

The Effect of Quadriceps Kinesio Tape on Functional Disability, Pain, and Knee Joint Position Sense in Knee Osteoarthritis Patients

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Introduction: Osteoarthritis is one of the most common joint and musculoskeletal problems, particularly within the knee joint, which causes functional disability and impaired proprioception. The aim of the present study was to study the effect of quadriceps kinesio tape on functional disability, pain, and knee joint position sense in females suffering from osteoarthritis of the knee. **Methods and Materials:** A total of 38 females suffering from knee osteoarthritis were randomly assigned to either the control group (n=19) or kinesio tape group (n=19). The extent of pain was measured using a Visual Analogue Scale (VAS), the extent of functional disability was measured using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), and the absolute error of reconstructing the active angle in 30 and 60 degrees of knee flexion was measured using an inclinometer. The results were analyzed using independent sample t-test to compare the treatment groups before the treatment and paired sample t-test to compare the groups before and immediately after the treatment. **Results:** In the kinesio tape group, a statistically significant improvement was observed in the reconstruction of the joint sense position at 30 and 60 angles of knee flexion before and after treatment ($P < 0.0001$). However, no statistically significant difference was observed in the control group at 30° and at 60°. Moreover, the results from the VAS and WOMAC tests revealed no statistically significant difference between the control and kinesio tape groups. **Conclusion:** The quadriceps kinesio tape improves knee joint position sense in patients with knee osteoarthritis, but it does not cause significant changes in their pain and functional ability.

Key Words: Functional disability; Joint position sense; Kinesio tape; Knee osteoarthritis

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Introduction

Osteoarthritis is one of the most prevalent joint and musculoskeletal disorders, occurring mostly in the knee joint (1) and it has become one of the biggest health problems, especially considering the fact that its prevalence increases with age. Moreover, it is thought that the prevalence of osteoarthritis has been significant because of the increase in the average age of the population (2). One report predicted that, by the year 2020, the approximate number of individuals diagnosed with osteoarthritis will increase by 57%, and the limitation in movement, caused by the outbreak of this disease, will increase by 66% (3).

There is a greater reduction in proprioception in individuals suffering from knee osteoarthritis. Proprioception dysfunction could increase the probability of onset or advancement of knee osteoarthritis and reduce the functional abilities of patients (4).

Currently, various methods of drug treatments, non-drug treatments, and surgery are used to treat or prevent further complications of knee osteoarthritis, which impose extremely

high economic burden on the individuals and society. Hence, the need for effective treatment methods that are economic and have fewer complications is necessary, such that in addition to symptom control they should aim at improving the quality of life for patients. Among the different treatments that have been carried out in treating proprioception, some researchers believe that the role of kinesio tape in reducing proprioception error and pain and improving quality of life for patients has been effective.

A number of studies have been carried out to measure the effect of quadriceps kinesio tape on this disorder, but the results are contradictory. Niknam et al. showed that quadriceps kinesio tape caused a significant improvement in knee joint position (5). However, Hosp *et al.* analyzed the effect of quadriceps kinesio tape on knee proprioception in healthy individuals and found no significant difference in the recovery of proprioception in this group of individuals, but they did observe improvements in proprioception in individuals suffering from proprioception dysfunction (6). Aytar *et al.*, after applying quadriceps kinesio tape on (Patellofemoral Pain Syndrome) PFPS patients, concluded



Figure 1. The method for assessing the joint position sense

that this method of treatment was not a cause for significant difference in the amount of pain and joint position sense (7).

However, to the best of our knowledge, no study has investigated the effect of quadriceps kinesio tape on the degree of pain, reconstructing the position of the joint sense, and functional disability in knee osteoarthritis patients using Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). The aim of conducting the present research was to review the non-aggressive methods of treatment that could effectively keep and improve the ability of these individuals and reduce their pain, and also help the patients' quality of life.

Materials and Methods

Participants

A total of 38 female patients with knee osteoarthritis with grade 3 and 4 of Kellgren and Lawrence (according to a doctors' opinion) within the age range of 45 to 70 years, history of knee pain for six months or more, having a range of motion from 0 to 100 degrees (extension to flexion), no history of surgery of the lower limb joints, and no problems such as knee malignancy and infection around the knee were enrolled in the study. In case of an abnormal skin reaction to kinesio tape (sign of allergy), lack of regular referral for visitation by the patient, and patient's unwillingness to continue treatment were observed, they were excluded from the study. Patients with knee osteoarthritis, who met the inclusion criteria, were selected by non-random sampling method from among the patients referring to in Hazrat Rasool hospital in Tehran, Iran.

