Relationship of anteversion of the femoral neck with patellofemoral pain syndrome in young women not practicing regular physical activity

Relação entre a anteversão de colo do fêmur e a síndrome da dor patelofemoral em mulheres jovens não praticantes de atividade física regular

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DOI 10.5935/2595-0118.20200179

ABSTRACT

BACKGROUND AND OBJECTIVES: Patellofemoral pain syndrome is an anterior knee pain (or retropatellar), associated to knee joint stress. The risk factors include musculoskeletal disorders that affect the distribution of forces acting on the knee joint, as in the femoral anteversion. The objective of this study was to verify the relationship between the femoral anteversion angle and the patellofemoral pain syndrome in young women who do not practice regular physical activity.
METHODS: This is a cross-sectional, case-control study. The sample includes 100 women (G1, n=50 - anterior knee pain; G2, n=50 – control group). The instruments applied were the Anterior Knee Pain Score, numerical pain scale, and Craig's test. The groups were compared using the Student's t-test, p<0.05 for significant results (GraphPad Prism 8).
RESULTS: The mean age was 21.5±3.45 and 20.9±2.85 years old for G1 and G2, respectively. Mean pain intensity was 4.6±1.97 for G1, with no pain recorded in G2 (p=0.0001). The mean anteversion angle of the femoral neck was 16.2±4.85 degrees in G1 and 15.6±4.87 degrees in G2 (p= 0.566). The average score obtained with the Anterior Knee Pain Score was 81.4±10.46 and 94.8±5.41 points for groups 1 and 2, respectively (p=0.0001).
CONCLUSION: No relationship was found between angulation of the femoral neck and the presence of anterior knee pain, however, a greater functional loss in the group with pain was observed.

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Submitted on March 28, 2020.
Accepted for publication on May 11, 2020.
Conflict of interests: none – Sponsoring sources: Fundação de Amparo à Pesquisa do Estado de Alagoas (FAPEAL).

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Keywords: Bone anteversion, Bone malalignment, Femur neck, Pain, Patellofemoral pain syndrome.

RESUMO

JUSTIFICATIVA E OBJETIVOS: A síndrome da dor patelofemoral se manifesta com dor anterior no joelho ou retropatelar, relacionada ao aumento do "stress" articular. Os fatores de risco incluem disfunções musculoesqueléticas que afetem a distribuição de forças na articulação do joelho, como ocorre na anteversão femoral. O objetivo deste estudo foi verificar a relação do ângulo de anteversão femoral com a dor anterior no joelho de mulheres jovens não praticantes de atividade física regular.
MÉTODOS: Estudo transversal, caso-controle. A amostra composta por 100 mulheres divididas nos grupos dor anterior no joelho (G1) e controle (G2) cada um com 50 indivíduos. Os instrumentos aplicados foram: o *Anterior Knee Pain Score*, a escala numérica da dor, e teste de Craig. Os grupos foram comparados entre si pelo teste *t* de Student, adotando-se p<0,05 para resultados significativos (GraphPad Prism 8).
RESULTADOS: A média de idade foi de 21,5±3,45 e 20,9±2,85 anos para os grupos G1 e G2, respectivamente. A intensidade média da dor foi 4,6±1,97 para o G1, não havendo registro de dor no G2 (p=0,0001). A angulação média de anteversão do colo femoral foi de 16,2±4,85 graus no G1 e 15,6±4,87 graus no G2 (p=0,566). Por fim, o escore médio obtido com o *Anterior Knee Pain Score* foi de 81,4±10,46 e 94,8±5,41 pontos para os grupos 1 e 2, respectivamente (p=0,0001).
CONCLUSÃO: Não foi encontrada relação entre angulação do colo femoral com a presença de dor anterior do joelho, no entanto, observou-se que no grupo com dor havia maior perda funcional.
Descritores: Anteversão óssea, Colo do fêmur, Dor, Mau alinhamento ósseo, Síndrome da dor patelofemoral.

INTRODUCTION

Patellofemoral pain syndrome (PFPS) is defined by the presence of anterior knee (retropatellar) pain, related to the increase of contact pressure (stress) in the patellofemoral joint, being the most common athlete's knee problem, especially in runners. PFPS etiology is not well established, nevertheless, it's related to multifactorial causes like direct trauma or any activity that may cause patellofemoral joint compression, like long periods of sitting, squatting, going up and down stairs, which makes it harder to diagnose[1-3].

Anterior knee pain impacts physical and psychic-emotional aspects, influencing directly in mental health and social relationships, taking to demotivation for everyday life activities[1].

Prevalence of PFPS in the world varies between 15-45%, its more common in women by the proportion of 2:1, and in young adults. PFPS also makes up 3% of all diseases that attack the knee[1,4].

PFPS risk factors include quadriceps muscle weakness and biomechanical misalignments in the Q angle, tibiofemoral angle, external static rotation of the knee, tibial lateral torsion and hyperpronation of the foot, which affect the distribution of forces acting on the knee joint, since their adequate alignment is necessary for a harmonious functioning between the hip and knee joints[1-3,5].

