Original Article

The effects of Functional Fascial Taping (FFT) associated with conventional physiotherapy on the knee functionality: a quasi-experimental study

Os efeitos do *Functional Fascial Taping* (FFT) associado a fisioterapia convencional na funcionalidade do joelho: um estudo quase-experimental

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ABSTRACT | INTRODUCTION: Functional Fascial Taping (FFT) is a rigid bandage technique aimed at stimulating the structural alignment of the collagen fibers of the muscular fascia, unblocking the passage of fluids thus ensuring its function. **OBJECTIVE:** To evaluate the effects of FFT associated with conventional physiotherapy on chronic knee dysfunctions based on the variables pain intensity, range of motion, muscle strength and flexibility. **METHODOLOGY:** This is a quasi-experimental study performed with 10 patients of both genders and symptomatology of pain and functional limitation, being in physiotherapeutic treatment. All of them underwent kinetic-functional evaluation, including data on pain, range of motion, muscle strength and flexibility. The application was standardized: first we identified the vectors, followed by the application of hypoallergenic tape. Then applied three strips of rigid bandage, then covered or hypoallergenic tape again. One application three times a week, totaling 10 sessions. **RESULTS:** There was a reduction in pain levels from a median 10.0 cm to 2.0 cm at the end of the 10 sessions (Z = 2.6; p = 0.007). Increased muscle strength for knee extension with initial median of 4.0 to final of 4.0 (Z = 2.0; p = 0.04). Range of motion also improved significantly for knee flexion (Median: from 102.5 ° to 110.0 °, Z = 2.3, p = 0.01) and increased flexibility (Median: from 5.0 cm to 0.0, Z = 2.0 cm, p = 0.04). **CONCLUSION:** FFT can be used as a coadjuvant in the treatment of knee disorders, both orthopedic and rheumatic, allowing stimuli to maintain a more balanced functional mechanics, which favors the reduction in pain, an increase in the range of motion and improvement in strength and muscle flexibility.

DESCRIPTORS: Fascia. Knee. Range of motion. Physical therapy.

RESUMO | INTRODUÇÃO: O *Functional Fascial Taping* (FFT) é uma técnica de aplicação de bandagem rígida objetivando estimular o alinhamento estrutural das fibras de colágeno da fáscia muscular, desobstruindo a passagem dos fluidos assegurando assim sua função. **OBJETIVO:** Avaliar os efeitos do FFT associado a Fisioterapia convencional nas disfunções crônicas no joelho baseado nas variáveis intensidade da dor, amplitude de movimento, força e flexibilidade muscular. **METODOLOGIA:** Tratou-se de um estudo quase-experimental realizado com 10 pacientes de ambos os gêneros e sintomatologia de dor e limitação funcional, estando em tratamento fisioterapêutico. Todos os pacientes foram submetidos a avaliação cinético-funcional, incluindo dados de dor, amplitude de movimento, força e flexibilidade muscular. A aplicação do FFT foi padronizada, onde primeiro identificou-se os vetores, seguido da aplicação do *tape* hipoalergênico. Depois aplicou-se três tiras de bandagem rígida, então, recobriu-se com o *tape* hipoalergênico novamente. A aplicação da bandagem ocorreu três vezes por semana, totalizando 10 sessões. **RESULTADOS:** Houve redução nos níveis de dor de mediana 10,0 cm para 2,0 cm ao final das 10 sessões (Z=2,6; p=0,007). Aumentou a força muscular para extensão do joelho com mediana inicial de 4,0 para final de 4,0 (Z=2,0; p=0,04). A amplitude de movimento para flexão (Mediana: de 102,5° para 110,0°, Z=2,3, p=0,01) e flexibilidade muscular (Mediana: de 5,0 cm para 0,0 cm, Z=2,0, p=0,04) também melhorou significavamente. **CONCLUSÃO:** O FFT pode ser utilizado como coadjuvante no tratamento de desordens no joelho, tanto ortopédicas quanto reumáticas, auxiliando a manutenção de uma mecânica funcional equilibrada, o que favorece a redução no quadro álgico, aumento no arco de movimento e melhora na força e flexibilidade muscular.

