Immediate effect of the elastic knee sleeve use on individuals with osteoarthritis

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ABSTRACT

Background: Knee osteoarthritis (KOA) is one of the major reasons for seeking medical and physical therapy services, because it usually causes difficulties in performing daily life activities. There are several types of treatment, with varied results. The use of knee sleeve as an adjuvant resource has been controversial in the literature. **Objective:** To assess the immediate efficacy of elastic knee sleeve on pain and functional capacity of individuals with KOA. **Methods:** Seventy-four patients (132 knees) with symptomatic KOA were assessed by use of the Stair Climb Power Test (SCPT), Timed Up and Go (TUG) and 8-Meter Walk (8MW) tests, in addition to the VAS for pain. The tests were performed with and without knee sleeves, with a cover on the knees to hide knee sleeve. The order and the presence of the knee sleeve were randomized, and the investigator was blind. **Results:** A statistically significant difference was found between the two compared circumstances (with and without knee sleeve) when using the VAS ($P < 0.001$), which showed a reduction in pain with the knee sleeve use. Analyses of the three functional tests under both circumstances were performed, resulting in statistically significant differences in 8MW and TUG tests ($P < 0.05$), but not in SCPT ($P > 0.1339$). **Conclusion:** The elastic knee sleeve proved to be effective to immediately improve the functional capacity and pain of individuals with KOA, because it enhanced performance during the tests proposed. Thus, the knee sleeve is an adjuvant resource for treating KOA, because it is practical, useful, and of easy clinical use, and can aid in the practice of therapeutic exercises.

Keywords: osteoarthritis, knee joint, rehabilitation, joint instability.

INTRODUCTION

Knee osteoarthritis (KOA) is one of the major reasons for seeking medical and physical therapy services, and its prevalence has increased with population aging.[1]

Clinical signs and symptoms are usually similar and comprise pain, joint instability, swelling, and muscle weakness, which result in a reduction in physical functioning, such as standing up from a sitting position, stair climbing, kneeling, standing up, and walking, in addition to increased susceptibility to falling.[2]

Several forms of treatment for KOA are found in the literature, but the non-pharmacological and non-surgical ones used in physical therapy are considered and recommended as first line treatment in an attempt to solve the problem.[3]

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The treatment comprises aerobic and muscle strengthening exercises, which are related to an improvement in pain and functioning of individuals with KOA.[4]

However, because of the functional limitations caused by pain and muscle weakness, the prescription of these exercises is limited by technical difficulties, and sometimes they become uninteresting, painful, and consequently ineffective.[4]

In an attempt to reduce pain, other types of therapy, such as neuromuscular electrostimulation (NMES),[5] some forms of manual therapy,[3] protocols of thermotherapy and cryotherapy, in addition to the use of knee sleeve and taping,[6,7] have been associated with the treatment of KOA.

However, except for the use of knee sleeve, all such resources depend on the technical skills of the physical therapist for their application. Thus, knee sleeve could be an easy self-use resource to control pain during exercise practice, making it more effective. Reports in the literature have shown an improvement in joint position sense, pain, stiffness, and function with the use of knee sleeves in individuals with KOA.[6,8]

Thus, this study aimed at assessing the immediate efficacy of elastic knee sleeve on pain and functional capacity of individuals with KOA, regarding its clinical importance as an adjuvant during an exercise-based treatment. The hypothesis is that knee sleeve could reduce pain and improve functional capacity during the tests proposed.

METHODS

This was a randomized study with a blind investigator, carried out at the Rehabilitation Sector of the Irmandade da Santa Casa de Misericórdia de São Paulo (ISCMSP) in partnership with the Irmandade da Santa Casa de Misericórdia de Diadema – Quarteirão da Saúde (ISCMD-QS).

Prior to data collection, all patients were informed on the procedure to be performed, and provided written informed consent, according to the resolution 196/96 of the National Health Council, declaring volunteer participation in the study. In addition, approval by the Research Ethics Committee of the ISCMSP (Project nº 281/09) was obtained.

Inclusion and exclusion criteria

All participants in the study were referred to the Physical Therapy Sector with a diagnosis of KOA after a visit with an orthopedist. To be included in the study, patients had to meet at least four American College of Rheumatology clinical criteria for diagnosing KOA.[9] Another inclusion criterion was a score above three in the visual analogue scale (VAS) for pain during the activity of climbing and going down stairs.

Individuals with the following characteristics were excluded from the study: neurological impairment, fibromyalgia, rheumatoid arthritis, total and/or partial prosthesis of the knees or hips, decompensated cardiopathies, hearing and visual deficiencies, and impossibility to undergo the tests proposed.