The proximal portion of the femur is influenced by both the frontal and axial plane. In the frontal plane, the angle of inclination can be observed, reporting the coxa valga or vara. While in the axial plane the anteversion angle of the femoral neck is observed, formed through an overlapping angulation of the femoral condyles and center of the femoral head, with normal value between 8° and 15°.

The anteversion occurs when the icondylar plane passes posteriorly to the center of the femoral head, forming an angle greater than 15°; if the opposite occurs, when it passes anteriorly to the center of the femoral head, the angle formed will be less than 8°, establishing a retroversion of the femoral neck[5].

Femoral anteversion can lead to increased medial rotation of the limb, resulting in inward deviated feet. On the other hand, if the anteversion is compensated by increased lateral tibial rotation, there will be compensation with adjustment of the foot, misaligning the knee, which will adopt the valgus pattern. The determination of the value for this anteversion is fundamental in the diagnosis and therapeutic planning with emphasis on the preventive screening of lesions.

A clinical measurement is through Craig's test, also called trochanteric prominence test, which has a level of accuracy close to the tomographic evaluation of the angulation and has the advantages of low cost and easy performance. Its clinical practice is justified because it generates values equivalent to the three-dimensional tests[5,6].

Recent studies validated the femoral anteversion angulation using Craig's test in comparison to measures obtained in computed tomography (CT) in children, however, there are not many records of the test in a young adult population[5]. This study's objective was to verify the existence of the relation between the angulation of the hip internal rotation and the intensity of anterior or retropatellar pain in the knee of young women not practicing regular physical activities.

METHODS

Cross-sectional, observational, case-control study conducted at a public state university in Alagoas. The sample was composed of 100 women university students, organized in two groups: G1 (n=50) - with anterior knee pain; and G2 (n=50) - control group, with no report of knee pain. Inclusion criteria was: female gender, aged between 18 and 30 years old, normal body mass index (BMI) (18.5 to 24.9 kg/m^2), not practicing regular physical activity. Those with a history of ligament lesion, meniscus, femorotibial arthrosis and other previous knee diseases were excluded. Sedentarism was adopted as a criteria to classify individuals as not practitioners of regular physical activities, which, in accordance to the American College of Sports Medicine (ACSM), is determined by less than 150 minutes per week of light physical activities[7].

Each participant was evaluated in a maximum time of 30 minutes. Initially, the Anterior Knee Pain Scale (AKPS) was applied, a psychometric evaluation composed of 13 closed questions related to day to day activities. The score could range between zero and 100 points, the smallest scores corresponding to greater knee functional disability[8].

Next, the intensity of pain was measured by the Numerical Pain Scale (NPS), in which zero means ''absence of pain" and 10 ''the worst pain ever felt by the interviewed". 1 to 3 points were considered as mild, 4 to 6 as moderate, and 7 to 10 as severe pain[9].

The measurement of the anteversion angle of the femoral neck was performed by the same two evaluators in all participants through Craig's clinical test. The individuals were positioned in ventral decubitus with a 90º knee flexion. One of the evaluators using a goniometer established the zero grade angle; the other evaluator palpating the large trochanter performed the internal rotation of the hip until its most lateral point was reached.

The goniometer evaluator measures the degrees of rotation in relation to the initial point, the normal value being between 8º and 15º and, above that, the anteversion of the femoral neck[5,6].

Both examiners presented similar results of the daily measurement established in tests before the actual collection. There was no therapeutic intervention for the presence of knee pain or for femoral neck anteversion.

This study was approved by the institution's Research Ethics Committee (CAAE 46333615.9.0000.5011). All participants signed the Free and Informed Consent Term (FICT).

Statistical analysis

The statistical analysis was descriptive, through mean±standard deviation. The groups were compared using the Student's *t* test, adopting $p<0.05$ for significant differences. Calculations were performed using the GraphPad Prism 8® statistical software.

RESULTS

The mean age found was 21.5±2.4 and 20.9±2.6 years old, respectively, for G1 and G2. The mean pain intensity measured by NPS was 4.58±1.97 and 0±0.0 for groups 1 and 2, respectively, presenting significant difference (p=0.0001).

The mean angulation found for anteversion of the femoral neck was 16.2 ± 4.85 degrees at G1 and 15.6 ± 4.87 degrees at G2, p=0.566. Finally, the mean value obtained with AKPS was 81.4±10.46 and 94.8±5.41 points for G1 and G2, respectively, with p=0.0001 (Figure 1). The characterization of the sample is grouped in table 1.

Table 1. Sample characterization. Values expressed in simple mean±SD

Variables	Groups			
	G1 (n=50)	G2 (n=50)	Total (n=100)	p-value
Age	21.5±3.45	20.9 (±2.58)	21.2 (±3.05)	-
Level of pain (NPS)	4.6±1.97	0	2.3 (±2.69)	0.0001*
Femoral neck anteversion angle (degrees)	16.2±4.85	15.6 (±4.87)	15.9 (±4.84)	0.566
Function (AKPS)	81.4±10.46	95.2 (±5.41)	88.3 (±10.82)	0.0001*

NPS = numerical pain scale; AKPS = Anterior Knee Pain Score; G1 = anterior knee pain; G2 – control group; n – number of participants. *statistically significant difference.

