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Diz Osteoartritli Yaşlı Kadınlarda Kinezyo Bantlama Öncesi ve Sonrası Fonksiyon, Ağrı ve Dinamik Denge: Bir Pilot Çalışma

Function, Pain And Dynamic Balance Before And After Kinesio Taping In Older Women With Knee Osteoarthritis: A Pilot Study

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Öz

Giriş ve Amaç: Diz osteoartritli yaşlı kadınlarda tek seans Kinezyo bantlama uygulamasının fonksiyon, ağrı ve dinamik denge üzerine etkisini belirlemekti.
Gereç ve Yöntemler: Çalışmaya unilateral diz osteoartritli 30 kadın dahil edildi. Kuadrisepsfemoris ve hamstring kaslarına tek seans Kinezyo bantlama uygulandı. Tüm değerlendirmeler,Kinezyo bantlama öncesi ve bantlama uygulamasından 30 dakika ve 48 saat sonra olmak üzere üç kez yapıldı. Fonksiyonel seviye ve ağrı Diz İncinme ve Osteoartrit Sonuç Skoru ile, dinamik denge libra-bilgisayarlı denge cihazı ile değerlendirildi.
Bulgular: Diz İncinme ve Osteoartrit Sonuç Skoru'nun semptom (p=0.001), ağrı (p=0.001), fonksiyon-günlük yaşam (p=0.001), yaşam kalitesi (p=0.01) alt ölçek puanları ile bipedal (p=0.005) ve etkilenen taraftaki (p=0.002) dinamik denge sonuçları üç zaman noktası arasında istatistiksel olarak anlamlı fark bulundu.
Sonuç: Tek seanslık bir Kinezyo bantlama uygulaması unilateral diz osteoartritli yaşlı kadınların fonksiyon, ağrı ve dinamik dengelerinde klinik olarak major değişiklik oluşturmayan ancak istatistiksel olarak anlamlı iyileşme ve kısa süreli pozitif etki sağladı.

Anahtar Kelimeler: Ağrı, Denge, Osteoartrit, Yaşlı.

Abstract

Objective: The study aim to establish the effect of single-session Kinesio Taping (KT) application upon the function, pain, and dynamic balance in older women with knee osteoarthritis (OA).
Materials and Methods: Thirty-women with unilateral knee (OA) were included. A single-session KT intervention was applied to the quadriceps-femoris and hamstrings muscles. All assessments were performed three times, before Kinesio taping, 30 minutes and 48 hours after taping. Functional level and pain were evaluated with the Knee Injury and Osteoarthritis Outcome Score (KOOS), and the dynamic balance was evaluated with the libra-computerized balance device.
Results: Symptoms (p=0.001), pain (p=0.001), function-daily life (p=0.001), quality of life (p=0.01) subscale scores of KOOS and bipedal (p=0.005) and affected side (p=0.002) dynamic balance results showed statistically significant improvements among the three time points.
Conclusion: A single session Kinesio taping application provided a statistically significant improvement and a short-term positive effect, which did not cause clinically significant changes in the function, pain and dynamic balances of elderly women with unilateral knee osteoarthritis.

Keywords: Balance, Elderly, Osteoarthritis, Pain.

1. Introduction

Osteoarthritis (OA) is a common degenerative disease affecting joint cartilage and an approximate 302 million people worldwide and is a significant reason of disability in elderly women [1]. It is stated that knee joint is the most frequently affected joint due to weight-bearing and repeated movement [1, 2]. A last study indicated that the approximate doubling of knee OA prevalence has occurred since the mid-20th century [2]. Moreover, Knee osteoarthritis in women is more severe than in men, and sex differences in severity were more significant among patients aged over 55 years [3]. The prevalence of knee OA in adults aged 60 years and over was approximately 10% in men and 13% in women [4]. It has been stated that the higher rate of knee OA occurrence and development in women may be due to differences in previous knee damage, hormonal responses, knee anatomy and kinematics [5].

Knee OA is usually accompanied by pain in and around the knee, joint stiffness, joint motion limitation, decreasing muscle strength, impaired knee proprioception, and pain-related fear of movement [6-8]. Knee instability, muscle weakness, and proprioceptive deficit, which are common impairments in knee OA, might lead to decreased postural control [9]. It has been shown that elderly women with unilateral knee OA have a decrease in postural balance with more swaying, less deliberate postural control ability and weight-bearing on the affected side [10]. In addition, it has been shown that as postural equilibration decreases in patients with knee OA, the level of pain and fatigue increases, while activity and motivation decrease [11].

