



# Correlation between anterior knee pain with flexibility muscles hip

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## ABSTRACT

**Introduction:** The patellofemoral pain syndrome (PFPS) is one of the most common affections of the knee joints that has as one of its main functions the human locomotion, while the hip is the largest spherical joint of the human body. **Objective:** To know the correlation of anterior knee pain with hip flexibility and range of motion (ROM) in female academics. **Method:** A cross-sectional descriptive study was carried out with a population composed by 40 academics, divided into 2 groups of equal size, one composed by volunteers with PFPS and the other without the syndrome. The volunteers were aged between 18 and 30 years. For flexibility and ROM evaluation was used a fleximeter and a universal goniometer, respectively. **Results:** After statistical analysis, it was verified that the ROM of the hip abduction was decreased in the PFPS group, probably due to the retraction of the adductor muscles of the hip, or even by the loss of the muscular strength of them. With regard to flexibility, hip flexor muscles were retracted, with a significant difference comparing the group with pain and the group without anterior knee pain. **Conclusion:** It was shown that there are muscle changes related to flexibility and ROM in the flexor and hip abductor groups, respectively, in the volunteers with presence of Patellofemoral Pain Syndrome.

**Keywords:** Femoropatellar pain; Hip; Knee; Flexibility; Range of motion.

## INTRODUCTION

The knee is a loading joint with a large range of motion, located in the central portion of the lower limb, and is subject to a large number of pathologies, mainly mechanical, despite its static stabilizers (meniscus, ligaments and capsule) and dynamic stabilizers (muscles and tendons).<sup>(1)</sup> Because it is an intermediate joint of the lower limb, changes in the hip muscles can generate imbalances in the knee, since these are inserted close to this joint, and perform important functions related to both movement and stabilization.<sup>(2)</sup>

The hip is the largest spherical joint of the human body. The head of the femur, the end of the long bone of the thigh, fits into the acetabular cavity of the pelvic bone. It is, therefore, a large joint adapted to support the weight of the body, distribute the efforts and allow the movements of flexion, extension and rotations of the lower limbs. Thus, when all these structures function correctly, the movement in the hip is made, without being noticed, and mainly, without pain. This occurs because the contact is made in the cartilage, which does not present innervation.<sup>(3)</sup>

The anterior knee pain, also known as Patellofemoral Pain Syndrome (PFPS), is characterized by a general non-specific pain present diffusely, with possibility of irradiation to the popliteal region.<sup>(5)</sup> Its onset is usually insidious, and may increase when walking up and down stairs, during physical

activity, maintenance for prolonged period of knee flexion and a squat position, and may be accompanied by pseudoblocks and increased of the Q angle.<sup>(6)</sup>

The SDPF Affects mainly young adults and female athletes, being these more susceptible when compared to male athletes practicing the same sports modalities. The most common symptoms are pain, crepitation, fissures and joint blockages.<sup>(7)</sup>

The patellofemoral pain syndrome, which accounts for 25% of all sports-related knee injuries, is of multifactorial origin, resulting from a combination of variables that include abnormal biomechanics of the lower limbs, soft tissue tightness, muscle weakness and excessive exercise.<sup>(8)</sup>

Among the factors predisposing to PFPS, can be mentioned: femoral anteversion, weakness or atrophy of the vastus medialis oblique muscle, increased Q angle, valgus knee, external tibial torsion, subtalar hyperpronation, trochlear dysplasia, the high patella, the rigidity of the iliotibial tract and the weakness of the abductor muscles and lateral rotators of the hip.<sup>(9)</sup>

The adduction and medial rotation of the femur during functional activities produce an increase in the angle Q, which generates an overpressure in the lateral aspect of the patellofemoral joint, leading to patellofemoral pain.<sup>(10)</sup>

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The diagnosis of a patient with patellofemoral pain requires a thorough physical examination based on a complete history. The nature of the injury and specific physical findings, including a detailed examination of the retinacular structure around the patella, identified more accurately the specific source of anterior knee pain or instability. Radiographs should include a standard 30 degree to 45 degree axial view of the patella and a precise lateral radiograph.<sup>(11)</sup>

Conservative treatment leads to relief of symptoms in most patients and generally includes strengthening exercises (with emphasis on the vastus medialis oblique muscle, one of the vastus medialis portions), muscle stretching, motor control, therapeutic modalities, and anti-inflammatory use<sup>(12)</sup>; however, there is no objective data to determine the best conservative approach to this syndrome, since the quadriceps femoral muscle strengthening performed on an open and a closed kinetic chain are considerably different.<sup>(13)</sup>

Therefore, the current study aimed to correlate anterior knee pain with flexibility and range of motion of the hip in female academics.

