

The effect of Kinesio taping on back pain in patients with Lenke Type 1 adolescent idiopathic scoliosis: A randomized controlled trial



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ABSTRACT

Purpose: This study investigated the short-term effects of KT on back pain (BP) in patients with Lenke Type 1 adolescent idiopathic scoliosis (AIS).

Methods: We chosen Lenke Type 1 scoliosis who have had only back pain (the localization of the pain: the only in the apical convex edge). Forty patients suffering from BP with Lenke Type 1 AIS were randomly separated into two groups, Group 1 (20 patients) and Group 2 (20 patients). Group 1 was given KT with tension and home exercises and Group 2 was given KT without tension and home exercises. KT and home exercises was applied to the thoracic area of the patients in both groups for four weeks. Pain intensity was measured using a visual analog scale (VAS) and SRS-22 (subtotal SRS-20) before and after treatment.

Results: Mean age of both groups was 16.1 years. Mean Cobb angle of the thoracic scoliosis was 31.8° (range: 17°–44°) in Group 1 and 32.8° (range: 19°–43°) in Group 2 before the treatment. The decrease in VAS score of Group 1 after taping was higher than that of Group 2. The difference between the pre- and post-treatment VAS scores of both groups was statistically significant ($p < 0.05$). The increase in mean SRS-20 score of Group 1 following taping application was significantly higher than the increase in the control group ($p < 0.05$).

Conclusion: Results demonstrated that KT application with tension effectively leads to back pain relief shortly after application. In addition, KT has a positive impact on quality of life. Thus, KT may be a suitable intervention in treating back pain of patients with AIS.

Level of Evidence: Level 1, Therapeutic study

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Introduction

Despite its lower prevalence in adolescents than adults, back pain is a more common problem in patients with BP scoliosis when compared with the normal population.^{1–3} Studies have reported a wide range for prevalence of back pain in adolescent idiopathic scoliosis (AIS), from 23 to 85%.^{1–7} When accompanied by AIS, BP has a negative impact on the psychosocial status of the individual.⁸

Several researches have been conducted to study conservative treatment methods for BP of patients with AIS. Conservative treatment of BP with AIS include swimming, home exercises, chiropractics, manual therapy, electrical stimulation, acupuncture, Pilates, yoga, use of medication (acetaminophen, nonsteroidal anti-inflammatory drugs, myorelaxants or opioid analgesics), back school and spinal manipulation.^{9–19} However, there is still no treatment algorithm based on evidence. Thus, order of choice for these methods is totally random. Kinesio taping (KT) is a conservative treatment method for controlling pain in the treatment of musculoskeletal conditions which have recently gained popularity. The technique has been first defined by Kenzo Kase. Kinesio tape is a non-invasive technique allowing a longitudinal stretch of 55–60% more than its regular length. Inventors of this technique suggested

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two different concepts with two different amounts of tension in application of the method. With the light (15–25%) tension application of the method from the insertion point to the origin of the muscle, the muscular function is inhibited, whereas with the light-to-moderate (25–50%) tension application of the method from the origin of the muscle to the insertion point activates the muscular function.²⁰

In this study, we aimed to evaluate the efficacy of KT as an alternative treatment choice in BP patients with Lenke Type 1 AIS who were given KT plus home exercises and control group KT (without tension) plus home exercises. Besides, we aimed to give variety and bring to innovation to an alternative conservative treatment choice for BP with AIS.

Materials and methods

This prospective, randomized controlled clinical trial with a 4-week follow-up period was performed as a single-center study. Patients who were diagnosed with Lenke Type 1 AIS, who have had only back pain (the localization of the pain: the only in the apical convex edge) for more than 3 months, and those between 10 and 18 years of age and were students were included in the study. We chosen Lenke Type 1 scoliosis with patients because they are seen more often than other types and KT is not successful for low back pain with other Lenke types (e.g. Lenke type 5 or 6). Those who had LBP, a systemic or local regional infection, malignancy, neurodermatitis, skin diseases such as eczema or psoriasis, decompensated heart failure; were pregnant; had advanced asthma, epilepsy, intervertebral disc disease, previous surgery (spinal fusion), spinal cord anomalies and tumors, any pathological spinal anomalies, such as spondylolysis, spondylolisthesis and lumbosacral transitional anomalies that could be associated with BP; underwent physiotherapy and medical treatment for scoliosis within last year and/or used brace were excluded. The patients were evaluated for decision of the conservative treatment by two orthopedics surgeons. The patients had only back pain. The patients did not have progressive curve. KT was performed by a certified Kinesio taping practitioner. Home exercises were given by the specialist of physical medicine and rehabilitation.