PALAVRAS-CHAVE: Fáscia. Joelho. Amplitude de movimento articular. Fisioterapia.

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Introduction

Lesions of great multifactorial incidence that trigger inflammatory processes resulting in painful syndromes characterize orthopedic and rheumatologic disorders in the knee[1]. Many of these injuries are due to joint instability, where the knee depends on factors such as geometry, soft tissue restriction, the action of the muscles and the loads applied by the body in order to maintain its function[2].

In contrast, when a synovial joint is injured, a chain of compromises is observed between its constituent elements, generating morphofunctional changes that increase stress in the segment during the performance of daily physical activities, in addition to causing mechanical instability and pain in which it affects functional capacity of the individual[3,4].

In the musculoskeletal repercussions, the weakness of the quadriceps muscle stands out, caused by sensory changes in the mechanoreceptors of the joint, thus reducing the muscle activation ability, and, consequently, reducing the functional capacity predisposing to structural damage[5].

Among the anatomical components of the knee, there is the muscular fascia, which is a periarticular structure composed of fibrous connective tissue rich in collagen and elastin which, when subjected to mechanical overload, alters its composition[6]. Sudden biomechanical stresses in this joint lead to collagen rupture, and in an attempt to heal fascial tissue, disorganized collagen deposition occurs resulting in fibrosis, which can affect lymphatic circulation, muscle performance and range of motion[7].

Several methods are used in physiotherapy in an attempt to accelerate collagen synthesis and deposition in an organized manner. A new alternative used as a therapeutic intervention is the Functional Fascial Taping (FFT), which consists of a non-invasive technique of applying a rigid bandage whose objective is to stimulate the structural alignment of the collagen fibers of the muscular fascia, thus unblocking the passage of fluids thus ensuring its function. The maintenance of this stimulus in the muscular fascia induces an accelerated rehabilitation process, since the transmission of tension impulses allows the muscles covered by this connective envelope to guarantee the capacity of support, contraction and flexibility, assisting in the levers of functional movements[8].

There is a great diversity of therapeutic resources for the treatment of knee disorders. The FFT can play a supporting role in the association of these resources. However, there is still a shortage of information in the literature regarding the use of this bandage, as it is still a recent technique in the field of rehabilitation. A study aimed at analyzing the effects of FFT in individuals with pain and decreased function in the knees would bring benefits to the academic and professional area seeking improvement in the recovery of these patients. Therefore, the present study aimed to evaluate the effects of FFT associated with conventional physiotherapy in patients with chronic knee dysfunction based on the variables pain intensity, range of motion, muscle strength and flexibility.

Methods

Sample

The study was analyzed and approved by the Human Research Ethics Committee of the Institute of Health Sciences of Pará State University (CEP UFPA), under Technical Opinion no. 813.807 (CAAE36573514.1.0000.0018) following ethical standards, in accordance with Resolution 466/12 of the National Health Council. It was a quasi-experimental study, carried out at the Clínica de Fisioterapia Desportiva Ortoclínica do Pará, in Belém of Pará, from October to November 2014.

Participants in the study were men and women, over 18 years old, selected through non-probabilistic sampling for convenience, with a clinical diagnosis of orthopedic and rheumatologic injuries, as they were already undergoing physical therapy. This consisted of low intensity electrotherapy resources such as transcutaneous electrical nerve stimulation (TENS) (Pulse width: 75us and frequency: 100 Hz, for 20 minutes), followed by free active kinesiotherapy for muscle flexibility and resisted kinesiotherapy for strength gain, as well as proprioceptive exercises to gain balance.

As inclusion criteria, they should have moderate to severe pain intensity using the Visual Analogue Scale (VAS) and incomplete range of motion for flexion of the affected knee. The exclusion criteria, on the other hand, consisted of patients with range of motion with

fixed limitation, neoplastic conditions and allergic reaction to the material used.