Kinesio®Tape has emerged as a relatively new method with minimal side effects for the treatment of musculoskeletal diseases, including knee OA [12, 13]. Kinesio Taping (KT) is conditionally recommended for managing knee OA by the American College of Rheumatology (ACR) [1]. KT has several therapeutic benefits, including enhancing muscle function, increasing lymphatic drainage and blood flow and decreasing pain through neurological suppression [14, 15]. However, little is known about KT's possible effects on proprioception, and available studies have conflicting results. Some studies suggest that KT is ineffective in proprioception [16], while Cho et al. suggested that application of KT with appropriate tension to the quadriceps femoris muscle efficiently improved proprioception in OA patients [13]. Furthermore, it is hypothesized that increased proprioception through increased stimulation of cutaneous mechanoreceptors enhances balance ability [15, 17]. However, evidence balance is still limited, and KT's immediate effect on dynamic balance in knee OA has not been well identified, and further studies are needed to assess whether it has beneficial effects on dynamic balance [18, 19].

We aimed to investigate the patient-reported level of function, pain, and objectively assessed dynamic balance following a single-session KT application in older women with unilateral knee OA in this pilot study.

2. Materials and Methods

2.1. Ethical Approval

Ethical approval for this study was obtained from the Clinical Research Ethics Committee of xxx University (Approval number: 422). The protocol complies with the standards for human experimentation set by the Declaration of Helsinki.

2.2. Study Design and Setting

The present study used an uncontrolled single blind before-after study design. The elderly women with unilateral knee OA over 65 years were recruited over one year (2014–2015) from xxx Hospital in xxx. All patients provided informed consent before participation.

Participants were aged between 65 and 80 years and had unilateral knee OA were included in this study. A specialist in orthopedics performed the clinical examination and radiological imaging assessment. The participants met the ACR criteria of knee OA with grades 2-4 [20]. Participants with a neurologic disease, history of knee operation or intraarticular corticosteroid injection in the past six months, vestibular system disease, severe visual disturbance, radiculopathy, or peripheral neuropathy, psychiatric disease, and history of any skin allergy were excluded. Exclusion criteria from the study: Undergoing any physiotherapy for their current knee pain and receiving oral or topical analgesics or medication that affects balance control.

The InStat sample size calculator was used to determine sample size and power calculations. The calculations were based on a standard deviation of 18.8 points, the minimal clinically important difference (MCID) for Knee Injury and Osteoarthritis Outcome Score (KOOS) of 15.6 points, an alpha level of 0.05, a β level of 20%, and the desired power of 80% [21]. Using these parameters, the sample size was calculated to be at least 23 participants. We planned to recruit at least 30 subjects into the study.

2.3. Study Design

Individuals received a single-session KT application based on the manual by Kase et al. [12]. A physiotherapist with more than five years of experience in musculoskeletal care applied the KT application (SYY). All data analysis were performed by another researcher (TB), while a blind physiotherapist (SBH) evaluate the individuals. Outcome measurements were determined at baseline, 30 min after the KT application (with tape), and 48 h after the KT application (with tape) (Figure 1). Patients were informed to wear the tape for two days. Outcome measurements were performed at the same time and at the same place because in patients with

