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Evaluation of Gait Speed after Applying Kinesio Tape on Quadriceps Femoris Muscle in Patients with Knee Osteoarthritis

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Keywords: Knee osteoarthritis; Gait; Kinesio Tape; Rehabilitation; 10-meter walk test; Gait speed

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Abstract

BACKGROUND: Knee osteoarthritis is a chronic degenerative disease, known as the most common cause of difficulty walking in older adults and subsequently is associated with slow walking. Functional decline, increased risk of falls and the presence of pain are, in many studies, related to the muscle weakness caused by osteoarthritis especially weakness of the quadriceps muscles. Many studies have shown that the strength of the quadriceps femoris muscle can affect gait, by improving or weakening it. Kinesio Tape is a physiotherapeutic technique, which reduces pain and increases muscular strength by irritating the skin receptors.

AIM: This study aimed to verify if the application of Kinesio Tape on quadriceps femoris muscle increases gait speed while decreasing the time needed to accomplish the 10-meter walk test in patients with knee osteoarthritis and also in subjects without knee osteoarthritis.

METHOD: In this study, we observed the change of gait speed with the help of the 10-meter walk test before, one day and three days after the application of Kinesio Tape in quadriceps femoris muscle. We compared the results of the time needed to perform the 10-meter walk in two groups. In the first group, the Patients group, participated 102 out-patients with a clinical diagnosis of primary knee osteoarthritis, while in the second group, the Control group, participated 73 subjects with a main excluding criterion a clinical diagnosis of primary knee osteoarthritis.

RESULTS: Our results indicated that there was a significant decrease of time needed to perform the 10-meter walk test in both groups three days after application of Kinesio Tape on quadriceps femoris muscle. However, there was not a significant change one day after the application of Kinesio Tape compared before its application in both groups.

CONCLUSIONS: Our results indicated that there was a significant decrease in time needed to accomplish the 10-meter walk test. Kinesio Tape is a technique that can be used especially when changing walking stereotypes is a long-term goal of the treatment.

Introduction

Osteoarthritis is a widespread, slowly developing disease, with a high prevalence increasing with age, also known as a metabolically active, dynamic disease that includes both destruction and repair mechanisms that may be triggered by biochemical and mechanical insults [1]. In developed countries, knee osteoarthritis (OA) affects between 17% and 30% of the elderly population over 65 years of age, with greater incidence, prevalence and severity in women than in men [2] [3]. Functional decline, increased risk of falls and presence of pain are, in many studies, related to the muscle weakness caused by OA [4] [5] especially the weakness of the quadriceps muscles [6].

Quadriceps weakness is one of the most common and disabling impairments seen in individuals with knee OA [7]. Sufficient quadriceps and hamstrings strength, both isometric and dynamic, is essential for undertaking basic activities of daily living such as standing and walking [8].

Patients with knee osteoarthritis have a problem walking and tend to walk slower than controls. It is shown that knee osteoarthritis is the

most common cause of difficulty walking in older adults [9] [10] and subsequently is associated with slow walking [11] [12]. In knee osteoarthritis, decreased walking speed is associated with joint space narrowing [13], increased concentrations of inflammation mediators [14], pain [15] and also quadriceps muscle weakness [16] [17].

Quadriceps femoris weakness, in particular, has been linked to functional impairment such as increased fall risk and slower walking speed, also is one of the earliest and most common symptoms of osteoarthritis [18] [19] [20]. It is also associated with adaptations in walking patterns that are theorised to put articular cartilage at risk.

For instance, subjects with knee OA who have weaker quadriceps femoris muscles exhibit less stance phase knee motion during walking. At self-selected walking speeds, it is the role of the quadriceps femoris muscles to control knee flexion during weight acceptance while the hamstring and gastrocnemius muscles are typically silent. However, in the presence of quadriceps femoris weakness, which occurs with ageing, and in the presence of knee OA, either the hamstring or the gastrocnemius muscles may be required to assist with knee control [21].

Muscle strength testing has revealed that those with knee OA have a 25% to 45% loss of knee extension strength and a 19% to 25% loss of knee flexion strength compared with similarly aged controls [22] [23] [24]. There are 3 factors thought to contribute to knee extension and flexion weakness in those with knee OA: muscle atrophy, failure of voluntary muscle activity, and apparent weakness from increased antagonist muscle co-contraction [25]. Decreases in muscle cross-sectional area (CSA) have been established in subjects with early OA degenerative changes [26] and those with severe knee OA [27]. Ikeda et al., [26] found that women with early degenerative changes in the knee joint had reductions in quadriceps CSA of up to 12%, compared with age-matched women without radiographic changes.