Patients

Eighty individuals of both genders were selected for data collection. Of the 80, only 74 individuals were able to complete the tests proposed, being, then, included in the study and totalizing 132 knees. The following items were assessed: age, weight, height, body mass index (BMI), duration (years) of knee pain, size of the knee sleeve, and whether the impairment was unilateral or bilateral.

Knee sleeves

Elastic knee sleeves without patellar openings (Tensor® – ANVISA/MS registration 80017170005) were used, because they provide compression to the tissues and increase the contact area, thus, promoting less pressure and reducing knee pain.[10]

According to the manufacturer, the knee sleeves were of three different sizes: small (S), medium (M), and large (L). The size was chosen based on knee circumference as follows: size S for knee circumferences from 32 to 35 cm; size M, from 35 to 39 cm; and size L, from 39 to 44 cm. Thus, before choosing the size of the knee sleeve, knee perimeter was measured, considering the apex of patella as the anatomic parameter. If the knee circumference was between two sizes, the smallest was chosen.

The knee sleeve was placed according to the manufacturer's instructions, which determine a central position for the impaired knee, allowing comfortable motion.

Function tests and pain scale

The VAS was used to quantify the pain of the patients during the Stair Climb Power Test (SCPT),[11] because this scale is considered a useful tool for that.[12,13] The scale consisted of a 10-cm line with an initial number (0) positioned at the left end of the line, indicating "no pain", and a final number (10) positioned at the right end of the line, indicating " the worst pain possible". In order to avoid influencing the individuals assessed and affecting the reliability of the measurement, there were no grade markings on the line.

The SCPT was used to provide information regarding complex functional activities, of higher overload and difficulty.

For the SCPT, the patients were positioned in front of a flight of stairs, with five steps of 165-cm total width, 26.5-cm length, and 17-cm height. The area they could use when going up and down the stairs (40 cm) was indicated by adhesive tapes.

The patients were asked to climb the stairs, turn around, and go down the five steps, without using the handrail, as fast as possible, but safely to prevent them from falling. Then, the patients should use the VAS to rate their pain during the test.

The SCPT was timed with a chronometer, which was started at the verbal command "Go!" ("one, two, three, go!"), marking the beginning of the test, and stopped when both of the individual's feet were no longer on the steps.

The Timed Up and Go (TUG) test is a widely used functional test to measure basic mobility of the elderly. The test begins with the individual sitting on a chair. On the word "Go!", the individual stands up, walks three meters towards the line on the floor, circles a cone, walks back three more meters to the chair, and sits down.[14] The test was timed, and the patient instructed to begin the test on the examiner's verbal command "Go!" ("one, two, three, go!").

In addition, we also used the eight-meter walk (8MW) test and timed with a chronometer. The patients were positioned on an initial mark, and, on the investigator's verbal command "Go!" ("one, two, three, go!"), they performed the test as fast as possible and safely. The chronometer was started by the investigator on the word "Go!" and stopped when the patient crossed the eight-meter final mark. The investigator was positioned on the final mark.[15]

Procedures

Data were collected by two investigators (Investigator 1 and Investigator 2). Investigator 1 was responsible for randomizing the sequence of tests, determining the order of knee sleeve use (with and without), hiding the knee sleeve, and choosing the adequate knee sleeve size (perimeter). Investigator 2 ("blind") was responsible for applying the tests proposed.

The tests were divided into two stages (with and without knee sleeve), and each stage consisted of performing the TUG and 8MW tests and the SCPT, with pain rating by use of the VAS at the end of the SCPT.

During the two stages, the patients wore a cover to hide their knees (Figure 1), so Investigator 2 could not know whether they were wearing the knee sleeve. All patients were instructed not to reveal whether they were or not wearing the knee sleeve.

Before starting the assessments, the participants were given a practice trial. One five-minute pause was allowed between the assessment stages to avoid excessive fatigue, due to age and pain intensity of most patients. After the first stage of tests, the patients returned to Investigator 1 to either remove or put on the knee sleeve, and, after hiding it with the cover, they would go back to Investigator 2 to undergo the second stage of the tests. The sequence of tests of the initial stage was also reproduced at the final stage.

Data analysis

After data collection, the statistical program Graph Pad was used for data processing. At first, the Kolmogorov-Smirnov (K-S) test adjusted to Lilliefors test was used to assess data normality, and the significance level adopted was 95%. Initially, the Mann-Whitney (non-paired) test was used to compare the dominant and non-dominant knees on the VAS during the SCPT, with and without knee sleeve. Then, the Wilcoxon (paired) test was used to compare the SCPT, VAS, and TUG and 8MW tests under the two circumstances.