## METHODS

This is a descriptive cross-sectional study. According to the Resolution 466/12 of the National Health Council of the Ministry of Health, this project was approved by the Research Ethics Committee of the "Universidade de Rio Verde – UniRV" and the identity of the people evaluated was not disclosed at all, but only the data obtained. The information collected through the evaluation was archived with the researchers.

The research was conducted at the Clinical School of Physiotherapy of the UniRV (Universidade de Rio Verde), located in the city of Rio Verde – Goiás, and had duration of 20 minutes for evaluation of each volunteer, and the stipulated time was 14h 40minutes. The suit worn by them was gym clothes. The population of this study was composed of 40 academics of the UniRV, aged between 18 and 30 years, divided into two groups of equal size, being composed of academics with PFPS (group with pain), diagnosed by special tests performed by qualified professionals, and the other group by academics without PFPS (group without pain).

Inclusion criteria were female between 18 and 30 years old, university students who accepted to participate in the study, with PFPS constant over 3 months (confirmed by the positivity of the femur-patellar compression test and the Femur-patellar friction), practicing physical activity and signed the free and informed consent form.

On the other hand, the exclusion criteria were academic who are not enrolled in the Physiotherapy course of the UniRV or who did not accept to participate in the study, with age under 18 years or above 30 years, sedentary, volunteer who had other associated lesions such as ligaments, meniscal or osteoarticular injuries, volunteers who underwent knee

or hip surgeries, pregnant women, and persons with a body mass index above 40.

The data collection was done only after acceptance and signing of the Informed Consent Term clarifying doubts that may arise about the evaluation to be applied.

Data collection was performed by the researchers, after training, through the goniometer, which is an instrument used to quantify the amplitude of the angles formed by the joints in several movements, and through the fleximeter, equipment that was used to assess flexibility, providing the values in degrees.

The goniometric evaluation was performed by two evaluators, one responsible for reading the goniometer and another responsible for stabilizing the hip joint, and the goniometer reading was expressed in degrees. The evaluator responsible for reading placed the goniometer at the recommended test position and followed the movement of the joint to the maximum amplitude reached by the evaluated and, at the end of the movement, read the instrument, which was recorded in an individual file.

The goniometry of the hip flexion movement is made in the dorsal decubitus position with the knee flexed, the goniometer arm was in the medial line of the trunk, the movable arm on the lateral surface of the thigh, the axis at the greater trochanter level, and the movement was moving the leg toward the trunk, being normal angle from 0 to 125°. <sup>(14)</sup> The hip extension movement is made in the ventral decubitus with the knee extended, the fixed arm in the median line of the trunk, the movable arm in the lateral part of the thigh, the axis at the greater trochanter level, making a movement to raise the maximum of the leg, being normal angle from 0 to 10°. The abduction movement of the hip is made in dorsal decubitus with extended knee, fixed arm on the line drawn between the antero-superior iliac spine (ASIS), movable arm on the anterior region of the thigh, axis on ASIS, doing abduction movement, being normal angle from 0 to 45°. The adduction movement of the hip is made in dorsal decubitus with extended knee in the leg that was not test in abduction, fixed arm on the line drawn between the ASIS, movable arm on the anterior thigh, axis on the ASIS, approaching the leg tested from the other, being normal angle from 0 to 15°.

The internal rotation of the hip is made with the individual sitting with the legs hanging, fixed arm in the anterior midline of the tibia, movable arm in the anterior midline of the tibia, axis in the anterior face of the patella, making the movement of the leg to the outside, being normal angle from 0 to 45°. The external rotation of the hip is made with the individual sitting with the legs hanging, fixed arm in the anterior midline of the tibia, movable arm in the anterior midline of the tibia, axis in the anterior face of the patella, making the movement of the leg to the inside, being normal angle from 0 to 45°.

For flexibility assessment, using the fleximeter, the hip extension movement was performed with the individual in the



ventral decubitus, making the hip extension movement with the knee extended, stabilizing the pelvis and the fleximeter was fixed on the lateral face of the distal part of the thigh, being the normal angle from 0 to 10°. <sup>(15)</sup> The hip flexion movement was performed with the individual in the ventral decubitus, making the hip flexion movement with the knee of the leg tested and the fleximeter was fixed on the lateral face of the distal part of the thigh, being the normal angle from 0 to 125°.