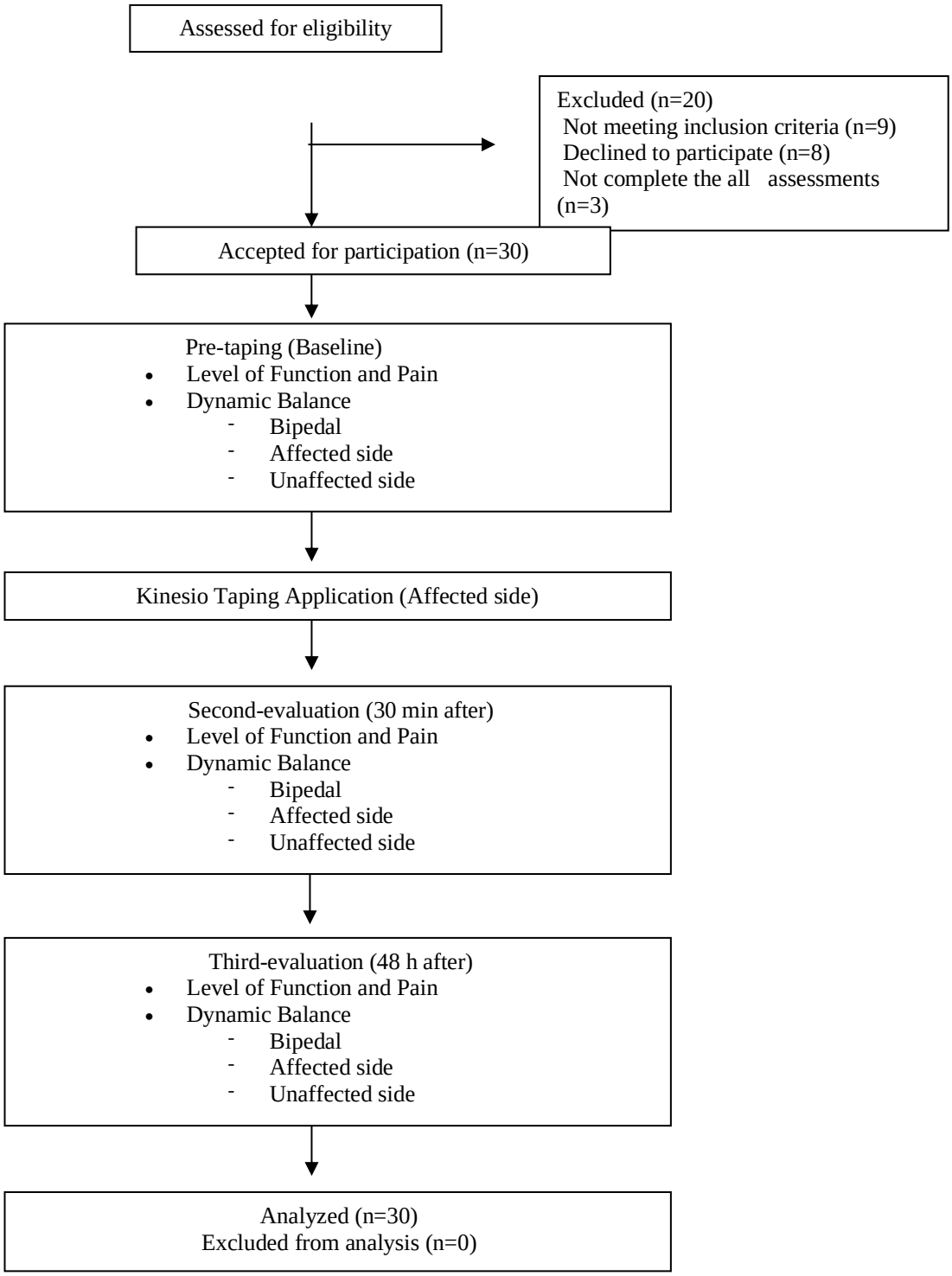

Figure 1. Flow chart of the study.

knee OA, balance ability seems to be impaired in the morning compared to the afternoon [22].

Tape Application

An adhesive Kinesio tape that was 5 cm wide and 0.5 cm thick was used. The tape was pre-cut as four Y strips and one I strip and individually tailored to each patient. First, the patients were in a supine position with the hip extended, the knee flexed at 20 degrees.

-The superior Y technique

The superior Y strip representing roughly mid-thigh over the vastus medialis muscle was applied from its

insertion to the origin with moderate tension (50% of available). The taping had no tension at the ends and were in a prone position with the hip extended and the affected knee at extension position. The fourth Y-strip applied to the hamstring muscle was applied from insertion to origin with moderate tension (50% of available). The tip of the tape terminated tension-free at the femoral epicondyles.

-The inferior Y technique

The inferior Y strip was representative of the inferior pole of the patella. Its medial tail ended on the vastus medialis muscle, while its lateral tail ended on the vastus lateralis muscle with moderate tension (50% of available). The taping had no tension at the ends and beginning, while the part between the anchor and the inferior patella was stretched.