Evaluation procedures

Prior to the application of the technique, a kinetic-functional evaluation was carried out to collect personal data and physical examination. In assessing pain, VAS was used to measure pain intensity, where scores from 0 to 2 are classified as mild; 3 to 7, classified as moderate; and 8 to 10, classified as intense[9]. The graduation of the muscular strength of the knee extensors and flexors was measured using the Medical Research Council (MRC)[10] scale, performing the concentric muscle contraction of these muscles while the patient was seated with the pending limb. This scale consists of grading the strength from 0 to 5, according to the following classification: Grade 0 (No contraction); Grade 1 (visible or palpable muscle contraction without movement); Grade 2 (Active movement with elimination of gravity); Grade 3 (Active movement against gravity); Grade 4 (Active movement against gravity and resistance) and Grade 5 (Normal strength).

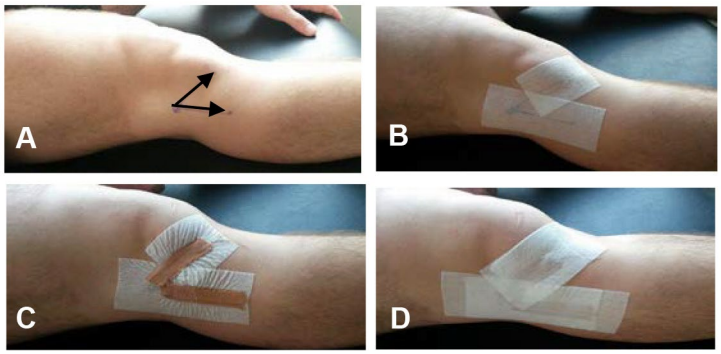
The knee flexion range of motion was measured using the large CARCI goniometer (degrees), with the patient in the supine position on a stretcher and the physiotherapist beside the limb to be tested. The axis of the goniometer was located on the knee joint line, with the fixed arm parallel to the lateral surface of the femur directed towards the greater trochanter and with the movable arm parallel to the lateral face of the fibula directed to the lateral malleolus, the patient requested voluntary flexion of the joint, where the measurement point was when a slight discomfort or muscle tension was felt.

For the muscular flexibility of the posterior chain of the lower limb, the fingertip-to-floor test[11] was used, requesting that the patient remain with the feet together and the knees extended during the anterior trunk flexion, in an attempt to touch the ground. Through the tape measure (cm) it was possible to measure the distance from the 3rd finger to the floor and thus to graduate the muscular flexibility of the patients. All variables studied were reassessed at the end of the 10 FFT sessions.

FFT application

The application of FFT occurred using vector identification (Figure 1A). The patient was first asked to identify the point of pain in the knee. Then, from this point, the vectors were identified. The vector is the direction of digital pressure that leads to pain relief and, consequently, improvement of knee movements. Thus, the application of the bandage occurred in the direction of the vectors found with maximum reduction of pain.

Figure 1. (A) Vector identification (black arrow). (B) Application of hypoallergenic tape. (C) Application of the three strips of tape for each vector found. (D) Completion of the technique with the application of hypoallergenic tape



The application of the bandage was preceded by a standardized process. First, skin cleansing was performed, followed by trichotomy when necessary as can be seen in Figure 1A. After this process, contact glue (Coloplast Prep Protective Skin Barrier) was used to better fix the bandage, as guided by the technique itself. Then, the hypoallergenic tape was applied (Figure 1B), in the direction of the identified vectors, avoiding any skin irritation after the application of FFT, favoring the accommodation of the rigid bandage. For the application of this bandage, the hard tape was applied consecutively after small stresses on the patient's skin in order to cause tension in the muscular fascia. And to obtain this result, three sequential tape strips were applied to each vector found (Figure 1C). Finally, the rigid bandage was covered with the hypoallergenic tape again (Figure 1D). After the application of FFT, patients normally participated in physiotherapy treatment. The study proposal was to apply this resource alternately three times a week, totaling 10 sessions.

