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 B – Collection and/or assembly of data
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Effects of kinesiotape versus soft brace on selected parameters in patients with knee osteoarthritis

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Abstract

Introduction: Knee osteoarthritis (OA) is a chronic condition that results in pain, muscular fatigue, functional instability, and disability. Bracing and taping can be a suitable treatment for knee OA, hence the aim of this study was to compare the effects of a soft knee brace and kinesiotaping (KT) on gait and balance parameters in patients with knee OA.

Material and methods: Twenty-three patients with knee OA, grade I or II were evaluated. Gait parameters were measured using the motion analysis system including gait velocity and stance time (of the affected limb). Balance parameters including Overall Stability Index (OSI) and Medial-Lateral Stability Index variables were assessed using the Biodex stability system. Patients were assessed in three situations: without a knee soft brace or KT, with a soft brace, and with KT. The time interval was one week between each measurement. A paired t-test was used to compare patients in the three conditions.

Results: There were statistically significant differences in all gait and balance parameters except for the OSI after using kinesiotaping ($p < 0.05$) but not after bracing. There were clinical improvements in all outcomes after taping more significant than after a soft knee brace.

Conclusions: Kinesiotaping is more effective than the soft knee brace for gait and balance improvement in patients with knee OA.

Keywords: balance, gait, kinesiotaping, knee Osteoarthritis, soft knee brace



Introduction

Osteoarthritis (OA) is a chronic condition that commonly causes pain, fatigue, functional limitations, greater healthcare use, and high economic costs to society [1]. It is highly prevalent in the knee joint, accounting for 37% of OA cases [2].

Knee OA has several risk factors, including muscle imbalance [3], poor neuromuscular control [4], and malalignment [5,6]. Numerous changes in articular and periarticular soft tissues can arise due to knee OA. These include synovial hyperplasia, [7] joint effusions, and inflammation [8]. Knee OA patients have slower and disordered gait [9,10,11]. Furthermore, balance parameters are affected due to knee pain and disability in patients with knee OA [11,12].

Knee OA is commonly managed with medications, diet, and exercises [13,14]. Although these are effective, patients always prefer more passive, easy, fast strategies to control their pain and sense of fatigue and instability. For this reason, they usually use soft braces and kinesiotaping [15].

Soft braces are flexible and non-stick orthodontic devices recommended for non-surgical administration of patients with knee OA. Due to the ease of use, the absence of complications, and the low cost, soft braces are commonly used in order to reduce pain and activity restrictions [16]. It is also assumed that the soft brace stimulates the skin's mechanical receptors, which improves the accuracy of the deep sense of the joint, thus having an effect on the stability of the knee joint [17]. Improving the stability of the knee joint in this way may reduce activity restrictions [18,19]. A soft brace for OA in the knee leads to a moderate improvement in pain and a small-to-moderate improvement in self-reported physical function [20].

Kinesiotaping is a rehabilitative taping technique that is used to enhance the body's natural healing process while providing support and stability to the muscles and joints without restricting the body's range of motion. It comprises applying soft adhesive elastic tape to the patella and/or accompanying soft tissue structures. Kinesiotaping reduces pain, changes patellar alignment, and promotes deep sense, function and muscle activation [21–24]. Kinesiotaping also increases muscle flexibility, strength and improves proprioceptive sense in patients with various musculoskeletal disorders by normalizing muscle tone, decreasing pain, adjusting position and stimulating skin receptors. The effects of KT on muscle strength have been investigated by many researchers, who have concluded that KT increases muscle strength by creating a concentric pull on the fascia [25].

To the best of our knowledge, no study has been performed that compares the effects of kinesiotaping and soft brace in patients with knee osteoarthritis. Therefore, the aim of the study is to compare between kinesiotaping and soft brace on gait and balance parameters in patients with knee osteoarthritis.

Materials and methods

The current study design was a single group repeated measures design that was conducted in the physical therapy outpatient clinic at the Modern University for Technology and Information (MTI). Written consent was taken from all study participants. The study was approved by the Ethical Committee of the Faculty of Physical Therapy, Cairo University (P.T.REC/012/003651).