The aim of this study was to verify if the application of Kinesio Tape (KT) on quadriceps muscle changes gait speed while walking for 10 meters at normal speed, in patients with knee osteoarthritis and also in subjects without knee OA, before the application of KT, a day and three days after the application of KT on quadriceps femoris muscle.

Patients and Methods

In this study, we compared the results of the gait speed in two groups. The first group was the Patients group. The subjects (n = 102), aged 50-73 years (mean age 63.2), 67% of whom were female, were consecutive out-patients with a clinical diagnosis of primary unilateral knee osteoarthritis made by a rheumatologist. The main criterion for the selection of the subjects in this study was the diagnosis of knee osteoarthritis by X-ray. The second group was the Control group. The subjects (n = 73), aged 50-69 years (mean age 59.4), 70% of whom were female, were randomly chosen and the main criterion for their selection was that they were not diagnosed with knee osteoarthritis.

Criteria for excluding subjects from both groups in the study were other musculoskeletal diseases, total knee replacement, significant hip or spinal arthritis, neurological diseases and diseases that affect balance and coordination. The subjects were not in medical treatment. All of the subjects signed a written consent to participate in the study voluntarily.

Kinesio Tape (KT) was applied with a tonus regulation technique also called muscle technique on quadriceps femoris muscle. We measured the tape length in the maximal stretched position of the tissue. The application was done with the patient in this maximal stretched position. The tape was applied without stretch following the course of the muscle borders from one insertion to the opposite one.

In the patient's group, the worse knee as assessed by X-ray was the “index” knee, while in the control group we randomly chose a knee where we applied the KT.

We observed the change of time while walking for 10 meters at normal speed for each patient, before, a day after and three days after the application of KT on quadriceps femoris muscle, with the help of a 10-meter walk test, where we measured and marked a 10-metre walkway adding a mark at 2-metres and 8-metres. The patient performed three trials, and we calculate the average of three trials [28].

Statistical Analysis

Continuous variables were presented as mean and standard deviation: mean ± SD (standard deviation). Categorical variables are presented as actual numbers (n) and percentages (%). Chi-square analysis was used to compare frequencies between groups and Student t-test, one-way ANOVA or non-parametric tests were used when necessary for quantitative analysis of the variables. The analysis was conducted using the SPSS (statistical software statistics package for social scientists) version 15.0. Statistical significance was considered to be the value of $P \leq 0.05$.

Results

In this study, we compared the results of the time needed to perform the 10-meter walk test in two groups. In the first group, the Patients group participated in 102 out-patients with a clinical diagnosis of primary knee osteoarthritis, the mean age of the participants was 63.2 (range: 50-73).

Table 1: Data results on gait speed, of the Control group, in seconds before the application of KT (10 MWT before KT), one day after the application of KT (10 MWT 1 Day after KT) and three days after the application of KT (10 MWT 3 Days after KT) on quadriceps femoris muscle

	Number	Mean value	Standard Deviation	Minimum value	Maximum value
Control Group 10MWT before KT	73	7.223	1.0052	5.247	9.610
Control Group 10MWT 1 day after KT	73	7.082	0.9923	5.167	9.497
Control Group 10MWT 3 days after KT	73	6.199	0.9098	4.567	8.193

The worse knee as assessed by X-ray was the “index” knee. In the second group, the Control group, participated 73 subjects aged 50-69 years (mean age 59.4), with a main excluding criterion a clinical diagnosis of primary knee osteoarthritis.

Table 2: Data results on gait speed, of the Patients group, in seconds before the application of KT (10 MWT before KT), one day after the application of KT (10 MWT 1 Day after KT) and three days after the application of KT (10 MWT 3 Days after KT) on quadriceps femoris muscle

	Number	Mean value	Standard Deviation	Minimum value	Maximum value
Patients 10MWT before KT	102	10.412	2.5025	6.173	16.277
Patients 10MWT 1 day after KT	102	9.976	2.4712	6.160	15.847
Patients 10MWT 3 days after KT	102	6.743	1.8205	4.123	10.807

The results show that 1 day after applying KT on quadriceps femoris muscle there was not a significant change of time needed to perform the 10-meter walk test in a comparison of the time needed a day before application of KT, in both groups: Control group P = 0.405 and in the Patients group P = 0.20.

The time needed to perform the 10-meter walk 3 days after KT's application changed significantly from the time needed before KT's application on quadriceps femoris muscle in both groups: in the Control group P < 0.0001 and the Patients group P < 0.0001.

The time needed to perform the 10-meter walk 3 days after KT's application changed significantly from the time needed 1 day after KT's application on quadriceps femoris muscle in both groups: in the Control group P < 0.0001 and the Patients group P < 0.0001.