Procedures

Prior to the study, the aims and procedures were explained to the participants and signed informed consents were obtained. The study was approved by the Ethical Committee of Iran University of Medical Sciences, Tehran (ir.iums.rec.9311340010). The study followed a clinical trial type of intervention. The

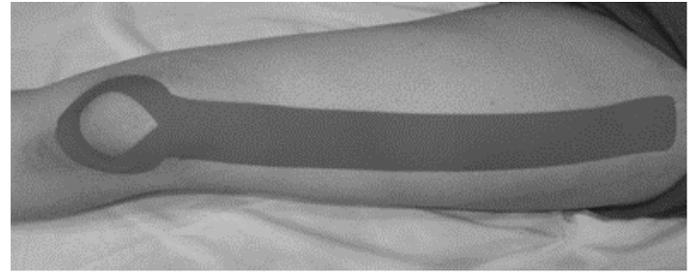


Figure 2. kinesio tape rectus femoris

sampling method was based on simple non-probability sampling. The patients referring to the physiotherapy clinic in Hazrat Rasool hospital were provided with a general description of the research method, and then the individuals who were willing to participate in the study were invited. After a primary evaluation, the researcher made sure that the individuals were qualified for the research, then they stated their readiness to take part in the test by signing the consent form. In the current study, 38 patients were randomly assigned in to two groups of kinesio tape and control, each consisting of 19.

Evaluation of the extent of pain in patients was recorded via the VAS with a 0-10 grading system (8). Evaluation of the participants' functional disability was done using the WOMAC questionnaire. This questionnaire is considered to be one of the most reliable questionnaires for assessing patient's quality of life, health and level of performance, and the most common tool for reviewing knee osteoarthritis patients. It is translated into Farsi and its validity and reliability has been verified (9)(10). Pain, stiffness, and crepitus during active motion of the knee are the most common symptoms of knee osteoarthritis, which not only reduce an individual's ability, but also affect his/her health and quality of life. This questionnaire consists of 3 sections and 24 questions. In the first section, the extent of pain during various activities, in the second section, the stiffness of the patient's joint, and in the third section, the functional condition of the knee in daily activities are assessed (9).

Evaluation of the knee joint position sense was performed in the seated position. To assess the knee joint position sense, the method of "active test along with active reconstruction of the limb" was put to use. For this purpose, the individual was asked to actively reconstruct a certain angle that was displayed to the individual as the aim, using the same limb and without the use of visual senses, only relying on proprioception. The absolute error of the individual in reconstructing the target angle was recorded (11). Measurements for the angles of the knee joint in testing and response stages were carried out using an inclinometer, which is one of the simple and cheap clinical methods of assessing the joint position sense (12).

A metal rod was fixed on the upper and lower parts of the leg via two straps. From its magnetic part, the inclinometer

Table 1. Participants' Demographic details

Parameter	n=19	Mean (SD)	Min-Max	P-Value
Age (Years)	Kinesio tape group	55.63 (8.45)	45-70	0.576
	Control group	55.63 (8.95)	45-70	
Height (cm)	Kinesio tape group	161.68 (6.33)	153-170	0.636
	Control group	157.68 (5.83)	150-168	
Weight (kg)	Kinesio tape group	59 (7.31)	59-80	0.326
	Control group	61 (5.92)	61-78	

Table 2. Comparison of the Means of the variables before and after the treatment in both groups

Parameter	Group	Mean (SD) Before Treatment	Mean (SD) After Treatment	Mean difference (after-before)	Min-Max (before treatment)	P-Value
VAS	Control	5.95 (1.64)	2.89 (1.32)	-3.05	4-9	<0.0001
	Kinesio tape	6.42 (1.34)	4 (4.1)	-2.42	4-9	<0.0001
WOMAC	Control	58.42 (12.5)	44.83 (14.53)	-13.59	40-75.83	<0.0001
	Kinesio tape	65.52 (12.54)	53.15 (15.46)	-12.37	40-85.83	<0.0001
Error in reconstructing 30 degrees angle	Control	4.93 (3.34)	3.62 (2.39)	-1.03	1.2-8.2	0.144
	Kinesio tape	5.71 (2.99)	1.76 (1.72)	-3.93	1.4-7.3	<0.0001
Error in reconstructing 60 degrees angle	Control	6.54 (3.6)	4.02 (4.41)	-2.51	1.7-9.4	0.075
	Kinesio tape	7.25 (3.45)	2.61 (2.9)	-4.63	1.5-8.8	<0.0001

was installed on the metal rod. The inclinometers' angle display was set to zero. While the movement of the leg causes movement of the metal rod, the angle of the knee joint and position of the leg was shown by the inclinometer's display (Figure 1).