Participants

The study was conducted on 23 patients referred by an orthopedic surgeon with knee osteoarthritis and a mean age of 44.5 years. The patients were included if they were aged 30–60 years, diagnosed with unilateral symptomatic knee osteoarthritis, grade I or II on the Kellgren and Lawrence Scale, and had a body mass index $<35 \text{ kg/m}^2$. Patients were excluded if they had a history of major knee trauma, injury or surgery, tumors, moderate-to-severe osteoporosis, medications known to affect pain level, systemic illness, dermatological problems, local ischemic problems, bleeding tendency, psychiatric disorders, marked hearing impairment, and an inability to understand instructions or given consent. Figure 1 shows the flow chart of the study participants.

Sample size was calculated using G^* power (3.1) with an effect size of taping on balance = 0.53 (dependent t-test), $\alpha = 0.05$, and power = 0.8 showed a total sample size of 23 patients [18].

Procedures

Patients first underwent an assessment of gait parameters, followed by a balance parameters assessment for each subject as follow:

- without wearing any brace or tape;
- after one week, the second measurement was performed immediately after wearing the soft brace;
- and finally, the third measurement was performed after one week immediately following KT application.

The time interval was one week between each measurement and the next for washout and to avoid any remaining previous effect from the previous treatment. The tests were performed at the same time in the morning, at the same clinic, by the same clinician, and with the same instructions for each subject.