All patients were evaluated according to Lenke et al²¹ classification, with standing anteroposterior, lateral, traction and bending radiographs. Type 1 deviation (structural, main thoracic curvature, non-structural proximal and thoracolumbar/lumbar curvature) was present in all cases. Type and size of deviation, lumbar and sagittal plane parameters, kyphosis, lordosis, SVA, PI, SS, and PT were measured and recorded. But, we did not evaluate the thoracic hump of patients.

Our hospital has an experts group for spine surgery. We planned this study for 6 months. We hoped that more patients will come in our clinic. But forty-six patients with Lenke Type 1 AIS accepting our study came for KT treatment. Six patients did not adjust to treatment. These patients were removed from this study. Forty patients who met the inclusion criteria were randomly with computer program divided into two groups. Group 1 (20 patients) was given KT and home exercises application and Group 2 (20 patients) control group KT and home exercises. Patients' data regarding their age, sex, height, weight and profession were collected and their preference for KT color was noted. After they were trained about the KT application, the patients were asked not to remove the tape unless a reaction developed. The skin was cleaned with alcohol. Patients with bristle were asked to cut them 1 h prior to application. Attention was paid to ensure the tapes had rounded edges. The patients were called for follow-up with intervals of one week and standard Kinesio[®] Tex Gold Classic tape (5 cm width) was applied for four times. In the Group

1 (KT with tension), the tape was applied over the area of spinalis thoracis muscle (between T3 and L1) (origin point: spinous processes of T11 to L3, insertion point: spinous processes of T3 to T8) with 25–50% of tension for the convex side (from the origin of the muscle to the insertion point) for and 15–25% of tension for the concave side (from the insertion of the muscle to the origin point) (Fig. 1). In the Group 2 (KT without tension), a paper off tension application of taping was done longitudinally over the thoracic area (between T3 and L1) for the convex side (from the origin of the muscle to the insertion point) for the concave side (from the insertion of the muscle to the origin point) (Fig. 2). That is, we applied similar to areas in Group 2 according to the KT with tension group. Application area (between T3 and L1) was contained both painful region origin and insertion points of the each muscle.

Home exercises consisted of stretching and strengthening exercises. Stretching exercise for the concave side and strengthening exercise for the convex was performed all patients. Three sets of stretching exercise for the concave side, with each set involving a 20-s hold and 20-s rest with four reps were performed three times a week for four weeks. Three sets of strengthening exercise for the convex side, included 20 reps with a 20-s hold, was performed three times a week for four weeks. Benefits of regular exercise were told to the patients and they were encouraged to do their first session with a supervisor. Patients were told to avoid repetitive and compelling thoracic and lumbar movements.

Patients were given visual analog scale (VAS) forms and were asked to fill them in before and after treatment for evaluation of pain.²² Subtotal SRS-20 section of the SRS-22 questionnaire were filled for assessing their quality of life. Patients' perception of their deformity has become a measurable quantity through the use of health-related quality of life. The most commonly used tool currently is the Scoliosis Research Society-22 (SRS-22) questionnaire for the assessment of spinal deformity, whose Turkish version has been validated.²³ Pain, self-image, functional activity, and mental health were the components of the SRS-22 questionnaire (subtotal SRS-20).

Mean, standard deviation, median, minimum and maximum values were used in descriptive statistics of the data. Distribution of the variables was analyzed with the Kolmogorov–Smirnov test. Mann–Whitney U test was utilized in analyzing quantitative data. Analysis of repetitive measurements was done with the Wilcoxon test. The chi-square test was employed in analysis of qualitative data, or Fischer's test where chi-square test conditions were not met. Level of statistical significance was set at $p < 0.05$. Statistical analyses were performed using the SPSS 22.0 software.

Results

Mean age was 16.1 (range: 14–18) years in Group 1 and 16.1 (range: 13–18) years in Group 2 ($p > 0.05$). Nineteen female (95%) and one male (5%) patient were in Group 1 and 18 female (90%) and two male (10%) patients in Group 2 ($p > 0.05$).