-The I strip technique

For mechanical correction, an I strip was applied from the medial line to the lateral line of the knee joint with high (100% of available) and inward pressure along the lower pole of the patella. By holding the base with one hand, no tension was created during the application and no tension was ensured on the side joint line of the taping.

2.4. Outcome Measures

Primary Outcome

Knee Injury and Osteoarthritis Outcome Score is a reliable (α=0.90) and valid (r=0.83) questionnaire designed to evaluate symptoms and functional status related to knee OA. The KOOS holds five subscales: Pain, Symptoms, Function in daily living, Function in sport and recreation, and Qality of life. For each subscale, the possible scores that can be obtained from the scale range from 0 to 100, where the low scores indicate a decreased level of function [23]. The MCID in patients with knee arthritis is ranged from 2.2 to 15.0 for KOOS-pain and from 8.0 to 15.6 for KOOS-quality of life [21].

Secondary Outcomes

The Libra board (42 x 42 cm, weight 2.7 kg) is a device connected to a personal computer, and balance ability can be evaluated with software for assessing balance (Libra software, version 2.2). The Libra board has three difficulty levels (40 cm = high; 24 cm = medium; 12 cm = easy). In this study, the medium difficulty level was chosen and the participants were asked to fix their eyes on the wall (a point 3 m away at eye level). The balance test was performed on the lateral plane in three stance positions, including bipedal and monopodial (both left and right) positions. Each position was held for 30-s. The mean value of three repeated measurements of the dynamic balance with a 30-s time between repetitions was used to minimize the measurement error. The total score was ranged from 0 to 100, where the lower scores indicate a better dynamic balance ability [24]. The interclass correlation coefficient (ICC) for repeated tests was found as 0.90 [95% confidence interval (CI): 0.86 to 0.95] for bipedal position, 0.88 [95% CI: 0.86 to 0.91] for the monopodial position (right limb) and 0.90 beginning. The tip of the tail should end with no tension on the tibial tuberosity. Then, the participants [95% CI: 0.88 to 0.98] for the monopodial position (left limb) [25].

2.5. Statistical Analysis

We used Statistical Package for Social Science (SPSS version 21.0) for all statistical analyses. The distribution of data was evaluated with the Kolmogorov-Smirnov test. A one-way repeated-measures analysis of variance was used to compare the mean KOOS scores and dynamic balance among three-time points (baseline, at 30 min after and 48 h after). Partial eta-squared was used as an indicator of effect size, which was determined as small 0.01; medium 0.06, and large 0.14 [26]. A p-value less than 0.05 was considered evidence for a statistically significant difference. After differences among the means were determined, the least significant difference (LSD) post hoc test was used with a Bonferroni correction**.**

3. Results and Discussion

Fifty people were included with OA in the study , but 30 women with OA (mean age, 69.8±10.3 years) completed all assessments. Twenty women excluded from the study; nine of them did not meet inclusion criteria, eight of them declined to participate and three of them did not complete the all assessments. All participants were Caucasian. The demographic and characteristics data of participants are shown in Table 1.

Tablo 1. Characteristics of participants

Variable	**Mean (SD)**
Age (years)	69.8 (10.3)
Height (cm)	160 (7.90)
BMI (kg/cm^2)	31.5 (5.2)
Dominant side	**n (%)***
Right **Left**	30 (100) 0 (0)
Affected side	**n (%)***
Right **Left**	16 (53.3) 14 (46.7)
Radiological stage	**n (%)***
Stage 2 **Stage 3** **Stage 4** **Occupation** **Housewife** **Teacher** **Retired**	12 (40.0) 14 (46.7) 4 (13.3) **n (%)*** 23 (76.7) 4 (13.3) 3 (10)

Abbreviations: BMI, Body Mass Index.

The variables are expressed as mean (standard deviation (SD).

*Indicates that the number of patients (percentage) with unilateral osteoarthritis.

3.1. Knee Injury and Osteoarthritis Outcome Scores

There were statistically significant differences among the three time points were found for the symptoms (p = 0.001), the pain (p = 0.001), the function-daily living (p = 0.001), and the quality of life (p = 0.01) (Table 2). Pairwise comparisons revealed significant increases for the symptoms subscale score, 4.31 from Time 1 to Time 3 (p=0.001) and 3.45 from Time 2 to Time 3 (p=0.001). There were also significant increases for the pain subscale score, 7.43 from Time 3 to Time 1 (p=0.001), 5.42 from Time 3 to Time 2 (p=0.001), and 2.00 from Time 2 to Time 1 (p=0.01). Other significant differences were found in the function-daily living subscale score, 4.12 from Time 3 to Time 1 (p=0.001) and 3.71 from Time 3 to Time 2 (p=0.001) (Table 2).