The patient was told she could can perform three trials in any desired angle with her eyes open. Then, she was asked to actively move her knees to 30° and 60° flexion and hold this position for five seconds. She was asked to remember the angles. After returning to the original position and resting for five seconds, the individual was asked to reconstruct the angles using active extension. This time, the angles performed were recorded via the inclinometer. Between each repetition, there was a five-second delay. This procedure was repeated for each angle of 30° and 60° of knee flexion with 30-second rest intervals, and it was reconstructed 3 times (13). The angle reconstructed by the individual was calculated and subtracted from the target angle and was recorded as the absolute error for each angle of 30° and 60° of knee flexion. The mean of the three reconstructions of the movement angle was used in the statistical analysis.

Participants of both groups were provided with similar physiotherapy treatments. First, 1 MHZ ultrasound with an intensity of 1 W/mc2 in continuous form was applied for five minutes, then hot pack was provided for 20 minutes followed by application of conventional Transcutaneous Electrical Nerve

Stimulation with 100 HZ frequency and 50 μs duration to the extent of the patient's complete feeling for 20 minutes. Also, a program was taught to both groups to strengthen the muscles around the knee. Physiotherapy was used in the treatment program of both groups for 10 sessions (three days a week).

In the study group, in addition to the aforementioned treatments, they were also given the quadriceps kinesio tape intervention. Before the application of kinesio tape, the skin was completely cleansed to make sure that grease or any other factors do not prevent the tape from sticking. The method of applying the kinesio tape was done with the purpose of facilitating the quadriceps muscle with 35% tension and the tape was installed on the rectus femoris from the proximal to the distal vertically in a Y shape. After preparation of the tape, the individual was asked to extend her hip joint and flex the knee joint. The start of the tape was set 10 centimeters below the ASIS with 35% tension, until the Y split reached the upper patella. The patient's hip and knee were placed in a flexion position and the remainder of the tape was stuck to the inner and outer edges of the patella with 25% tension. Thus, the end of the tape was placed against the tuberosity tibia. The first and the last part of the kinesio tape was used without any tension (14) (Figure 2).