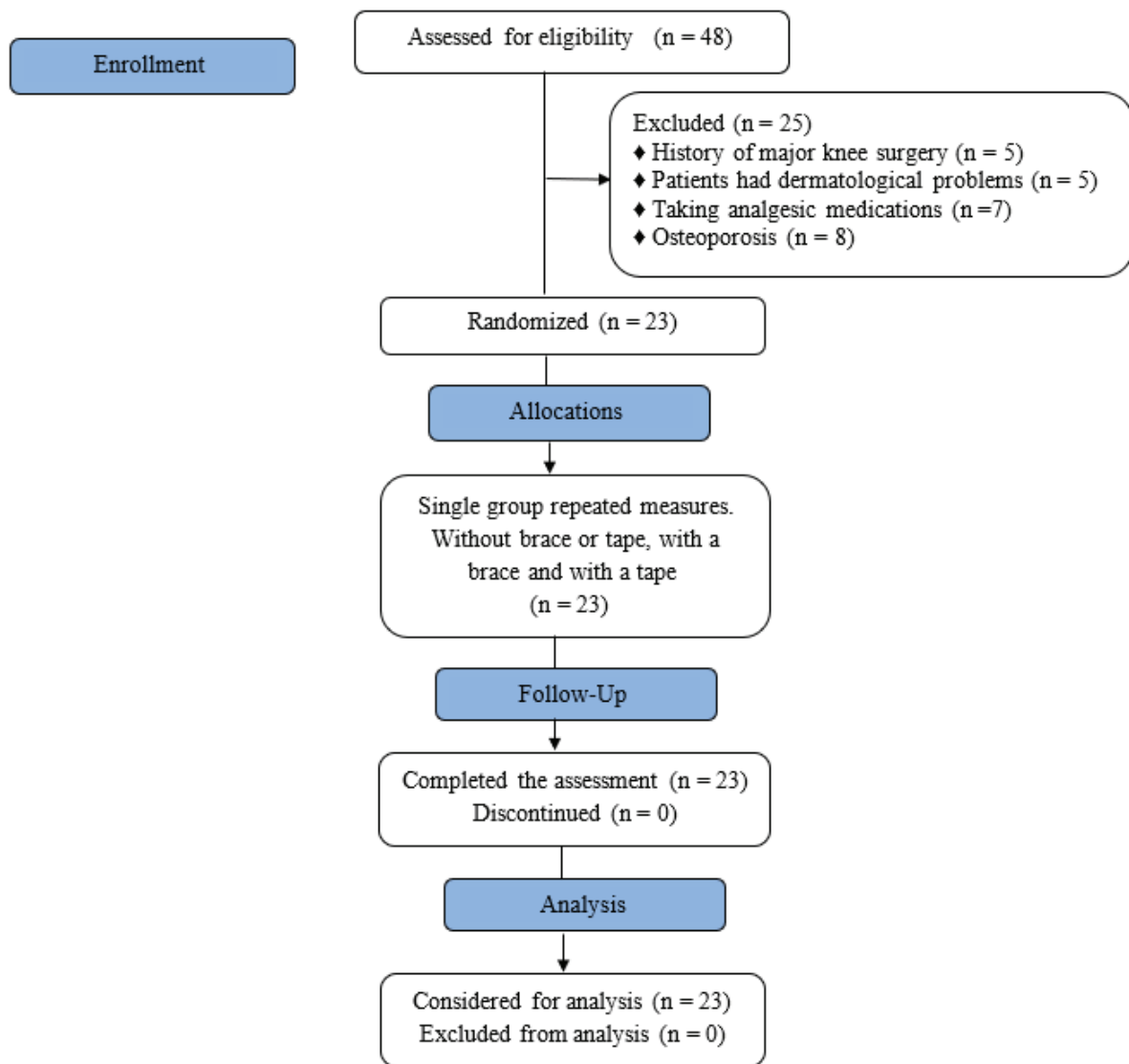


Fig. 1. The patients' flowchart



No brace or tape

After using a knee brace

After using KT

Fig. 2. Assessment of gait parameters for patients in the three conditions



No brace or tape After using a knee brace After using KT

Fig. 3. Assessment of balance for patients in the three conditions

Assessment of gait parameters

Gait parameters were measured using the motion analysis system and included gait velocity, left stance time, and right stance time. The patients were prepared and informed about wearing no brace or tape, then about wearing the soft brace, and finally, about using KT.

The patients were prepared and informed about the experiment and its steps. Patients were asked to walk on the walkway of the motion analysis system without the knee brace or tape, then after wearing the knee brace, and then immediately after using kinesiotaping on the knee muscles. The time interval was one week between measurements [26]. The mean of each selected gait parameter was calculated and recorded for comparison (no brace or tape, after using a knee brace, after using KT) as shown in Figure 2.

Assessment of balance parameters

Balance parameters including Overall Stability Index (OSI) and Medial-Lateral Stability Index variables were assessed using the Biodex stability system to test postural stability. The patient stood on the balance board of the apparatus without a knee brace or tape and the patient's foot angle, height, and personal data were entered into the system. Patients were asked to try to put the black point in the middle and maintain it as much as possible by using their body weight, repeating the test three times and calculating the mean of each balance index. Then patients performed the same test steps after wearing the knee brace, and after using kinesiotaping. The tests were performed by the same clinician, at the same time in the

morning, at the same center, and with the same instructions for each subject (with one week time interval between each measure and the next). Figure 3 shows the three assessment conditions for the balance parameters.

Treatment

The KT technique applied in the study was a Y-shaped technique for the knee and quadriceps. A transverse belt was applied across the patella in the individual maximum knee flexion. The base of the Y-shaped tape was applied at the tibial tuberosity and pulled at maximum tension around the patella, ending in the lower third of the quadriceps muscle. The medial and lateral bands were applied in the knee bend 45 degrees along the medial and lateral collateral ligaments [18]. The soft brace used in the study was a commercially available soft knee brace (GenuTex A2, Human I; Centrum for bones). Its size was determined according to the circumference of the thigh, knee, and upper leg for each patient. Evaluations took 10–15 minutes after KT and braces were applied.

Statistical analysis

The statistical analysis was accomplished by using the statistical package for the social science (SPSS) program version 20 for Windows (SPSS, Inc., Chicago, IL). Descriptive statistics included the mean and standard deviation for age, weight, height, BMI, gait velocity, left stance time, right stance time, OSI, and Medial-Lateral Stability Index variables. A dependent t-test (as the data was normally distributed) was used to compare the three conditions (with and without

a brace, with and without tape, and with a brace and tape) in the measures of gait velocity, left stance time, right stance time, OSI, and Medial-Lateral Stability Index variables. The alpha or significance level after Bonferroni correction for multiple comparisons (12 comparisons) was 0.004.

