Research Article
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Analysis of agreement between assessment tools for hamstring flexibility in elderly.

Análise da concordância entre instrumentos de avaliação de flexibilidade para os músculos isquiocrurais em idosos.

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Abstract
Introduction: The aging is characterized by a reduction in the effectiveness of skills, among them the loss of the flexibility. The hamstring muscles may be affected by the decreased flexibility occurs when elderly can present limitation of gait, low back problems and osteomuscular. Among the techniques used to evaluate the flexibility of the hamstring muscles are the Sit and Reach Test and Computerized Photogrammetry evaluation of the popliteal angle . However, the scientific literature doesn't provide consistent data on the correlation of these forms of evaluation. **Objective:** To analyze the correlation between the sit and reach test and Computerized Photogrammetry evaluation of the popliteal angle used to assess the flexibility of the hamstring muscles in elderly women. **Method:** This was a cross-sectional, observational study, consisting of 39 elderly, healthy. The evaluation was composed by forms with personal details and physical examination (body weight, height and body mass index), and the evaluation of tests to measure the flexibility of the hamstring muscles (Sit and reach test and Computerized Photogrammetry evaluation of the popliteal angle). The correlation of the data was done by using the Spearmam's rank correlation coefficient, with a significance level of 5% ($p<0.05$). **Results:** The data showed a positive correlation between Sit and Reach Test Computerized Photogrammetry and the popliteal angle of the right leg ($r=0.4690$, $p=0.0026$) and the left leg ($r=0.3604$, $p=0.0241$). **Conclusion:** The data from this study allow conclude that the tests for assessing hamstring flexibility in elderly women, the Sit and Reach Test and Computerized Photogrammetry evaluation of the popliteal angle are complementary because it doesn't correlate strongly.
Keywords: Range of Motion, Articular. Aged. Geriatric Assessment.

Resumo
Introdução: O envelhecimento é caracterizado pela redução na eficácia das habilidades, dentre elas esta a perda de flexibilidade. Os músculos isquiocrurais podem ser acometidos pela diminuição da flexibilidade quando ocorre os idosos podem apresentar limitação da marcha, problemas lombares e osteomusculares. Dentre as técnicas utilizadas para avaliar a flexibilidade dos músculos isquiocrurais esta o Teste Sentar e Alcançar e a Fotogrametria Computadorizada da avaliação do ângulo poplíteo. Entretanto, a literatura científica não apresenta dados consistentes sobre a concordância dessas formas de avaliação. **Objetivo:** Analisar a correlação entre o Teste sentar e alcançar e a Fotogrametria Computadorizada da avaliação do ângulo poplíteo usados para avaliar a flexibilidade dos músculos isquiocrurais em idosas. **Método:** Tratou-se de um estudo transversal, observacional, formado por 39 idosas, hígidas. A avaliação foi composta por ficha com dados pessoais e exame físico (Massa corpórea, estatura e índice de massa corpórea), além de ser realizada a avaliação dos testes para medir a flexibilidade dos músculos isquiocrurais (Teste Sentar e alcançar e Fotogrametria Computadorizada da avaliação do ângulo poplíteo). A correlação dos dados foi feita por meio da aplicação do Coeficiente de Correlação de Spearman, com nível de significância de 5% ($p<0,05$). **Resultados:** Os dados mostraram correlação positiva entre o Teste Sentar e Alcançar e a Fotogrametria Computadorizada do ângulo poplíteo do membro inferior direito ($r=0,4690$; $p=0,0026$) e do membro inferior esquerdo ($r= 0,3604$, $p=0,0241$). **Conclusão:** Os dados do presente estudo permitem concluir que os testes para avaliação de flexibilidade isquiocrurais em idosas, o Teste Sentar e Alcançar e a Fotogrametria Computadorizada da avaliação do ângulo poplíteo são complementares, pois não se correlacionaram fortemente.
Palavras Chaves: Amplitude de Movimento Articular. Idoso. Avaliação geriátrica.