The abduction movement was in lateral decubitus with the leg to be tested facing upwards, and the individual made the abduction movement, and the fleximeter was fixed on the posterior face of the distal part of the thigh, being the angle from 0 to 45°. The adduction movement was in lateral decubitus and the evaluated member was upward, and the individual made the adduction movement with the evaluated leg jumping out of the stretcher, and the fleximeter was fixed on the posterior face of the distal part of the thigh, being the normal angle from 0 to 15°.

The internal rotation of the hip was made with the individual seated on the stretcher, with the segment to be measured extended, and made the internal rotation movement with the foot, and the fleximeter was positioned on the sole of the foot, being the normal angle from 0 to 45°. The external rotation of the hip was made with the individual seated on the stretcher, with the segment to be measured extended, and made the external movement with the foot, and the fleximeter was positioned on the sole of the foot, being the normal angle from 0 to 45°.

The quantitative data were organized and analyzed for frequency of occurrence and the results were presented through graphs and tables, using the data tabulation program. Student t test was used to compare ROM values and hip flexibility between groups. The program used for the calculation was the SPSS 22.0 and were considered significant values of  $p < 0.05$ .

## RESULTS AND DISCUSSION

Forty academics with a mean age of  $21 \pm 2.54$  years were evaluated, with the objective of evaluating the ROM and flexibility of the hip muscles.

It is known that the involvement of the proximal musculature of the patellofemoral joint can contribute to the development of PFPS.

Regarding ROM, a statistically significant difference was observed ( $p = 0.049$ ) in the abduction of the volunteers with PFPS, that is, the abduction movement was diminished in these individuals, from this it can be understood that the adductor muscles are retracted causing the mentioned ROM decrease. Such comparisons between the ROM of the group with and without pain are shown in Table 1.

Corroborating with the present study, Cabral et al. (12), observed the ROM can be diminished by several factors, such as the shortening and loss of muscle strength. In the

patients evaluated by the authors, it can be inferred that muscle shortening occurred because the leg extension was performed more easily after the treatment, since the shortening evaluation was made with the active contraction of the patient.

The study carried out by Miyamoto, Soriano and Cabral <sup>(16)</sup> evaluated the ROM and the shortening of the ischiotibial muscles of patients with PFPS, being verified retraction of this muscular group and significant improvement after the treatment. In the present study, no statistically significant difference was found in ROM of flexion, which would represent the retraction of the hamstrings. Such difference in results could be due to the fact that the present study did not perform effective treatment to verify the efficacy of this in the pain, it only verified the presence or not of ROM alteration, whereas in the work of Miyamoto, Soriano and Cabral <sup>(16)</sup>, was verified the efficacy of the hamstring elongation in the treatment of PFPS.

The most obvious function of the hip adductor muscles is the production of the adduction torque in the frontal plane. <sup>(17)</sup> In the sagittal plane the adductor muscles from a position of 50 to 60 degrees of hip flexion has an extensor movement and is capable of generating an extension torque. It also has an internal rotator component, and thus can act in the formation of a knee valgus on the femoral component. The increased valgus promotes a greater force resulting from lateralization of the patella, increasing the contact between the lateral facet of the patella and the lateral femoral condyle. Because it has an important extensor torque, such shrinkage verified in the current study may also interfere with flexion ROM as cited in the study of Miyamoto, Soriano and Cabral. <sup>(16)</sup>

The study of Tyler et al. <sup>(18)</sup> cited by Nakagawa et al. <sup>(9)</sup>, with 35 patients with PFPS, undergoing a 6-week treatment program, composed of hip strengthening and flexibility exercises in open and closed kinetic chain, in which was reported the association of the gain of 35% of muscle strength of the hip flexors and increase in flexibility of the iliopsoas muscle and the iliotibial band with the success of the treatment.

A result that could be expected is the reduction of the ROM in adduction, which would represent the retraction of the iliotibial tract/tensor fasciae latae muscle, because according

**Table 1.** Description of the ROM values and the comparison between the groups.

	Without pain	With pain	t test
Flexion	99.5±11.2	95.6±18.4	0.573
Extension	20.8±7.0	22.5±9.1	0.481
Internal Rotation	29.6±5.5	26.2±7.4	0.134
External Rotation	25.2±5.7	22.2±8.2	0.317
Abduction	32.2±5.6	26.6±7.8	0.049*
Adduction	24.4±7.4	27.3±5.8	0.28

\*  $p < 0.05$



to Nakagawa et al.<sup>(9)</sup> the normalization of the flexibility of the iliotibial tract/tensor fasciae latae muscle and the flexors muscle of the hip decreased the pelvic anteversion, as well as medial rotation of the femur, positively influencing the alignment of the patellofemoral joint. Another theory is that the shortening of the iliotibial tract/tensor fasciae latae muscle may predispose to PFPS because its distal fibers are inserted in the lateral facet of the patella and, once shortened, would laterally pull it, increasing the stress on the lateral facet of the patella on this articulation. An explanation for the absence of ROM decrease in adduction would be a significant decrease already found in ROM in abduction, since this as previously mentioned may be caused by adductor retraction, which is extremely potent from the point of view of postural maintenance, composed of five strong muscles, because the composition of this group is primarily muscle fibers type I, with high fatigue strength and with greater potential for muscular retraction.