Results

Table 1 presents the demographic data (age, weight, height, and BMI) of the study participants.

Table 2 presents the comparative mean values of gait velocity. The percentage of improvement after the brace was applied was 6%, whereas after the tape it was 16.84%. The statistical analysis revealed that there was a significant difference in gait velocity between the condition of tape and the condition without tape or brace ($p = 0.0066$).

Table 3 presents the comparative values of stance time (affected leg) in the three conditions (without tape or brace, with a brace, and with tape). The improvement percentage was 18.3% after bracing, whereas after

taping it was 58.3%. The statistical analysis showed that there were significant differences in the stance time of the affected side between the conditions without tape or brace and with tape ($p = 0.001$). Kinesiotaping showed the highest improvement in stance time.

Table 4 presents the comparative values of the OSI in the three conditions (without tape or a brace, with a brace, and with tape). The improvement percentage

Tab. 1. Demographic data values for the study participants (n = 23)

Variables	Mean ± SD
Age [years]	44.5 ± 7.6
Weight [kg]	89.7 ± 21.3
Height [cm]	164.3 ± 9.6
BMI [kg/m ²]	33.8 ± 9.8
Gender	10 males [43.5%] 13 females [56.5%]
Affected side [left %]	83%

BMI – body mass index, N – number, SD – standard deviation.

Tab. 2. Comparisons of gait velocity parameters

	Items	Mean ± SD	Difference	Improvement [%]	t-value	p-value	Significance
Gait velocity	No brace or tape	0.79 ± 0.40	0.06	6.31%	-1.126	0.27	NS
	With brace	0.85 ± 0.31					
	No brace or tape	0.79 ± 0.40	0.10	16.8%	-2.988	0.006	S
	With tape	0.95 ± 0.36					
	With brace	0.85 ± 0.31					
	With tape	0.95 ± 0.36					

NS – non-significant, S – significant, SD – standard deviation.

Tab. 3. Comparisons of stance time (of the affected side) mean values

	Items	Mean ± SD	Difference	Improvement %	t-value	p-value	Significance
Stance time (affected)	No brace or tape	0.95 ± 0.35	0.11	18.3%	1.854	0.078	NS
	With brace	0.85 ± 0.31					
	No brace or tape	0.79 ± 0.40	0.10	16.8%	-2.988	0.006	S
	With tape	0.95 ± 0.36					
	With brace	0.85 ± 0.31					
	With tape	0.95 ± 0.36					

NS – non-significant, S – significant, SD – standard deviation.

after bracing was 2.3%, whereas after taping it was 30.1%. The statistical analysis revealed that there were insignificant differences in the OSI between the three conditions. Kinesiotaping demonstrated the highest improvement in the OSI.

Table 5 represents the comparative values of Medial-Lateral Stability Index in the three conditions (without tape or brace, with a brace, and with tape). The improvement percentage after bracing was 28.9%, whereas after

taping it was 42.1%. The statistical analysis revealed that there was a significant difference in Medial-Lateral Stability Index only between the conditions without tape or a brace and after taping ($p = 0.001$).

As can be observed in Table 6, the overall improvement % for gait velocity, left stance time, right stance time, OSI, and the actual Medial-Lateral Index was 14 and 36.9% for brace and tape treatments, respectively. The results indicated that the overall improvement

Tab. 4. Comparisons of actual OSI mean values

	Items	Mean \pm SD	Difference	Improvement %	t-value	p-value	Significance
Overall Stability Index	No brace or tape	0.88 \pm 0.57	0.03	2.3%	1.009	0.33	NS
	With brace	0.85 \pm 0.31					
	No brace or tape	0.79 \pm 0.40	0.16	16.8%	-2.988	0.006	S
	With tape	0.95 \pm 0.36					
	With brace	0.85 \pm 0.31	0.10	10.5%	-1.955	0.058	NS
	With tape	0.95 \pm 0.36					

NS – non-significant, S – significant, SD – standard deviation.