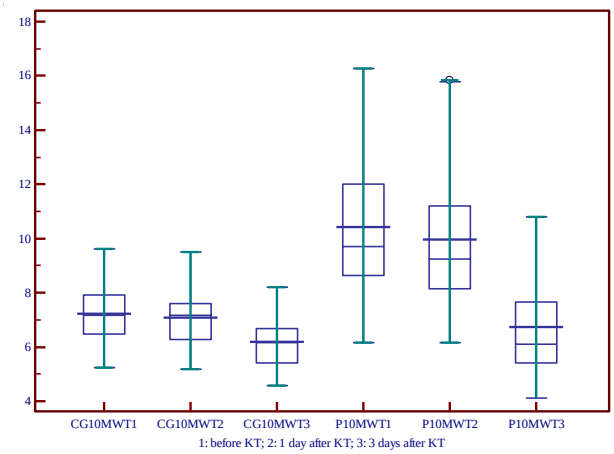

Figure 1: Comparison of values of 10-meter walk test (10MWT) in the control group (CG) and the patient's group (PG), before Kinesio Tape (KT) application (1), 1 day after KT application (2) and 3 days after KT application (3)

Discussion

Lack of information about the impact of elastic therapeutic tape in gait speed in this diagnosis led us to carry out this research. Our objective was to determine whether the application of KT on quadriceps muscle, in patients with knee osteoarthritis and also in subjects without knee OA, will lead on increasing gait speed while walking a 10-meter distance on normal speed.

The results of this study showed a significant decrease of time needed to accomplish the 10-meter walk test three days after applying KT on quadriceps femoris muscle. In graphic 1 is shown that the Patients group and the Control group finish the 10-meter walk test in a shorter time after applying KT on quadriceps muscle three days after the application. However, there was not a significant decrease of time needed to perform the 10-meter walk test one day after application of KT in both groups.

Based on these results, it can be inferred that applying KT facilitated muscle activation in the indexed knee by increasing gait speed and decreasing the time needed to perform the 10-meter walk test three days after applying KT. This suggests that applying KT leads in improving the walking speed through muscle facilitation in the indexed knee [29]. This is because KT effectively stimulated the proprioceptive sense, muscle spindles, Golgi tendons, etc., and strengthened muscles in the affected parts [30]. These results were in agreement with the results of previous studies, which reported that KT increases muscle activity, restricts excessive movement of the joint and increases gait speed [31] [32].

Kase et al., [33] and Thelen et al., [34] also recommend at least three daily actions of elastic therapeutic tape. Kase et al., mentions those three days after the application of KT can occur soft tissue changes, improvement of muscle function, an increase of blood circulation and lymphatic drainage. Thelen et al. found that after three days of KT application, was shown a significant decrease of the functional shoulder joint pain and increase of movement. Similar results as in our study were found in other studies where no significant differences were found immediately after KT application [35] [36]. Also, Chang et al., [37] found no change in grip strength immediately after applying Kinesio tape in healthy people.

The fact that the gait speed also changed in the subjects without knee OA makes us think that the application of KT has a placebo effect. There are anecdotal reports ranging from improvements in circulation to greater strength, but researchers suggest these improvements in performance are due to a placebo effect, not from the KT itself [40]. Ella Ward [41], claims that overall, KT and the placebo effect are relevant in sport and performance, as psychologists can manipulate this intervention to enhance athletic performance; avoiding more intrusive, unethical and expensive treatment methods.

However Słupik et al., [38] evaluated the effects of applying KT over the vastus medialis and found no change in muscle activity 10 minutes post-taping, but they found increased muscle activity 24 hours after Kinesio tape application. Also Lins et al., [39] evaluated the effects of KT application on the activity of the vastus lateral, rectus femoris, and vastus medialis muscles of healthy women who exercised and found no significant effects. The difference between these results may be due to different forms and tensions of Kinesio tape application. Different Kinesio tape techniques can provide different tactile stimulation intensities [30].

Limitations in this study were the sample size, with a greater sample size we could get better results. In this study, the effect of KT in increasing gait speed in knee OA and also in subjects without knee OA was statistically significant. This leads to the fact that the application of KT is effective in all subjects without any significance if they have knee osteoarthritis or not. Further studies are needed to investigate the effect of KT in gait speed on knee osteoarthritis.

In conclusion, there seems to be a significant increase of gait speed and a decrease of time needed to accomplish the 10-meter walk test three days after applying KT on quadriceps femoris muscle in the patient's group and also the control group. However, there was not such a significant decrease of time needed to accomplish the 10-meter walk test one day after application in both groups.

Kinesio Tape is a technique that can be used especially when changing walking stereotypes is a long-term goal of the treatment. More clinical research is needed to investigate the effect of KT on gait speed on knee osteoarthritis.

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