Table 2. Comparison of the KOOS subscale scores after Kinesio taping application in patients with knee OA (n=30

Assessment	**Baseline (T1)**	**30 minutes after (T2)**	**48 hours after (T3)**	**ANOVA**	**Effect size**	**LSD**	
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**F (p)***		**Time-point**	**p****
KOOS							
Symptoms	53.49 (19.90)	54.35 (19.96)	57.80 (18.74)	***22.37 (0.001)***	0.49	T1-T2 T1-T3 T2-T3	0.07 ***0.001*** ***0.001***
Pain	51.91 (17.70)	53.91 (18.06)	59.34 (17.99)	***44.80 (0.001)***	0.68	T1-T2 T1-T3 T2-T3	***0.01*** ***0.001*** ***0.001***
Function, daily living	48.83 (21.02)	49.24 (21.16)	52.96 (22.05)	***34.35 (0.001)***	0.57	T1-T2 T1-T3 T2-T3	0.32 ***0.001*** ***0.001***
Function, sports and recreational activities	15.66 (10.24)	15.50 (10.01)	16.37 (9.93)	3.89 (0.05)	0.19	-	-
Quality of life	27.69 (15.09)	28.02 (15.05)	29.24 (15.39)	***5.39 (0.01)***	0.19	T1-T2 T1-T3 T2-T3	0.45 0.04 0.28

Abbreviations: KOOS, Knee Injury and Osteoarthritis Outcome Score; LSD, Least Significant Difference; T1, Time 1; T2, Time 2; T3, Time 3; Standard deviation, SD.

The variables are expressed as mean.

*One-way repeated-measures analysis of variance (one-way repeated-measures ANOVA); significance level set at <0.05.

Significance was accepted as p = 0.05/3 = 0.016 after Bonferroni correction

3.2. Dynamic Balance Outcomes

Significant differences among the three-time points were found for dynamic balance ability on bipedal (p=0.005), and on the affected side (taping side) (p=0.002), except for the dynamic balance on unaffected side (p=0.05) (Table 3).

Pairwise comparisons indicated statistically significant decreases for the bipedal dynamic balance score, − 1.11, and for dynamic balance on affected side score, − 2.97 from Time 1 to Time 3 (p=0.003 and p=0.005) (Table 3).

3.3. Discussion

The present study demonstrated that a single-session KT application had provided statistically significant, not clinically meaningful improvement in pain, symptoms, function in daily living, and quality of life subscale scores of KOOS. Besides, a single-session KT application has a short-term effect in terms of dynamic balance on both bipedal and affected side in patients with unilateral knee OA. However, no long-term effects of KT were identified.

The KT application showed a positive effect on pain, one of the major symptoms of knee OA. The pain-related mechanisms of KT application have not been explained yet. However, the continuous stretch stimulation provided by KT might impede the transmission of noxious stimuli via stimulated neuromuscular pathways (gate control theory) [27]. Another hypothesis proposes that KT might generate neural feedback received by the patients, facilitates their ability to move the knee joint with reduced mechanical irritation of the soft tissues easier [12]. Further, fear of movement, which is a significant factor for pain perception, has important clinical for patients with OA [8]. Pain causes fear of movement acquired by associative learning, thus being afraid of aggravating the pain, resulting in more pain [28].

Table 3. Comparison of the dynamic balance after Kinesio Taping application in patients with knee OA (n = 30)

Assessment	Baseline (T1)	30 minutes after (T2)	48 hours after (T3)	ANOVA	Effect size	LSD	
	Mean (SD)	Mean (SD)	Mean (SD)	F (p)*		Time-point	p**
Dynamic Balance							
Bipedal	6.40 (2.99)	5.99 (3.12)	4.88 (2.29)	***5.98 (0.005)***	0.34	T1-T2 T1-T3 T2-T3	0.34 ***0.003*** 0.27
Affected knee	7.30 (4.02)	5.23 (2.80)	4.33 (2.67)	***8.65 (0.002)***	0.30	T1-T2 T1-T3 T2-T3	0.22 ***0.005*** 0.61
Non-affected knee	6.76 (3.76)	5.60 (3.62)	5.30 (2.63)	3.25 (0.05)	0.23	-	-

Abbreviations: LSD, Least Significant Difference; T1, Time 1; T2, Time 2; T3, Time 3.
The variables are expressed as mean (standard deviation).
*One-way repeated-measures analysis of variance (one-way repeated-measures ANOVA); significance level set at <0.05. **Significance was accepted as p** = 0.05/3 = 0.016 after Bonferroni correction.