Tab. 5. Comparisons of actual Medial Lateral Stability Index mean values

	Items	Mean \pm SD	Difference	Improvement %	t-value	p-value	Significance
Medial Lateral Stability Index	No brace or tape	0.38 \pm 0.32	0.11	28.9%	2.350	0.028	NS
	With brace	0.85 \pm 0.31					
	No brace or tape	0.79 \pm 0.40	0.16	16.8%	-2.988	0.006	S
	With tape	0.95 \pm 0.36					
	With brace	0.85 \pm 0.31	0.10	10.5%	-1.955	0.058	NS
	With tape	0.95 \pm 0.36					

NS – non-significant, S – significant, SD – standard deviation.

Tab. 6. Overall improvement % of brace treatment vs. tape treatment

Items	Overall improvement %	
	Brace treatment	Tape treatment
Gait velocity	6.31%	16.8%
Stance time (affected)	18.3%	58.3%
Overall stability index	2.3%	30.1%
Medial Lateral Stability Index	28.9%	42.1%
Overall improvement %	14%	36.9%

percentage improved with tape treatment compared to brace treatment.

Discussion

Osteoarthritis of the knee (OA) is a major public health concern worldwide and one of the most important causes of chronic disability in the elderly due to signs and symptoms associated with inflammation, including pain, stiffness, and loss of movement. The current study showed that the OSI using KT was better than the control condition (no brace or KT) because this

technique puts the muscle in some contraction, which means increased stability of the knee joint. The overall percentage showed that the KT is better than the soft brace in knee osteoarthritis treatment. The Medial-Lateral Stability Index is better with KT and this may be due to increasing the stability of the knee joint and controlling of the quadriceps muscle [24].

The basic mechanism behind KT assumed that the elasticity of the tape and its application under tension leads to the mobilization of the skin during movements and improves blood circulation and lymph. It is believed that this mechanism directly affects the perception of pain. Another influencing factor frequently discussed is stimulation of cutaneous mechanical receptors [27]. The current study concluded that improving balance and walking parameters in participants after the tape was applied may be due to a reduction in pain, increased control of balance when standing, limiting stiffness and enhancing knee range of motion, because knee pain significantly limits joint function [24–25].

The current study finding regarding improved balance after taping matches the finding of Rahlf et al. [24], who concluded that kinesiotaping is a clinically effective technique for improving standing balance control. In contrast, the current study contradicts Rahlf et al. [24], who stated that gait velocity did not improve after taping more than the control. Maleki et al. [28] found treatment with knee braces to be effective in reducing pain, improving function, improving the range of motion, and increasing walking speed and step length while reducing the moment of approach applied to the knee. They concluded that knee orthopedics could be considered to improve gait and treat osteoporosis of the knee in the medial compartment. In addition, Siebers et al. [29] found an improvement in walking parameters after knee orthodontics in healthy participants. This study does not support the results of Maleki et al. [28] and Sibers et al. [29] because processing did not improve balance or walking parameters more than control or recording.

The current study finding regarding insignificant differences between taping and bracing was in line with that of Adly et al. [30], who reported small differences between recording and predisposition in pain, motion ringing, and function in patients with patellofemoral pain syndrome.

Patients with knee OA had muscle weakness, slower gait velocity, and higher stance duration than the controls. Moreover, muscle weakness was significant in the early stage of knee OA but not postural control or balance impairment [9,11]. The results of the present study are in agreement with several studies [31,32] that reported an improvement in balance and gait parameters after taping in patients with different diseases (stroke, cerebral palsy, and patellofemoral pain syndrome).

This study had some limitations, as it did not use a cross-over study design. Therefore the authors were uncertain whether the previous application of either technique had affected the results of the following one. Moreover, it addressed the immediate effects of both techniques but not the long-term effects.

Conclusions

Kinesiotaping treatment techniques are more effective in enhancing balance and gait parameters in patients suffering from knee OA than bracing.

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Conflict of interest

The authors have no conflict of interest to declare.

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