Statistical analysis

Excel software® 2010 was adopted for data entry and preparation of tables, as well as BioEstat 5.0 software in statistical analysis. Categorical variables were presented as frequencies and numerical variables using measures of central tendency and dispersion. For the analysis of the significance of the data, the Wilcoxon test was used. All results were considered statistically significant at the significance level of 5% ($p \leq 0.05$).

Results

The sample consisted of 10 patients with a median of 45.5 years and an interquartile interval of 24.5 years, predominantly composed of females with 90% (n = 9) (Table 1). In two patients it was not necessary to apply the FFT until the end of the 10 sessions, since the pain ceased between the fourth and fifth session and its application was no longer useful. However, these continued with the treatment proposed by the clinic and were part of the final evaluation normally.

Table 1. General data of patients treated with FFT

Variables	N	%
Age (years)		
Median	45.5 years old	
Interquartile range	24.5 years old	
Sex		
Male	1	10%
Female	9	90%

Initially the median pain intensity found was 10.0 and was considered severe pain. At the end of the 10 physiotherapy sessions associating the FFT, the median pain decreased to 2.0 (mild pain), with significant results ($Z = 2.6$; $p = 0.007$), observing improvement in pain in these patients (Table 2).

Table 2. Variables analyzed before and after FFT application

Variables	Initial Evaluation		Final Evaluation		Z	p-value
	Median	IIQ	Median	IIQ		
Pain (cm)	10.0	4.0	2.0	4.0	2.6	0.007*
Muscle strength						
Flexors	3.5	1.0	4.0	0.0	1.6	0.10
Extensors	4.0	1.0	4.0	0.75	2.0	0.04*
Goniometry (°)						
Flexors	102.5	15.0	110.0	8.75	2.3	0.01*
fingertip-to-floor test. (cm)	5.0	17.5	0.0	5.0	2.0	0.04*

Interquartile range (II Q). * Statistically significant result, Wilcoxon test (p≤0,05).

Regarding the variable muscle strength, for knee flexion movement, no significant result was observed (Z = 1.6; p = 0.10). Initially the median muscle strength was 3.5 according to the MRC scale, and after FFT applications the median increased to 4.0 (Table 2). However, for knee extension movement, there was statistically muscle strength gain (Z = 2.0; p = 0.004), with an initial median of 4.0 and a final median of 4.0 after FFT, as observed in table 2.

Regarding the variable range of motion for knee flexion, a statistically significant result was observed. The initial median joint amplitude was 102.5º and the final median was 110.0º (Z = 2.3; p = 0.01), as shown in Table 2. Finally, with regard to muscle flexibility of the posterior chain of the lower limb, initially a median of 5.0 cm was observed and at the end of the sessions with a median of 0.0 cm presenting significant results (Z = 2.0; p = 0.04).

Discussion

FFT is a therapeutic proposal to improve functionality and allow rehabilitation to begin in an environment with fewer pain complaints, thus providing a window of opportunity for a more accessible and efficient therapeutic intervention to the patient[12,13].

In the context of physiotherapeutic rehabilitation, the FFT, despite the diversity of treatment, with regard to knee dysfunctions, assumes an adjuvant role in the association of these treatments, given its various benefits for the symptomatology observed in these dysfunctions[8,13]. In this study, it was possible to observe, significantly, a decrease in pain in the patients studied.

Pain measurement of intense characteristics became mild after 10 sessions of FFT application, although associated with other physiotherapy resources, because even in the rehabilitation process when using the proposed resource, acceleration in response to treatment was observed.

This finding can be proven by studies that used this same method and also obtained pain reduction due to the fact that it facilitates the sliding between the fascia and the muscle due to the release of collagen[8,14]. Spina, Cameron and Alexander[15] found, in their case study, results in pain improvement after the third session of FFT in the forefoot region in a patient with Morton neuroma. The study focused on data on pain relief and functionality, measured through VAS and the Functional Foot Index (FFI) functionality scale. As stated in the present study, VAS is widely used as a tool for assessing pain complaints.