Mean body mass index (BMI) in Group 1 was 28.4 ± 5.2 kg/m² and in Group 2, 26.8 ± 5.2 kg/m², respectively. There were no significant differences between the 2 groups in terms of BMI ($p > 0.05$).

Group 1 had 12 patients (60%) with Lenke Type 1A, six (30%) with Type 1B, and two (10%) with Type 1C curvature. Group 2 had nine patients (45%) with Type 1A, nine (45%) with Type 1B, and two (10%) with Type 1C curvature. No statistically significant difference was observed between two groups in terms of lumbar modifier ($p > 0.05$).

As shown in Table 1, there was no statistically significant difference between two groups in terms of other demographic

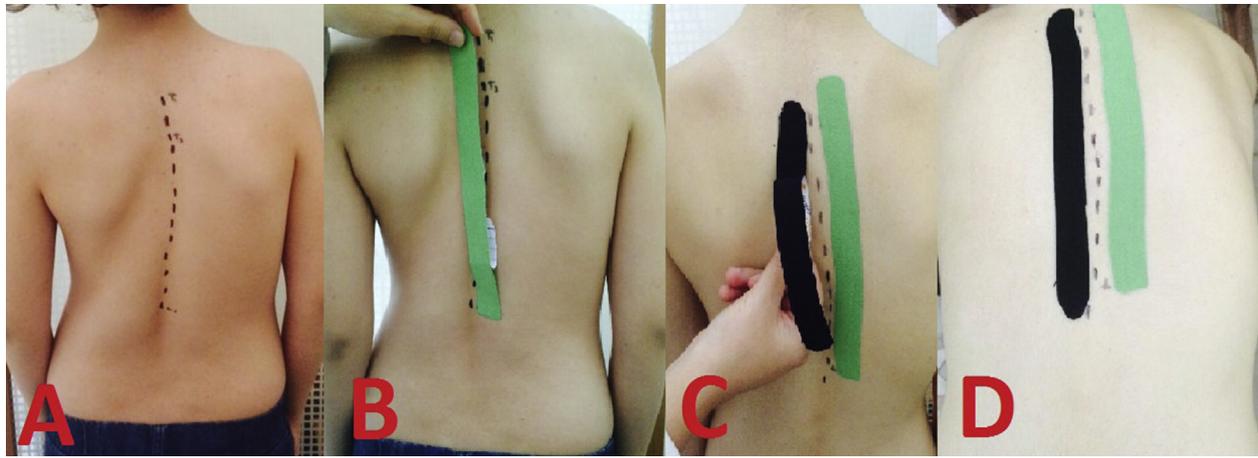


Fig. 1. KT with tension application: over the area of spinalis thoracis muscle (between T3 and L1) 25–50% of tension for the convex side (from the origin of the muscle to the insertion point) for and 15–25% of tension for the concave side (from the insertion of the muscle to the origin point). A. Determination of muscle localizations. B. Application for the convex side with tension (about between 25% and 50%). C. Application for the concave side with tension (about between 15% and 25%). D. Image after post-treatment KT application with tension.



Fig. 2. KT without tension or paper off technique application: over the thoracic area (between T3 and L1) for the convex side (from the origin of the muscle to the insertion point) for the concave side (from the insertion of the muscle to the origin point). A. Determination of muscle localizations. B. Application for the convex side without tension. C. Application for the concave side without tension. D. Image after post-treatment KT application without tension.

Table 1
Other demographic characteristics.

	Group 1 KT plus home exercises Mean ± S.D. Median (min–max)	Group 2 Control group Mean ± S.D. Median (min–max)	p values
Number of patients	20	20	
Mean thoracic scoliosis (°)	31.8 ± 8.5 31.5 (17–44)	32.8 ± 7.5 35 (19–43)	0.797
Mean lumbar scoliosis (°)	20.3 ± 9.5 19 (3–39)	21.6 ± 7.7 22 (5–33)	0.533
Mean thoracic kyphosis (°)	28.6 ± 12 24 (13–54)	27.3 ± 10.6 27.5 (6–48)	0.725
Mean lumbar lordosis (L1–S1) (°)	52.4 ± 11.2 51 (27–75)	47.6 ± 11.3 50 (15–61)	0.343
SVA (mm)	–9.2 ± 28.2 –7.5 (–63–33)	–12.4 ± 23.4 –8 (–51–42)	0.645
PI (°)	45.1 ± 12.9 43.5 (19–76)	40.6 ± 11.5 39 (22–60)	0.273
SS (°)	34.8 ± 9.9 36.5 (12–49)	31.9 ± 8 30.5 (17–47)	0.233
PT (°)	10.3 ± 8.1 9.5 (0–27)	8.8 ± 6.9 8 (0–25)	0.655

parameters ($p > 0.05$). Mean SRS-22 (subtotal SRS-20) and VAS values of the patients are given in Table 2.