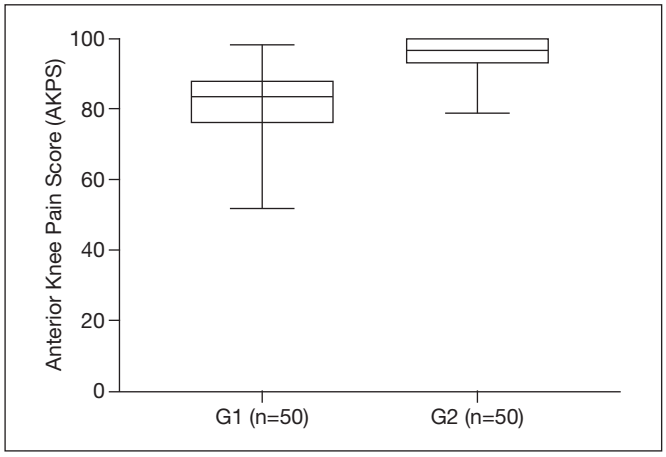

Figure 1. Knee function comparison

AKPS = Anterior Knee Pain Score; G1 = anterior knee pain; G2 = control group; n = number of participants.

DISCUSSION

The number of studies that assess the relation between knee pain and hip musculature has increased. This study presents in a pioneer way the relation of pain and the transversal angulation of the femoral neck. The outcomes of pain, function and anteversion angulation of the femoral neck were evaluated and no difference was identified between the angulations of people with anterior knee pain and those who do not have these angulations (p=0.566).

Muscular power depends on two primordial factors, the length-tension and cross-sectional area of the muscle. The initial hypothesis was that, with more femur anteversion, the length-tension of the lateral hip rotator muscles would be bigger, leading to a mechanical disadvantage for that muscle, favoring the dynamic valgo, an injury factor for the patellofemoral joint. That would be sustained through the mean angulation of women in pain (G1), which is very close to the borderline value of 15 degrees given as normal. In addition to that, biomechanical studies show that an accentuated femoral anteversion is associated with bigger movements of the dynamic valgo, which results in a bigger risk for PFPS[5,6,10,11]. A study[5] used CT measurements to validate Craig's test and found that the femoral neck angulation evaluated by this test may partially be the true anteversion angulation, as other factors may influence its value, even though the test has important clinical significance. Authors[6] investigated the Craig's test accuracy and concluded that it was closer to the results obtained by CT when compared to radiologic evaluation, suggesting that the test could be used in an outpatient population screening when tomography is not available. Such findings influenced this study to perform only the clinical assessment of the femoral angulation, since there was no resources for a tomography analysis. The study[5] also showed that women with increased femoral anteversion tend to present higher static external rotation of the knee, which can be a risk factor for PFPS; while men did not show this association in the findings. Moreover, another cohort study[10] observed that, the higher the angle of internal rotation of the hip during a dynamic activity, the higher the risk for developing PFPS.

Moreover, the same study also reported that the increase in internal rotation of the hip in relation to the tibia and the knee valgus were directly related to increased "stress" in the femoropatellar joint. Therefore, in contrast to the present study, no relation between the anteversion of the femoral neck and the appearance of anterior knee pain in sedentary young women was found (p=0.566).

The sample was limited to age and the female gender. The age factor is fundamentally important because in young people, as this study's participants, muscle strength is greater with less loss of fibers, unlike individuals of more advanced age, in which the number of fibers decreases due to the physiological process of aging[12]. Study[13] verified that women who had more knee injuries, when compared to men, had a tendency to have a larger femoral anteversion angulation. The pain and function outcomes, considered secondary, obtained differences (p=0.0001 for both). The presence of pain is justified in G1, with a mean value of 4.6 points in the NPS, while absent in G2.

In that sense, a notorious clinical difference was expected for cases of anterior knee pain. As for function, the value was observed in the pain group characterized by a score of patellofemoral joint disorder. The relation between pain and lessened function can be ascertained due to the lower knee function score of the pain group (G1), denoting more functional limitation of this joint[14].

One of the strengths of the present study was the covered evaluators, which had clinical experience in order to effective apply the test. The limiting factor was the sample being chosen by convenience, with no sample calculation Confirmar trad, making it impossible to project the results to the global population.

CONCLUSION

No influence of the femoral neck angulation on the emergence of anterior knee pain in young women not practicing regular physical activities was found, however, it was possible to observe that femoropatellar joint function was undermined, as well as a greater level of pain in proportion to the anteversion angulation.

ACKNOWLEDGMENTS

Thanks to the *Fundação de Amparo à Pesquisa do Estado de Alagoas* (FAPEAL – Alagoas State Research Support Foundation), for financing this study; and the *Universidade Estadual de Ciências da Saúde de Alagoas* (UNCISAL – Alagoas Health Sciences State University) for the location where the research was carried out.

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