A study conducted in 2018, showed a significant improvement in the pain intensity, range of motion, and function of the patients who received KT [29]. Abolhasani et al. have reported that 1-h of KT is an effective treatment for reducing pain and improving active range of motion and physical function at a 72-h follow-up in patients with OA [30]. The reduction of pain with KT can be explained by the flexibility of the band and its application under tension. Improvement in pain is believed to affect pain perception directly [27]. Similarly, in our study, pain and symptoms subscale scores were decreased at 48 h after KT application, compared to baseline. However, the pain subscale score of the KOOS at 48 hours later did not surpass the minimal detectable change of 13.4 [31]. Hence, it could be pointed out that KT reduced pain level, but our findings should be considered within the study design limitations (e.g. small sample size).

The function-daily living and quality of life subscales of the KOOS have significantly differed from baseline to 48 h after. However, the differences in function-daily living and quality of life subscales scores of the KOOS did not surpass the minimal detectable change values. Nevertheless, experience pain-related fear of movement may influence the ability to begin or maintain in daily activity [8]. Hence, in our study, a decrease in pain might have contributed to enhancing performance in daily living activities, function, and knee-related quality of life after the KT application. On the other hand, no difference in function, sports, and recreational activities subscale score was found. These findings may be related to our study sample consist of elderly women aged between 65-80 years, and the short-term effects of a single-session KT application were investigated.

A recent study concluded that positive changes in muscle strength and function were detected 30 minutes after KT administration in patients with knee OA, but no effect on tissue temperature and static balance [19]. However, a single-session KT application has a short-term effect on the bipedal dynamic balance and dynamic balance on the affected side in patients with unilateral knee OA in our study. The KT has been suggested to increase proprioception through stimulated cutaneous mechanoreceptors, which in turn brings information about joint position and movement; therefore, dynamic balance on the affected side may be enhanced as a result of stimulated cutaneous mechanoreceptors [15, 32]. Hence, improved dynamic balance on the affected side might lead to better performance in bipedal dynamic balance. Previous studies in the literature found a relationbetween the decreased pain level and improved proprioception in patients with knee OA [13, 33]. Thus, it was assumed that improvement in dynamic balance ability might occur due to reduce of pain, increased proprioceptive stimulation, and neural feedback provided by KT. Besides, limitations in the functional activity and participation restrictions that cause a reduction in quality of life were found to be associated with pain patterns and poor postural stability in patients with knee OA [11, 34].

Limitations

We had some limitations that should be acknowledged. In this study, the short-term effects of a single-session KT application on function, pain and dynamic balance were investigated. However, the long-term effects of KT application remain unclear. The study findings will not be generalizable to elderly adults with knee OA, who are over 80 years or older. Also, patient self-report using the KOOS did not reflect the magnitude of improvement in function present 48 h after KT application because the last week should be considered when answering its questions. Another limitation is the absence of a control

group, which is essential to eliminate the possibility of the KT's placebo effect.

4. Conclusion

This pilot study showed that a single-session KT application might improve dynamic balance 48 h after the KT application in older women with unilateral knee OA. However, it should be considered that a single-session KT application did not provide a clinically meaningful improvement in terms of pain and function. Nevertheless, within the limitations of the present study, KT seems to provide beneficial effects on dynamic balance and, to some extent, short-term effects on function and pain in older women, aged between 65-80 years, with unilateral knee OA. We think that KT can be used safely in balance training in the rehabilitation of OA in elderly individuals. Future randomized-controlled clinical trials with a larger sample size should be conducted to research the effects of KT, which is low-cost, safe, non-invasive, and non-pharmacological methods, on patients with knee OA while attempting to apply more than one session over a long period.

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