Post-treatment VAS score of Group 2 (control group) did not have a statistically significant difference when compared to the pre-treatment value ($p > 0.05$). In Group 1 (KT group), however, post-treatment VAS score was significantly lower than the pre-treatment value ($p < 0.05$). In addition, this decrease in VAS score of Group 1 was statistically significant when compared with that of the paper off tension application group ($p < 0.05$). Based on the difference in total SRS-20 score of Group 1, it was concluded that the quality of life of the patients was affected more positively ($p < 0.05$).

None of the patients developed a complication.

Discussion

In this study, we compared the results of KT with tension plus home exercises with KT without tension plus home exercises in treatment of AIS patients with BP. A statistically significant reduction in pain was observed in the KT with tension application group when compared to the control group.

Thérout et al.³ reported a BP prevalence of 47.3% in AIS patients but relationship between BP and specific spinal area was documented under 40% by authors. The authors also investigated possibility of an association between the type of scoliosis and pain and found a statistically significant relationship between BP and thoracic scoliosis. However, they did not find a significant relationship between the degree of Cobb's angle and BP. In addition, the authors reported the intensity of BP in scoliotic patients as mild or moderate and reported severe pain as only 1%. Joncas et al.² reviewed 239 AIS patients prospectively and analyzed the relationship between BP and low back pain (LBP). The authors observed curvatures both in thoracic and lumbar regions of the patients with scoliosis and noted the prevalence of pain as 54%. Pain intensity, as calculated by the mean VAS score, was moderate. The authors also failed to identify a statistically significant relationship between the degree of Cobb's angle and BP. In general, it is fair to say that BP is a common problem in AIS. The intensity of pain is either of a mild or moderate nature. Our patients also filled VAS for assessing their BP. VAS scores ≤ 3.4 were best reported for patients with chronic musculoskeletal pain as mild pain, 3.5 to 7.4 as moderate pain, and ≥ 7.5 as severe pain.²⁴ In our study, Group 1 patients had mild pain (10%), moderate pain (55%) and severe pain (35%) before treatment. Group 2 patients had mild pain (30%), moderate pain (60%) and severe pain (10%), before treatment according to analysis VAS scores. Our study found a high prevalence of severe pain but the patients in this study did not

represent all scoliosis. Even so, we best evaluated in terms of intervertebral disc disease, spinal cord anomalies and tumors, pathological spinal anomalies, spondylolysis, spondylolisthesis and lumbosacral transitional anomalies in MR. Our hospital has an experts group for spine surgery. We reevaluate the patients with regular periods. None of patients had these pathologies and another disease. Though there is no direct association between the size of deviation and BP, the occurrence of BP might increase based on the type of the deviation (thoracic), the degree of rotational subluxation, and sagittal balance problems.^{2,3,25} In order to avoid a possible negative impact of these results on our study, we chose the same type of deviation for both groups when planning the treatment. In addition, as pathologies on the sagittal plane could have an effect on the nature of the pain and results of our treatment, we also evaluated the parameters on the sagittal plane and checked to see whether a statistically significant difference between the groups existed. There was no statistically significant difference for both groups in terms of sagittal plane parameters.