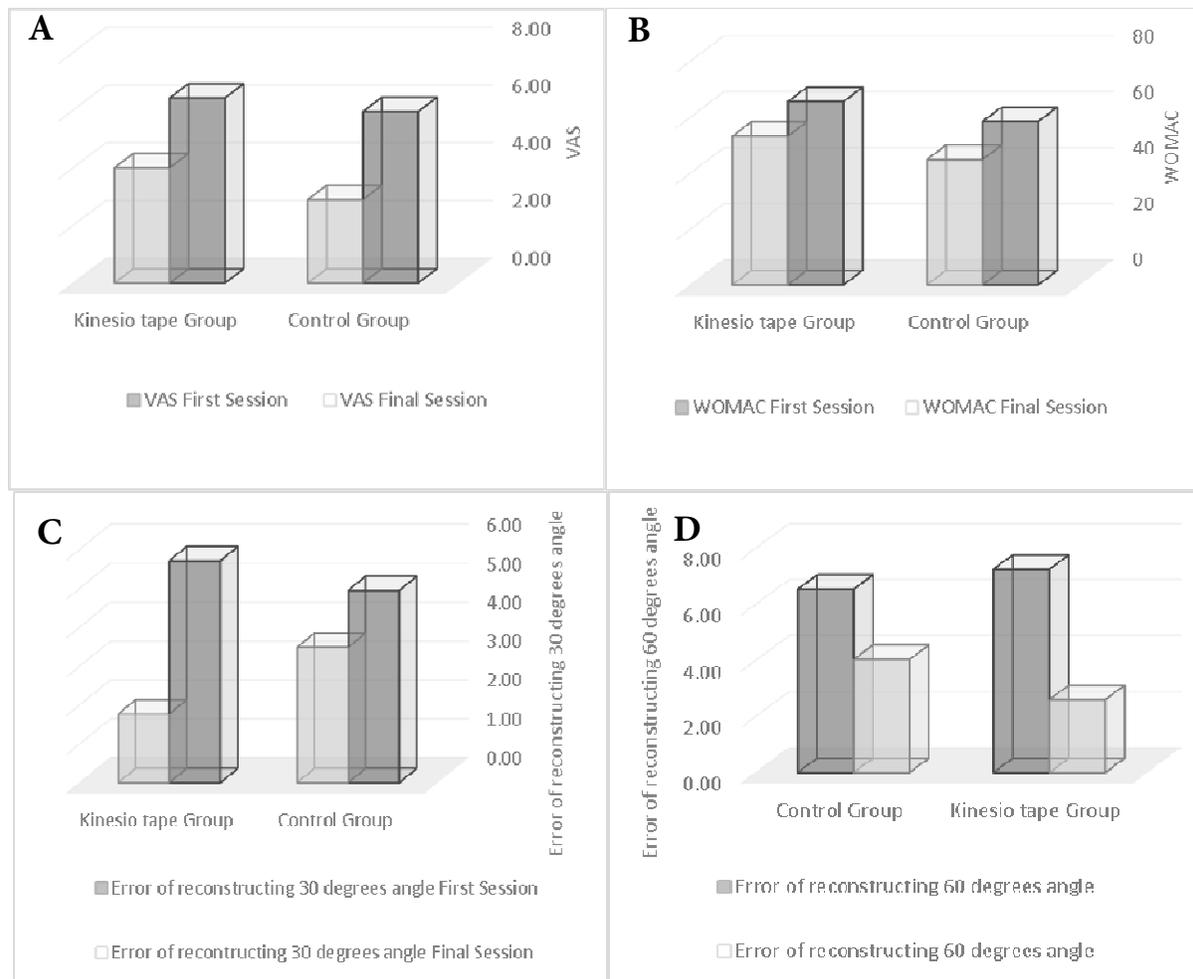


Figure 3. Changes in the variable before and after the treatment. (A: pain, B: womac, C: reconstructing the angle of 30 degrees, D: reconstructing the angle of 60 degrees)

Data analysis

Prior to running the main test, reliability measurement of inclinometer was calculated using SPSS running Internal Correlation Coefficient (ICC). ICC was 93% for reconstructing 30° and 94% for reconstructing 60°. Also, Minimal Detectable Change (MDC) was calculated using the following formula. MDC was 1.16 for reconstructing 30° and 2.34 for reconstructing 60°.

$$SEM = SD \sqrt{1-ICC}$$

$$MDC = SEM \times \sqrt{2} \times 1.96$$

The variables of VAS, WOMAC, and angle of reconstructing the joint at 30° and 60° of flexion were evaluated before the initiation of the treatment and after the last treatment session.

Statistical data regarding the extent of pain, WOMAC questionnaire, and absolute error in reconstructing the angle of the joint in knee osteoarthritis patients was analyzed using SPSS.

The results were analyzed running paired sample t-test for comparing the means before and immediately after treatment as

well as independent sample t-test for comparing the means of the treatment groups prior to the treatment. P-value was set at 0.05.

Results

Table 1 presents the demographic characteristics of the participants. Both groups were matched by determined variables of age, weight, and height, and no statistically significant difference was found (Table 1). Graphs a-d show the average change in the study variables before and after the treatment. The results from comparing the means of the variables calculated before and after the treatment revealed that the kinesio tape group had a significant improvement in reconstructing the position of joint sense at a 30° and 60° of knee flexion ($P < 0.0001$). On the other hand, in the control group, no statistically significant difference was observed at 30° and at 60° (Table 2 and Figure 3).

The VAS and WOMAC variables had also significantly reduced in both the control and kinesio tape groups ($P < 0.05$) (Table 2). However, the comparison did not show a statistically significant difference between the two groups (Figure 3A and 3B).

