

Estudo da associação entre dor patelofemoral e retropé varo

Study of the association between rear-foot varus and patellofemoral pain

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RESUMO

A dor patelofemoral, também denominada dor anterior do joelho está presente em 25% da população, onde 36% são adolescentes e com maior prevalência no sexo feminino e atletas. Objetivo: Verificar a associação entre a presença de retropé varo a partir da posição neutra da subtalar e a dor patelofemoral. Casuística e Métodos: Foram recrutados 10 voluntários com dor patelofemoral unilateral ou bilateral. Os voluntários foram submetidos à avaliação do alinhamento do retropé a partir da posição neutra da subtalar. Para isso, os voluntários foram posicionados em decúbito ventral, com o pé pendente para fora da mesa. Os ângulos formado pelas retas que dividem as pernas e os calcâneos ao meio foram medidas através de um goniômetro universal. O teste de Fisher foi utilizado para verificar a associação entre dor patelofemoral e varismo de retropé maior ou igual ou menor que 8 graus. Resultados: Os resultados do presente estudo demonstraram que todos os membros com grau de retropé maior que 8 (75%) apresentavam dor, totalizando 15 joelhos. Já os joelhos avaliados com retropé menor ou igual a 8; 2 (10%) apresentavam dor e 3 (15%) não apresentaram dor. Associação estatisticamente significativa entre o grau de retropé e a presença de dor foram encontrados ($p=0,009$). Discussão: O varismo de retropé leva a pronação excessiva da subtalar associada à rotação interna da tibia com conseqüente alteração do alinhamento do membro inferior e dor patelofemoral. Conclusão: Os resultados desse estudo sugerem que existe a associação entre o retropé varo e a dor patelofemoral.

PALAVRAS-CHAVE

dor, joelho, biomecânica, tornozelo e pé

ABSTRACT

Patellofemoral pain, also called anterior knee pain, is present in 25% of the population with 36% of them being adolescents, and with a higher prevalence among females and athletes. Objective: To assess the association between the presence of rear-foot varus, from the subtalar neutral position, and patellofemoral pain. Patients and Methods: Ten volunteers with unilateral or bilateral patellofemoral pain were assessed. The volunteers were submitted to the evaluation of rear-foot alignment from the subtalar neutral position. In order to do so, the volunteers were positioned in the ventral decubitus position, with the foot hanging parallel to the table. The angles formed by the straight lines that divide the legs and the calcanei were measured through a universal goniometer. Fisher test was used to assess the association between patellofemoral pain and rear-foot varus \geq or $<$ 8°. Results: The results of this study showed that all limbs with rear-foot varus $>$ 8° (75%) presented pain, totaling 15 knees. Of the knees that presented rear-foot varus \leq 8,2 (10%) presented pain and 3 (15%) did not. A statistically significant association between the degree of rear-foot varus and pain was demonstrated ($p=0.009$). Discussion: Rear-foot varus causes an excessive pronation of the subtalar joint associated to the internal rotation of the tibia, with a consequent alignment alteration of the lower limb and patellofemoral pain. Conclusion: The results of this study suggest that there is an association between the presence of rear-foot varus and patellofemoral pain.

KEY-WORDS

pain, knee, biomechanics, ankle and foot.

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Introduction

The term patellofemoral pain, also called anterior knee pain, Patello-Femoral Syndrome, subluxation or luxation of the patella, is used to define a series of affections found in the patello-femoral joint^{1,2,3}. Patellofemoral pain is present in 25% of the population with 36% of them being adolescents, and with a higher prevalence among females and athletes^{4,5,6}.

The etiology of patellofemoral pain is multifactorial and many theories have been proposed to explain it^{1,7,8}. Among the associated factors mentioned in literature, is the increase in the Q angle, tension in lateral knee structures, in the gastrocnemius muscle and the anterior hip structures, inadequate patellar positioning, vastus medialis obliquus failure, and weak activation of the posterior fibers of the gluteus medius. Lastly, one can mention the excessive subtalar joint pronation that leads to biomechanical compensations with patellofemoral joint overload^{1,4,7,8}.