It is a known fact that BP of patients with AIS cause health-related quality of life problems. As there is still no treatment algorithm, based on evidence, set for the management of BP in patients with AIS, the physicians tend to make their choices of treatment modalities on a random basis. Home exercises, physical therapy, use of medication (acetaminophen, nonsteroidal anti-inflammatory drugs, myorelaxants or opioid analgesics), back school and spinal manipulation are the most commonly used treatment methods.^{11–19} Kinesio taping has recently become a popular technique in conservative treatment of pain. One of the major aspects of this method is its applicability in all stages of rehabilitation (acute, subacute, chronic) and also as a prophylactic.²⁶ Although the number of scientific attempts to clarify the effect mechanism of KT is limited,²⁷ the idea of the technique is based on creating a free range of motion to enable the muscular system heal itself biomechanically and being a support for movement.^{27,28} The application lifts the skin, thus increases the interstitial space of the dermis and hypodermis and decreases the pressure in the region. As a consequence, the blood flow and movement of the region increase, leading to reduction of inflammation, in other words, cooling of the related zone. It also decreases the irritation of chemical receptors. Reduction of pain in turn gives way to improvement of muscle functions, reduction of neuromuscular system activation of blood and lymph circulation, and acceleration of the blood flow and tissue healing. It also increases the movement of the joints by stimulating the proprioceptors.^{26,28} The technique is also believed to directly reduce the pain via the gate control theory by activating the mechanoreceptors through application of the tape directly on the skin.^{29,30} Kinesio

Table 2
The results of subtotal SRS-22 and VAS scores.

	Group 1 KT plus home exercises Pre-treatment Mean \pm S.D. Median (min–max)	Group 1 KT plus home exercises Post-treatment Mean \pm S.D. Median (min–max)	p values	Group 2 Control group Pre-treatment Mean \pm S.D. Median (min–max)	Group 2 Control group Post-treatment Mean \pm S.D. Median (min–max)	p values
Pain	3.1 \pm 0.8 3.2 (1.8–4.6)	3.7 \pm 0.6 4 (1.8–4.4)	<0.05	3.5 \pm 0.6 3.4 (2.2–4.8)	3.8 \pm 0.7 4 (2.6–4.8)	<0.05
Self image	3.3 \pm 0.8 3.5 (2–4.4)	3.6 \pm 0.8 3.6 (1.6–4.8)	>0.05	3.4 \pm 0.8 3.6 (2–4.6)	3.5 \pm 0.6 3.5 (2.6–4.6)	>0.05
Functional activity	3.9 \pm 0.8 3.9 (2.2–5)	4.1 \pm 0.7 4.2 (2.8–5)	>0.05	4.1 \pm 0.6 4.1 (2.6–5)	4.3 \pm 0.6 4.3 (3.2–5)	>0.05
Mental health	3.1 \pm 0.7 3.1 (1.4–4)	3.2 \pm 0.8 3.2 (1.4–4.4)	>0.05	3.2 \pm 0.9 3.2 (1.4–4.8)	3.2 \pm 0.8 3.1 (1.8–4.8)	>0.05
Total average score (subtotal SRS-20)	3.3 \pm 0.6 3.5 (2.1–4.5)	3.7 \pm 0.6 3.8 (2–4.3)	<0.05	3.5 \pm 0.6 3.6 (2.7–4.4)	3.7 \pm 0.5 3.7 (2.7–4.8)	>0.05
VAS	6.6 \pm 2 7 (3–9)	3.5 \pm 2.2 3 (0–9)	<0.05	4.8 \pm 2.3 4 (1–10)	4.1 \pm 2.1 3.5 (1–8)	>0.05

taping has recently found itself an intriguing place in treatment of musculoskeletal disorders (physical therapy, orthopedics, and sports medicine).³¹ According to Kase, the success of the method depends on precise evaluation of the patients and proper application of the technique in all stages.²⁶ Muscle spasms on the concave side in scoliotic patients relieves with stretching exercises while muscle weakness on the convex side diminishes with strengthening exercises. Thus, the muscle balance will improve and BP will regress.^{32,33} We employed the same mentality in our application of KT and home exercises with the patients.