Figure 1
Cover to hide the knees used in all tests.

RESULTS

Table 1 shows the demographic data regarding the 74 patients included in this study. Their mean age was 58 ± 9.7 years, and 78% of them had bilateral impairment. Most patients (73%) were females.

The means obtained with the VAS during the SCPT for the dominant and non-dominant knees were compared under both circumstances (with and without knee sleeve). Because no statistically significant difference was found between the knees (P > 0.05 – Table 2), the means of the data regarding the dominant and non-dominant knees were added, and a new mean found. Thus, the comparative analysis for VAS was performed only between the groups without knee sleeve and with knee sleeve.

After the initial analysis, the VAS of the group without knee sleeve was compared with that of the group with knee sleeve, and a statistically significant difference (P < 0.001) was found between both circumstances (Figure 2).

Finally, the three functional tests were analyzed under both conditions (with and without knee sleeve), and a statistically significant difference was observed for the 8MW and TUG tests (P < 0.05), with a better performance in the group with knee sleeve (Figure 3). However, that same difference was not observed in the SCPT test (P > 0.1339).

Table 1
Demographic data of patients with KOA (mean ± SD, and %)

Number of patients	74
Weight (kg)	76 (± 14)
Height (m)	1.63 (± 0.1)
Body mass index (BMI)	24 (± 5)
Age	58 (± 9.7)
History of knee pain (years)	6 (± 6)
Number of knees	132
Unilateral impairment	22%
Bilateral impairment	78%
Gender	
Male	27%
Female	73%
Size of the knee sleeve	
Small	8%
Medium	42%
Large	50%

Table 2
VAS pain score with and without knee sleeve for the dominant and non-dominant knees (mean ± SD)

Without knee sleeve		With knee sleeve	
Dominant	Non-dominant	Dominant	Non-dominant
5 (± 3)	6 (± 3)	4 (± 3)	5 (± 3)

DISCUSSION

This randomized study with a "blind" investigator aimed at assessing the immediate effect of the elastic knee sleeve use on pain and functional capacity of individuals with KOA. In this study, a statistically significant improvement in pain and functional capacity could be observed during the use of the knee sleeve in the tests performed.

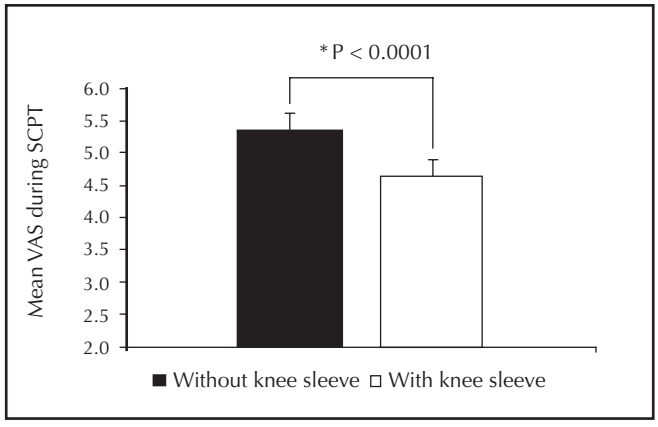

Figure 2
Difference (mean ± SEM) of VAS scores during SCPT with and without knee sleeve.
*Significant difference between the two circumstances.

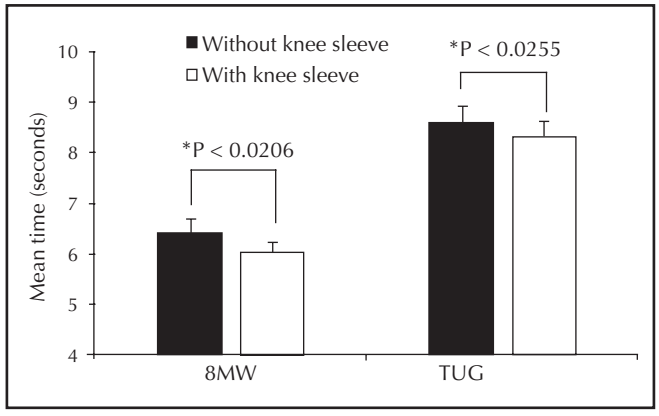

Figure 3
Difference between the values (mean ± SEM) of the 8MW and TUG tests with and without knee sleeve
*Significant difference between the two circumstances.