In this study, the flexibility of the hip flexor muscles in the with PFPS was decreased in the statistical analysis, that is, the hip flexor muscles of this group are retracted. Table 2 presents the results of flexibility, demonstrating the decrease of flexibility in flexors.

In relation to flexibility, Nakagawa et al<sup>(9)</sup> reported that the maximal isometric force of the abductor muscles and lateral rotators of the hip, in addition to the flexibility of the quadriceps muscles in 30 patients with PFPS, was smaller and less flexibility of the gastrocnemius, soleus, hamstrings and quadriceps muscles was found.

Another study that also analyzed the decrease of flexibility was the one of Cabral et al.<sup>(12)</sup>, which aimed to study the efficacy of the muscle stretching in the recovery of patients with PFPS. In their studies were evaluated 20 sedentary females divided into two groups, being G1 in which was realized the muscle stretching of the posterior chain by the global postural reeducation technique and in G2 was realized the stretching of the hamstrings and gastrocnemius muscles. The treatment was performed in two weekly sessions in eight weeks. The results showed that both groups had improved functional capacity, but only G1 reported a decrease in pain intensity and flexibility when compared to G2, which suggests that the stretching exercise, especially the global, should be indicated for patients with PFPS.

When assessing the muscles that perform the flexion, it is observed that the iliopsoas is one of the primary motors. The iliopsoas muscle attaches anteriorly to the femoral head and is a powerful flexor of the hip both of the femur over the pelvis and of the pelvis over the femur, but from the anatomical position the muscle is not an efficient rotator. In the position with the abducted hip, the iliopsoas muscle assists lateral rotation. The tensor fasciae latae muscle is also a flexor and a primary abductor of the hip, besides being a secondary medial rotator of the hip. As indicated by its name, the tensor fasciae

**Table 2.** Description of the values of flexibility and comparison of it between groups.

	Without pain	With pain	t test
Flexion	92.1±6.6	81.2±15.6	0.022*
Extension	23.5±9.5	27.8±10.4	0.221
Internal Rotation	79.2±11.3	18.8±18.0	0.958
External Rotation	38.8±18.4	29.1±12.2	0.137
Abduction	57.5±9.1	59.2±14.4	0.727
Adduction	20.2±15.6	13.1±6.0	0.206

\* p < 0.05

latae muscle increases the tension in whole the fasciae latae. Tension passed inferiorly through the iliotibial tract helps to stabilize the lateral side of the knee extended. In addition it also participates in the lateralization of the patella.<sup>(17)</sup> The influence of the tensor fasciae latae muscle on the ROM was not verified, however, as pointed out in the studies of Miyamoto, Soriano and Cabral<sup>(16)</sup>, this is a muscle that, when retracted, pulls the patella laterally and causes the appearance of femur-patellar pain, and since this muscle also has flexor function, its retraction was demonstrated in the present study when it was evaluated the flexibility of the hip flexors.

The rectus femoris muscle is responsible for about one third of the isometric flexor torque, in addition, it is a primary extensor of the knee and acts by pulling the patella superiorly, increasing its friction in the trochlear groove, generating a wear of the femur-patellar joint and consequent pain in this joint.<sup>(9)</sup>

## CONCLUSION

After analyzing the obtained results, it was observed that there are muscular alterations of the hip of the volunteers with PFPS, suggesting a possible relationship between the pain and hip changes. In the analogy of the range of motion of this study, it was observed an alteration in the hip abduction movement, which it is decreased, so that the hip adductor muscles may be retracted or with loss of muscle strength. In relation to flexibility, hip flexor muscles were retracted in this study, with a significant difference comparing the group with pain and the group without anterior knee pain.

Therefore, due to the relevance of this study, it should contribute with new research about the relations between the musculoskeletal alterations of the hip of the volunteers with PFPS.

## AUTHOR'S CONTRIBUTION

NFB: data collection, review, manuscript preparation; BB: bibliographic search, revision, manuscript preparation; EGMS: guidance, review, preparation of the manuscript; HMS: guidance, review, statistical analysis

## CONFLICTS OF INTEREST

The authors declare that there was no conflict of interest.



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