The use of KT in relieving or eliminating pain has increased in recent years with the focus mainly on LBP rather than BP.^{34–36} Parreira et al³⁴ applied 10–15% of tension to one of their groups with chronic, non-specific LBP and KT without tension on the second one and found no statistically significant difference between two groups. In their series of chronic, non-specific LBP patients, Castro Sánchez et al³⁵ applied KT on one group and KT without tension on the other. Although the authors concluded that KT reduced pain and disability when compared to KT without tension, they reported that the clinical improvement they observed was minimal. Paolini et al³⁶ compared KT plus exercise, KT alone and exercise alone on their patients with chronic LBP. Based on their results, all groups experienced pain relief, however, there was no statistically significant difference in terms of pain relief between the KT group and exercise alone group. Luz Júnior et al³⁷ divided their chronic, non-specific LBP patients into three groups based on their treatment methods; the KT group, Micropore (placebo) group, and the control (no tape application) group. The groups did not have a statistically significant difference in terms of pain. However, patients with KT and Micropore patients had slightly better results with pain relief. In terms of disability, KT and placebo groups had similar results; with the distinction that KT group was superior to the control group. However, the treatment results in this study are collected in a very short period (outcomes investigated at 48 h and at seven days after baseline testing). In our study, Group 1 patients had mild pain (10%), moderate pain (55%) and severe pain (35%) before treatment. Group 2 patients had mild pain (30%), moderate pain (60%) and severe pain (10%), before treatment. Group 1 patients had mild pain (55%), moderate pain (35%) and severe pain (10%) after treatment. Group 2 patients had mild pain (50%), moderate pain (40%) and severe pain (10%), after treatment. The mean VAS score for Group 1 was measured as 6.6 ± 2 (range 3–9) pre-treatment, 3.5 ± 2.2 (range 0–9) following the post-treatment ($p < 0.0001$). The mean VAS score for Group 2 was measured as 4.8 ± 2.3 (range 1–10) pre-treatment, 4.1 ± 2.1 (range 1–8) following the post-treatment ($p = 0.25$). Reduction in VAS score of Group 1 was statistically significant higher than Group 2 ($p = 0.001$). The mean pain component in SRS-22 questionnaire for Group 1 was measured as 3.1 ± 0.8 (range 1.8–4.6) pre-treatment, 3.7 ± 0.6 (range 1.8–4.4) following the post-treatment ($p = 0.001$). The mean pain component in SRS-22 questionnaire for Group 2 was measured as 3.5 ± 0.6 (range 2.2–4.8) pre-treatment, 3.8 ± 0.7 (range 2.6–4.8) following the post-treatment ($p = 0.022$). But, There was no statistically significant difference between two groups ($p = 0.083$). The increase in mean SRS-20 score of Group 1 following taping application was significantly higher than the increase in the control group ($p = 0.038$). These results demonstrated that KT application with tension effectively leads to back pain relief better than KT without tension.

Vanti et al³⁸ performed a meta-analysis of randomized trials on the effect of KT on spinal pain and disability. The authors investigated different types of KTs and following their systematic reviews they pointed out to the insignificant support for KT. Kachanathu

et al³¹ applied conventional physical therapy with KT and conventional physical therapy without KT to their non-specific LBP patients and evaluated the results of both groups. Although both groups achieved successful treatment results, the difference between pain, activities of daily living (ADL), and ranges of motion (ROM) of trunk flexion and extension parameters are not statistically significant. In contrast to the above studies, Bae et al³⁹ reported a statistically significant difference between VAS and ODI scores of chronic LBP patients treated with KT. It seems there are not many studies focusing on the treatment of BP with KT in scoliotic patients. In our study, however, we compared the treatment results of Group 1 (KT plus home exercises) with Group 2 (control group). According to the VAS scores, KT plus home exercise provided a statistically significant difference and also reduced pain more efficiently. In addition, there was a statistically significant difference between the mean totals of SRS-22 pain component which assessed general quality of life. This positive difference was in favor of KT plus home exercise patients.

The technique could simply be employed as a non-invasive method of treatment for BP in scoliotic patients as it is practical and does not hinder daily activities or cause a complicated side-effect. However, our study had some limitations. First, we only evaluated the short-term effects of KT application. Under these circumstances, it is impossible to tell whether the treatment is effective in the long-term. Another limitation of our study was the limited number of patients and lack of a group with no KT application. Tapes do have some tension capacity on their own and this might have had a therapeutical effect in the placebo group.²⁶ Although the lack of a control group and limited number of patients refrain us from reaching a general conclusion, favorable improvements were achieved, particularly in reduction of the pain, functional status, and health-related quality of life with the treatment applied and no side-effect was observed. It can be concluded that further randomized, controlled trials with high methodological quality and long follow-up periods are required to evaluate the use and efficacy of KT application on BP of patients with scoliosis and to present results or suggestions regarding the optimal number of sessions and duration of application.

Conclusion

According to the results of this study, the effects of Kinesio taping are better than a control group. The application of Kinesio tape reduces the back pain and increases the quality of life in patients with Lenke Type 1 adolescent idiopathic scoliosis. Spinal surgeons, sport physicians, physicians of physiotherapy and rehabilitation can use Kinesio taping in scoliosis with back pain.

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