Studies have shown that knee sleeves can favor individuals with bad proprioception, preventing sprains and consequent falls.[10,16] There is evidence that additional cutaneous stimuli generated by the knee sleeve around the joint can increase the joint position sense, favoring balance and the static and dynamic control of the knee, thus providing more safety for the individual's daily activities.[17,18]

On the other hand, there are theories that cutaneous mechanoreceptors provide information to the cerebral cortex about the knee joint movements, and that the stabilizing effects of taping and braces on large joints are due to skin somatosensory stimuli.[19]

The 8MW and TUG tests used in this study showed an improvement in the functional capacity of the individuals when using the knee sleeves. These tests were chosen aiming at simulating and mimicking the routine activities of individuals with KOA who have pain, inflammation, reduced range of motion, and joint stiffness, which influence their functional activities.[1]

Considering these and other deficits, such as the impairment of the articular capsule and its mechanoreceptors in neuromuscular performance, reduction in the sense of joint position and proprioception, and aiming always at relieving the symptoms of these individuals, several forms of therapies can be used. However, a simple and effective method, such as the elastic knee sleeve use, has not yet been well established in the literature.[1,2,10,16]

Bockrath et al.[20] have reported that constant tactile stimuli on the knee skin, such as those of patella taping, can cause neural inhibition, facilitating the entry of impulses through the large afferent fibers, and, consequently, reducing pain. However, it is not known for sure how long that effect takes to occur or its duration.

Although some antalgic mechanisms have been proposed in several studies, only one previous study assessed the effects of the elastic knee sleeve on pain and function in patients with KOA. However, this comparison was performed between the effects of a heat-retaining knee sleeve and knee sleeves that do not have that property. A 16%-reduction in pain was observed in the short term, with no statistically significant difference between both types of knee sleeves. However, a tendency was observed towards the heat-retaining knee sleeve, which can be more effective.[6] Even knowing that, in this study we chose to use the elastic knee sleeve without the heat-retaining characteristic to simply assess the compression provided by knee sleeve, without the presence of any other mechanism that could induce a reduction in symptoms.

Patellofemoral taping to relieve pain may also be used with knee sleeves, because they better distribute the contact area and decrease pressure on the joint,[21] promoting a better biomechanical balance between the structures, thus reducing pain. Contact area and pressure are inversely proportional, and the greater the contact area, the lower the pressure exerted on a certain region. In addition, compression of the extensor compartment occurs, reducing the pressure on Hoffa's fat pad, which is often inflamed in KOA, thus reducing pain.[22]

Of all hypotheses previously formulated, the biomechanical balance, obtained through an improvement in the joint contact area and consequent lower pressure in the extensor mechanism, is believed to justify the data obtained in this study. The elastic knee sleeve used in the TUG and 8MW functional tests favored an improvement in functional capacity, and also a significant reduction in the VAS pain score during the SCPT. Only the SCPT showed no statistical difference in the time for performing the task under the two circumstances assessed. However, it is worth noting that the individuals were instructed to undergo the SCPT in their usual manner and safely to prevent the risk of falling, aiming at assessing the VAS pain score.

Functional improvement statistically greater was observed in patients using the knee sleeve as compared with those not using it when undergoing the functional tests, assessed in the same patients and in a randomized way.

There are reports showing a small reduction in the pain of KOA with the use of elastic bandages loosely adjusted around the knee, and also with the use of more complex knee sleeves that provide a valgus strength in knees with OA of the medial tibiofemoral compartment. However, such devices are not simple, because they depend on certain technical skills to be applied. On the other hand, elastic knee sleeves are of easy and practical use, and can be applied and removed without much difficulty, because they do not require specific knowledge for their application.[23,24]

Thus, knee sleeve use can be effective during static and dynamic activities. This study showed an improvement in the functional capacity and pain with the immediate use of elastic knee sleeves, indicating that they can be an important aid in the physical rehabilitation process of patients with KOA. This resource cannot be used as the only form of treatment, and should be associated with other therapeutic strategies, such as therapeutic exercises,[25,26] low-intensity laser,[27] pulsed short waves,[28] and drug treatments,[29] such as viscosupplementation.[30]

One of the limitations of this study was the impossibility to access the radiographic examinations of the individuals studied, hindering the association between the results obtained and the degree of joint impairment. Knee sleeves can be effective in patients who want to perform activities that trigger pain, such as some physical exercises. However, as KOA is a chronic disease, further studies should be performed to assess the long-term use of elastic knee sleeves, and also to compare them with neoprene knee sleeves.

CONCLUSION

Based on the findings of the present study, the elastic knee sleeve has proved to be effective in immediately improving the functional capacity and pain of individuals with KOA, because it enhanced performance during the tests proposed. Thus, in conclusion, the knee sleeve is an adjuvant resource for treating KOA, because it is practical, useful, and of easy clinical use, and can aid in the practice of therapeutic exercises.

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