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INTRODUCTION

Brazil has a growing proportion of individuals who become seniors,[1] in 1991 the population over 65 years was 4.8%, rising to 7.4% of the population in 2010.[2] It is believed that with the increase in the elderly population scientific studies is necessary to investigating aging[3] which is characterized by a reduction in the effectiveness of skills, among them this flexibility.[4]

Flexibility is defined as the range of motion of the joint, and its decrease may be caused by bone, muscle and/or limiting structures that articulate how tendons, ligaments and joint capsules stability.[5] With increasing age the flexibility decreases due to deficiency of collagen,[4] so that there is loss of muscle elasticity, leading to deterioration of the joint capsule, ligament, tendon and synovial fluid.[6] Flexibility plays an important role in the elderly due to its performance in daily activities being responsible for performing the movements with greater or less facility.[7,8] Loss of elasticity of hamstring muscles can lead to limitations in walking, lumbar and musculoskeletal problems.[9]

Among this, there are several methods to perform the evaluation of flexibility of hamstring muscles among them this Computerized Photogrammetry assessing the popliteal angle[10] and the Sit and Reach Test (SRT).[11] Computerized Photogrammetry assessing the popliteal angle measuring the flexibility of hamstring muscles[10,12] by means of a picture that is processed using the AutoCAD ® software. [10] In turn, SRT has the function of measuring the flexibility of both muscles as the hamstring region and low back through the Wells bank which has a graded surface.[11]

As decreased flexibility of hamstring muscles can lead to limitations in daily activities, it is important your review because after identification of deficit initiatives to improve flexibility and therefore can be taken to facilitate the activities of daily living. In order to achieve the best possible way to assess the flexibility of muscles in elderly hamstring is necessary to assess the concordance between the two tests.

Thus this study aims to investigate and discuss the correlation between the SRT and the Computerized Photogrammetry assessment of the popliteal angle and discuss the pros and cons of the methods used to assess the flexibility of the muscles in elderly hamstring.

METHODS

It was a cross-sectional, observational study, approved by the Research Ethics Committee of the Faculdade de Filosofia e Ciências da Universidade Estadual Paulista "Júlio de Mesquita Filho" (UNESP), Marília, SP, Brazil (process number 0077/2011). All subjects were informed about the study and signed an informed consent. Recruitment was done through the dissemination of research establishments in activities that promote or offer some assistance to the elderly population.

The sample consisted of thirty-nine heathy female elderly, aged 66.26 ± 3.83 years and BMI between 29.34 ± 4.30 kg/m², residents in Marília, SP, Brazil. The volunteers were not included if they had neurological symptoms, lower limbs discrepancy greater than two centimeters, ankylosing spondylitis, rheumatoid arthritis, herniated disc, tumor, infection, spinal fracture, cauda equina syndrome, cardiovascular or cognitive impairment.[13,14]

The evaluation consisted of forms with personal data and physical examination (body weight, height and body mass index), and the evaluation of tests to measure the flexibility of hamstring muscles (SRT and photogrammetric evaluation of the popliteal angle) be performed.

Sit and reach test

Aims to measure the flexibility both as hamstring muscles and lumbar region.[11] The volunteer was positioned sitting on the mat with your feet in full contact with the front edge of the seat, the legs with knees in full extension and the hip flexed at 90°. After the volunteers are positioned correctly, was asked to stage a flexion of the trunk and drove them the marker on the millimeter surface. The test was performed three times, being choosed the best value observed.[4,5]

Computerized Photogrammetry assessment of popliteal angle

This test is performed to assess the flexibility of hamstring muscles.[10,12] The adhesive markers were placed at three points in the lower limb of voluntary assessed: At greater trochanter of the femur, the head of the fibula and the lateral malleolus.

A digital camera was positioned two meters, centered on the direction of voluntary knee, which was initially positioned supine under the wooden plank with the limb to be assessed at 90° of hip flexion and knee and the contralateral limb on the plank with hip and knee joint in full extension.

After initial placement of the examiner passively held the greatest extent possible knee until the voluntary speak some discomfort caused by muscle shortening. At this point, we performed the photographic record of the popliteal angle. Throughout the review, was maintained 90° of hip flexion (with the aid of wooden plank).

After an analysis of photographic records was performed using the software AutoCAD 2010 ®, where two lines, one of the greater trochanter toward the head of the fibula were traced; and one of the lateral malleolus toward the head of the fibula, forming an angular measure called arithmetic as far as popliteal angle.[10]

Statistical Analysis

For statistical analysis, we used the BioEstat 5.0 program. The verification of normality and homogeneity was performed by Shapiro-Wilk test and the correlation data hamstring flexibility of muscles were made by applying the Spearman correlation coefficient. For data interpretation was adopted significance level of 5% ($p < 0.05$).