Studies in literature show that 77% of all knee injuries are associated to foot and ankle biomechanical alterations^{10,11,12}. During the support phase of gait, the excessive subtalar joint pronation leads to an excessive internal rotation of the tibia, with a consequent increase of the lateral forces that act on the patella, causing its lateralization, and altering the knee joint biomechanics and creating pain^{10,13}.

However, one of the factors that lead to excessive pronation is the rearfoot varus, which is considered a congenital alteration in which the calcaneus rests in an inverted position due to a medial arching of the rearfoot¹⁴. The etiology of this deformity is related to a tibial and/or calcaneus failure in straightening inverted positions, present in infancy. The rearfoot varus is one of the biomechanical alterations related to excessive pronation^{15,16}. On the other hand, the measurement of the rearfoot varus is not routinely assessed in individuals with patellofemoral pain, despite the fact that studies have suggested that rearfoot varus is a contributive factor to this type of pain¹⁷.

The ideal foot position in relation to the subtalar joint in the neutral position is characterized by the alignment of the lines that divide longitudinally the leg and the calcaneus. There is no consensus in the literature regarding the alignment of the rearfoot, and an acceptable measurement is considered to be between 2 to 6° of rearfoot varus^{18,19,20}.

The literature describes two easily applied techniques to measure the rearfoot alignment from the neutral position of the subtalar joint²¹. The measurement performed in closed kinetic chain was described by Elveru et al.²² and Root et al.²³, and the one performed in open kinetic chain was described by Wernick and Langer²⁴. In addition to these measurements, there are other techniques that present more reliability for the measurement of rearfoot, such as the three-dimensional analysis of the static and/or dynamic position of the foot, but these measurements do not have a clinical application²⁵.

Objectives

Based on the accepted biomechanical interrelation of the foot

and knee complex dysfunctions, the aim of the present study was to carry out a pilot study to assess the association between the presence of rearfoot varus from the neutral subtalar position and patellofemoral pain.

Material and Methods

After approval from the Ethics Committee in Research of the Centro Universitário de Belo Horizonte - Uni-BH, a transversal descriptive pilot study was carried out. Initially, two academicians from the Physical Therapy Course underwent a training period to get acquainted with the measurement procedures of rearfoot alignment from the neutral subtalar position in open kinetic chain, according to the data provided by Wemick and Langer²⁴. After the training, ten healthy volunteers were evaluated for the reliability study of the measurements obtained for the intra-examiner as well as the interexaminer conditions.

For the measurement, the volunteers were placed on ventral decubitus, with the lower limb under test extended and the other crossed over the opposite limb. Afterward, the examiner positioned the lower limb in the neutral position in relation to the internal and external hip rotation. Then, the talus was palpated in its medial and lateral borders with one hand, while the other hand positioned the forefoot. Then, the subtalar joint was positioned in the neutral position, being considered the position between the supination and pronation. Next, two lines were traced, dividing in two halves the distal third of the leg and the calcaneus. The angle formed by the intersection of these two lines was measured by a universal goniometer. Another examiner was in charge of helping the goniometer positioning, and another was responsible for registering the data. The measurements were repeated three consecutive times, with a 2-minute interval between them. The lines were erased between measurements, so that they would not interfere with the measurements performed by the other examiner. While one examiner carried out the measurement procedures with a volunteer, the second examiner evaluated another volunteer.

After the analysis of the measurement reliability, volunteers with a medical diagnosis of patellofemoral pain aged 18 to 35 yrs were recruited through explicative posters and file list of patients from the Clínica Escola do Centro Universitário Uni-BH. The exclusion criteria were: individuals with a previous history of foot, ankle, knee and/or hip fractures. After reading and signing the written informed consent form, the volunteers were evaluated regarding the pain pattern, affected side and age.

