is that it shows short-term improvement at the end and after the treatment.

In conclusion, our study results suggest that KT ensures reduction in pain and disability, irrespective of the technique of taping, with sustainable effects in the short term at the end and after the treatment. We consider that this method is effective when used together with the other methods of treatment for chronic LBP. Nonetheless, there is still a need for further large-scale and long-term studies to investigate the effect of KT on chronic non-spesific LBP.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

REFERENCES

1. Krismer M, van Tulder M. Strategies for prevention and management of musculoskeletal conditions. Low back pain (non-specific). Best Pract Res Clin Rheumatol 2007;21:77-91.
2. Hooten WM, Cohen SP. Evaluation and treatment of low back pain: a clinically focused review for primary care specialists. Mayo Clin Proc 2015;90:1699-718.
3. Koes BW, van Tulder MW, Thomas S. Diagnosis and treatment of low back pain. BMJ 2006;332:1430-4.
4. van Middelkoop M, Rubinstein SM, Verhagen AP, Ostelo RW, Koes BW, van Tulder MW. Exercise therapy for chronic nonspecific low-back pain. Best Pract Res Clin Rheumatol 2010;24:193-204.
5. van Middelkoop M, Rubinstein SM, Kuijpers T, Verhagen AP, Ostelo R, Koes BW, et al. A systematic review on the effectiveness of physical and rehabilitation interventions for chronic non-specific low back pain. Eur Spine J 2011;20:19-39.
6. French SD, Cameron M, Walker BF, Reggars JW, Esterman AJ. A Cochrane review of superficial heat or cold for low back pain. Spine (Phila Pa 1976) 2006;31:998-1006.
7. Castro-Sánchez AM, Lara-Palomo IC, Matarán-Peñarrocha GA, Fernández-Sánchez M, Sánchez-Labraca N, Arroyo-Morales M. Kinesio Taping reduces disability and pain slightly in chronic non-specific low back pain: a randomised trial. J Physiother 2012;58:89-95.
8. de-la-Torre-Domingo C, Alguacil-Diego IM, Molina-Rueda F, López-Román A, Fernández-Carnero J. Effect of kinesiology tape on measurements of balance in subjects with chronic ankle instability: a randomized controlled trial. Arch Phys Med Rehabil 2015;96:2169-75.
9. Paoloni M, Bernetti A, Fratocchi G, Mangone M, Parrinello L, Del Pilar Cooper M, et al. Kinesio Taping applied to lumbar muscles influences clinical and electromyographic characteristics in chronic low back pain patients. Eur J Phys Rehabil Med 2011;47:237-44.
10. Kase K, Wallis J, Kase T. Clinical therapeutic application of the kinesiotaping method. 2nd ed. Tokyo: Ken Ikai Co Ltd; 2003.
11. Kase K, Wallis J, Kase T, editors. Clinical therapeutic application of the kinesiotaping method. 3rd ed. Albuquerque, NM: Kinesio Taping Association International; 2013.
12. Luz Júnior MA, Sousa MV, Neves LA, Cezar AA, Costa LO. Kinesio Taping® is not better than placebo in reducing pain and disability in patients with chronic non-specific low back pain: a randomized controlled trial. Braz J Phys Ther 2015;19:482-90.
13. Lemos TV, Albino AC, Matheus JP, Barbosa Ade M. The effect of kinesio taping in forward bending of the lumbar spine. J Phys Ther Sci 2014;26:1371-5.
14. Moll J, Wright V. Measurement of spinal movement. In: Jayson M, editor. The Lumbar Spine and Back Pain., New York: Grune and Stratton Inc,; 1976. p. 96.
15. Yakut E, Düger T, Oksüz C, Yörükan S, Ureten K, Turan D, et al. Validation of the Turkish version of the Oswestry Disability Index for patients with low back pain. Spine (Phila Pa 1976) 2004;29:581-5.
16. Küçükdeveci AA, Tennant A, Elhan AH, Niyazoglu H. Validation of the Turkish version of the Roland-Morris Disability Questionnaire for use in low back pain. Spine (Phila Pa 1976) 2001;26:2738-43.
17. Kuukkanen T, Mälkiä E. Effects of a three-month therapeutic exercise programme on flexibility in subjects with low back pain. Physiother Res Int 2000;5:46-61.
18. Kim TH, Kim EH, Cho HY. The effects of the CORE programme on pain at rest, movement-induced and secondary pain, active range of motion, and proprioception in female office workers with chronic low back pain: a randomized controlled trial. Clin Rehabil 2015;29:653-62.