Furthermore, ratifying this finding two patients did not need to complete the number of FFT applications stipulated, since the pain had ceased in the fourth session. It is also worth mentioning that in all cases, patients reported decreased pain at the first application of the bandage. Corroborating the results of a study developed by Chen, Alexander and Cook[16] that demonstrated that patients with nonspecific low back pain achieved significant improvement in pain complaint after application of FFT.

For muscle strength, there are still no studies that confirm a direct relationship between increased muscle strength and the application of FFT. However, in this study, gain was observed only for knee extensors significantly, according to the MRC scale.

It is believed, with this result, that the relationship between the bandage and the muscle strength gain may be linked to the fact that with pain relief the patient is able to perform greater joint movement by reducing the load on the joint, and thus having better muscle performance during the performance of the exercises[17].

In relation to range of motion, there was a significant gain for knee flexion with an increase of 9.5º after FFT applications. Reinforcing the results of Spina, Cameron and Alexander[15], who also observed gain in range of motion and which may be related to improved pain levels, similar to what was observed in the present study. In a survey of research on the results obtained through the use of FFT, Alexander[13] states that in more than 95% of cases significant improvement in range of motion is observed. According to the author, this is possible, because there is the displacement and release of the fibrosis points developed in the fascias by the inflammatory process. This release facilitates the process of sliding between planes and tissues, as happens between the muscle fascia and the muscle itself, facilitating the response of muscle contraction and consequent improvement of the range of motion.

In response to injury, the literature states that the body stimulates collagen production[18]. The application of the FFT method promotes continuous stretching of this collagen and influences both the structure and function of fascial tissue, facilitating the sliding between the fascial layers[19]. The frequent reduction of pain and improvement of range of motion can be explained by the alteration of the afferent nociceptive activity of mechanoreceptors[20,21] caused by the application of the bandage. Thus, what differentiates this technique from the others is the specificity, direction and quantity of the tape applied[12]. Regarding the muscular flexibility of the posterior chain of the lower limb, a significant result was also obtained for the fingertip-to-floor test. This demonstrates that the muscular fascia can interfere with the functioning of knee joint mechanics and the overall context of the posterior muscle chain. This result can be sustained by explaining the action of FFT on fascial architecture[12], allowing a better sliding of muscle components, aiding its stretching. However, similar to muscle strength, there are no data that confirm a direct relationship between bandages and the increase in muscle stretching, but rather in improving the flexibility between fascia and muscle slippage.

Much is written about another type of bandage, known as kinesio taping (KT), within a rehabilitation protocol for sportsmen[22,23], and this technique is not restricted only to this public. In the literature, there are several studies in various clinical situations. Little is yet written of the FFT, which makes it difficult to base scientific studies involving this bandage. But despite this obstacle, a research focused on the analysis of the technique in patients with pain and decrease in knee function would bring benefits to the academic and professional area that aims at the quality of life of these patients.

This study presents some limitations such as not presenting randomization and not having a control group, as well as having a selection bias, and limitations regarding internal and external validity.

Conclusion

The research showed a reduction in pain intensity, improved range of motion for knee extension, muscle strength gain and increased muscle flexibility when associated with FFT with conventional physiotherapy. Showing in this study that this technique can be very useful in the rehabilitation of these patients. However, further studies are needed to verify the performance of the bandage in an attempt to provide new physiological information in the use of this technique.

Author contributions

Santos SSS participated in the conception, outline, data collection and interpretation of the results. Araújo APM and Silva MCR participated in the search for data from the literature, interpretation of the data and writing of the manuscript. Melo RA participated in the conception of the project and critical review of the manuscript. Pontes LS participated in the conception, outline and review of the manuscript. Brito AJC participated in the outline, data search in the literature and data analysis. Cardoso-Dias BA participated in the conception, outline, statistical analysis of research data and interpretation of the results. Dias GAS participated in the conception, statistical analysis of research data, interpretation of the results and writing.

Competing interests

No financial, legal, or political conflicts involving third parties (government, corporations, private foundations, etc.) have been declared on any aspect of the work submitted (including, but not limited to grants and funding, participation in advisory board, study design, preparation of manuscript, statistical analysis, etc.).

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