Then, the examiner who presented the higher reliability in the measurements carried out in the first phase of the study, evaluated the rearfoot alignment measurement in relation to the neutral subtalar position. A second examiner helped to trace the bisecting lines between the tibia and the calcaneus, following the same procedures mentioned before in the reliability study.

After the data collection, the volunteers were categorized as having rearfoot varus when the measurement was > 8° of varus. Fisher's test was used to analyze the association between the presence or absence of pain and rearfoot varus, with the significance

level set at $p < 0.05$. This statistical method was chosen due to the reduced sample size of the present study. A descriptive analysis of age and gender distribution was also verified. The intraexaminer reliability study of the rearfoot measurement from the subtalar joint neutral position was evaluated through the intraclass correlation coefficient (ICC).

Results

The study of the intraexaminer reliability of the rearfoot varus measurement from the neutral position of the subtalar joint showed an ICC of 0.90 and 0.86 for the evaluated examiners. For the study of interexaminer reliability, the ICC obtained was 0.52. The descriptive analysis of the data showed that 60% of the volunteers evaluated were females and 40% were males; mean age was 24.7 ± 3.2 years. Of a total number of 20 limbs examined, 85% of them presented pain, and the female volunteers presented higher incidence of pain (59%) when compared to males (41%).

The results of the present study showed that all limbs with a rearfoot varus > 8 (75%) presented pain, totaling 15 knees. Of the knees that presented rearfoot varus ≤ 8 , only 2 (10%) presented pain and 3 (15%) did not present according to Figure 1. As for the pain variables, 90% of the individuals reported pain when climbing stairs, and walking was the less frequently reported cause of pain.

According to Fisher's exact test, the present study demonstrated a significant association between the presence of pain and rearfoot varus > 8 ($p = 0.009$).

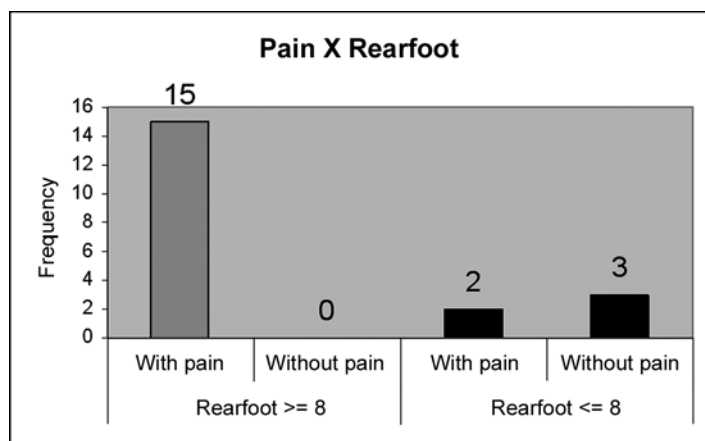


Figure 1

X axis: distribution of the measurement of rearfoot $>$ or \leq 8 degrees and the presence or absence of pain; Y axis: Distribution of frequency of the individuals

Discussion

The results of the present study demonstrated high intraexaminer reliability of the rearfoot varus measurement from the neutral subtalar joint position after a period of training and familiarization

with the measurement procedure. According to Portney and Watkins²⁶, an ICC higher or equal to 0.90 is the ideal one for its clinical application, which favors the use of this measurement in physical therapy practice after a training period and by the same examiner. Therefore, the second phase of the study was carried out with a single examiner, thus preventing the error obtained when the two examiners carried out the measurements demonstrated by the low CCI disclosed by this analysis (CCI: 0.52).

The results of the present study are also in accordance with El-veru et al.²⁷, who used the same methodology to measure the rearfoot in an open kinetic chain and obtained high intraexaminer reliability. In opposition, Jonson and Gross²⁸ performed the measurement of the rearfoot in a closed kinetic chain and found an ICC of 0.88; however, these authors evaluated the intersession reliability with a two-day interval between the tests.