Discussion

The present study was an attempt to evaluate the effect of kinesio tape on knee joint proprioception, pain, and its function. One of the factors related to knee osteoarthritis is reduced neuromuscular factors such as proprioception, which in turn leads to a dysfunction in mechanoreceptors, and causes increased force on joints and ultimately increases the resonance effect (4). The knee joint's proprioception arises from afferent signals from receptors in the joint, muscle-tendon, capsule-ligament, and skin (15). In knee osteoarthritis, because of the changes that come about in the proprioception receptors of the joint, the ability to reconstruct the joint angle is significantly impaired. Kinesio tape could improve proprioception via its direct and/or indirect effect.

According to Chen, kinesio tape reduces latency in the quadriceps muscle's action, and this could itself increase the proprioception accuracy (16). According to Niknam's study on the effect of quadriceps kinesio tape, with the reconstruction of the anterior cruciate ligament, patients still suffer from impaired proprioception after surgery; in this study, the tape produced skin stimulation and provision of afferent input, which in turn caused increases in proprioception (5).

One of the reasons that kinesio tape could increase proprioception is the stimulation of skin mechanoreceptors. Stimulation of mechanoreceptors by kinesio tape has made proprioception recover and improved the accuracy of reconstructing the joint angle. Given that the skin is one of the sources that provides proprioception, the stimulation of proprioception receptors outside the joint could replace receptors inside the joint and the compensation system could be used to correct poor proprioception performance (13).

Clark's study was carried out in 1979. He believed skin receptors have a role in the start of reflex responses in response to a painful, mechanical or thermal stimulus, and so have noted that the role skin receptors play in determining proprioception is important (17). Also, stretching of the skin, due to kinesio tape stimulation from the change in their electrical discharge by means of skin strain and also muscle spindle stimulation sends proprioception information to higher centers (18) (13). Han believes that kinesio tape, after muscle fatigue following skin stimulation by kinesio tape and stretching of the skin, causes a reduction in error of the joint angle reconstruction (19).

On the other hand, Aytar disagrees with this opinion. His research focused on knee position sense in PFPS patients. This difference in opinion is likely due to a difference in techniques used as well as the underlying disorders of the patients involved in his study (7).

Given that there is a direct relationship between impaired proprioception and pain and a reduction in the quality of life, it is expected that there would be an increase in the functional ability of the patients as well as a reduction in pain in the kinesio tape group (20).

Despite the recovery in patients' ability to reconstruct the joint knee angle, the tape did not seem to significantly cause a reduction in pain and recovery of function in these patients.

Since proprioception improved in these patients, there is a potential to investigate whether applying kinesio tape could cause slower progression in knee osteoarthritis in future studies. But the immediate and short term effects of kinesio tape have not changed the functionality of these individual's knee, as osteoarthritis is a chronic and progressive injury. There is a probability that the lack of effectiveness in reducing pain and improving the general quality of life, using the kinesio tape, is due to the stimulation of chemical receptors. Furthermore, because these receptors are constantly being stimulated in osteoarthritis patients, then the extent of pain is not reduced (18). The studies by Akbas and Aytar confirm this issue (21, 7). Thus, kinesio tape may be able to stimulate dermal mechanoreceptors, but the tension used to reduce patients' pain was probably insufficient. Also, Aytar noted that previous studies in the field of reducing pain using kinesio tape were conducted without a control group; thus a reduction in pain cannot be directly presumed to be correlated to the use of the kinesio tape (7).

On the other hand, Chen and Campolo observed that kinesio tape caused a reduction in pain and improved functionality (16, 22). Campolo states that the exact mechanisms behind the effectiveness of the kinesio tape is still unclear, but patients' reduced pain can be related to the gate control mechanism of pain (22). It is recommended that in future studies, the relationship between a reduction in pain, improvements in quality of life, and improvements in proprioception in this group of patients be further investigated. On the other hand, since knee osteoarthritis is more common in females, the present study was conducted only on the female population. Thus, further comparative studies should be conducted to investigate the variables studied between the two genders.

Conclusion

Kinesio tape can improve recovery of proprioception and help increase the accuracy of knee joint angle reconstruction in patients with osteoarthritis. However, in short-term, this did not cause a reduction in pain and major improvements in joint function. Given the existing evidence, it can be concluded that kinesio tape could be effective in the treatment of disease but in the short term it does not affect the functionality. Hence, kinesio tape cannot act as an independent treatment in the field of reducing pain and increasing functionality, and must certainly be integrated with other treatments.

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Conflict of interest:

None

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Authors' contributions:

All authors made substantial contributions to conception, design, acquisition, analysis and interpretation of data.

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