In the present study, the measurements were carried three consecutive times with a 2-min interval between them. Despite the small interval between the measurements, the examiner intercalated the measurements with the other examiner between volunteers, which probably decreased the possibility of comparison between the repeated measurements. It is likely that the reduced interval interfered with the obtained results, decreasing the variability of the consecutive results. Portney and Watkins²⁶ suggest a 24-hr interval between each evaluation. Therefore a longer time interval between the measurements is suggested for future studies.

According to Powers²⁹ and Vogelbach³⁰, the rearfoot varus contributes to an excessive pronation and consequently, to patellofemoral pain. The rearfoot varus leads to the excessive pronation of the subtalar joint, with a consequent excessive internal rotation of the tibia, altering the force vector that acts on the patella. This, in turn, generates more tension on the lateral soft tissues with the resulting patellofemoral pain.

There is no consensus in the literature regarding the reference of angulation of rearfoot varus that is considered normal or acceptable. The studies suggest a variation of 2 to 6° as an acceptable angulation. Some studies suggest a cutoff of up to 8° of rearfoot varus¹⁷. On the other hand, the study by Powers, Maffucci and Hampton³¹ demonstrated high variability of the measurements obtained from healthy individuals and those with patellofemoral pain, with a difference of only 1° when the groups were compared.

The results of the association between patellofemoral pain and rearfoot varus showed a statistically significant correlation in the evaluated limbs. However, the limitations of such results are known, considering the small sample size and the absence of a control group. These data are in accordance with Gilleard and Levinger¹⁷, who also used a value $> 8^\circ$ as reference for rearfoot varus. However, these authors evaluated the difference between the control group and that with patellofemoral pain, totaling a sample of 27 female volunteers.

Therefore, based on the preliminary results, it becomes necessary to compare the difference between the two groups of individuals, with and without patellofemoral pain, using a larger sample size. Additionally, one must bear in mind the variability of the measurements obtained in the symptomatic and asymptomatic groups,

which suggests the necessity to verify the difference between the asymptomatic and symptomatic sides of individuals with unilateral patellofemoral pain. On the other hand, it is known that the prevalence of bilateral patellofemoral pain is higher than the unilateral one, which would limit the external validity of results¹⁷.

In the present study, 90% of the individuals reported pain when climbing stairs. According to Grelsamer and Kelin³², during knee flexion in a closed kinetic chain, with an angulation between 0 and 90° of flexion, there is an increased compression of the patellofemoral joint, with consequent symptomatology in this region. On the other hand, the less frequently reported cause of pain was walking. This can be explained by the fact that, when deambulating, there is an internal rotation of the tibia due to the excessive subtalar pronation, which leads to an increased overload on knee structures. However, during this activity, the rotational forces exerted are lower than the compressive forces on the knee at the moment of flexion when climbing stairs.

According to Powers²⁹ and McPoil et al.³⁴, the measurement of the rearfoot alignment must be included in the assessment process of individuals with patellofemoral pain, considering the biomechanical compensations that result from this dysfunction. In the present study, the high variability of this measurement was observed in the interexaminer condition. Therefore, it is suggested that the patient's evaluation and re-evaluation be performed by the same therapist during the physical therapy follow-up.

The lack of consensus about the cutoff of the rearfoot angulation that might be considered acceptable, suggest the necessity of further studies comparing the measurements in a population with and without patellofemoral pain, and also verifying the difference between the symptomatic and asymptomatic limbs in individuals with unilateral patellofemoral pain.

Conclusion

The results of this pilot study suggest that there is an association between the presence of rearfoot varus and patellofemoral pain, and further studies are necessary on this subject. Additionally, the present study results suggest the use of the rearfoot alignment measurement as part of the physical assessment of individuals with patellofemoral pain.

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