RESULTS

The result of SRT was 21.18 ± 9.03 cm and Computerized Photogrammetry assessment of right popliteal angle was 166.97 ± 9.04 degrees and the left was 167.28 ± 9.69 degrees.

When performing the correlation data showed a positive correlation between the SRT and the Computerized Photogrammetry of the popliteal angle, both the right limb ($r = 0.4690$, $p = 0.0026$), as the left limb ($r = 0.3604$, $p = 0.0241$). By comparing the values of the right and left popliteal angle was observed significant positive correlation ($r = 0.7031$, $p < 0.0001$) (Figure 1).

DISCUSSION

The scientific literature hasn't data on the agreement between the methods for evaluating the flexibility of the hamstring muscles, so the present study investigated the correlation between SRT and the Photogrammetry computerized assessment of right and left popliteal angle.

The results indicate a moderate positive correlation between the SRT and the computerized photogrammetry of popliteal angle of both knees, indicating that both tests can be used to assess the flexibility of hamstring muscles in elderly and when performing the correlation between the Computerized Photogrammetry right and left popliteal angle was positive and strong, ie the flexibility between both members are similar in elderly.

Corroborating with our data, Atamaz *et al.*[15] found the reliability of testing flexibility hamstring muscle (popliteal angle, sit and reach test, finger to the floor and the modified sit and reach test) and the results showed that all tests were reliable, and the most reliable among them was the popliteal angle. But the test for the evaluation of the popliteal angle evaluated by studying Atamaz *et al.*[15] was different to our because they used the goniometer and our study Computerized Photogrammetry.

The Photogrammetry is based on photographs taken during body movements with advantages in clinical application [16] in addition to enable quantification of postural changes of the human body to make more accurate data than the values of visual observation[17] is effective and the evaluation range of motion of flexion and knee extension when a single evaluator performs the evaluation in addition to being sensitive to small changes in amplitude.[18] The photogrammetry shows limitation in markers placement on the bone surfaces of motion of the markers on the skin may introduce errors in the measurement.[19]

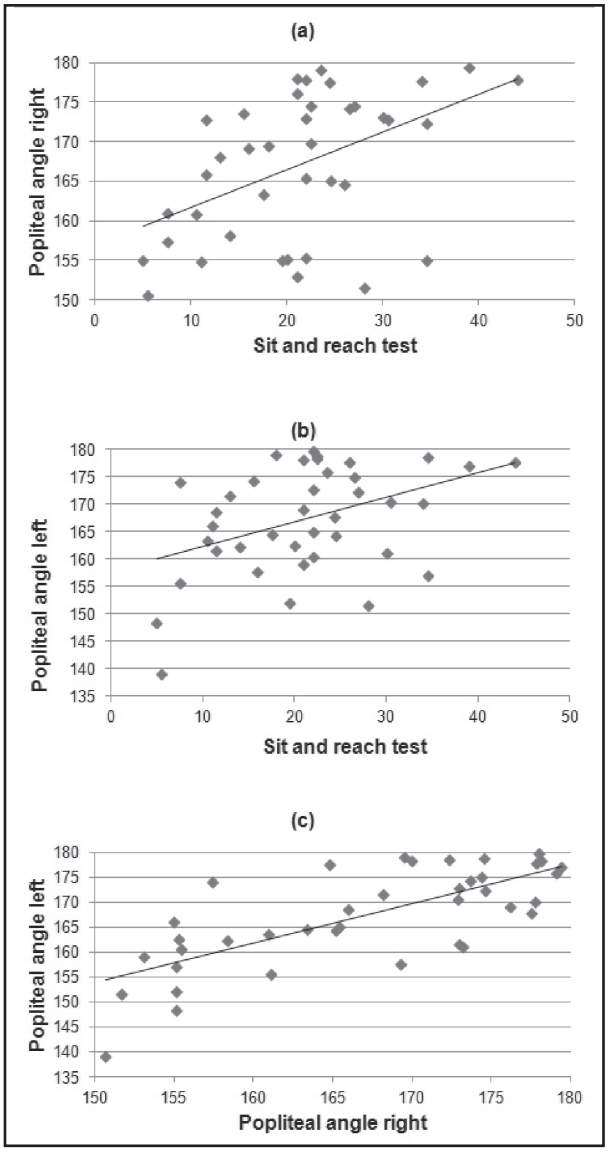

Figure 1. (a) Correlation between the Computerized Photogrammetry assessing of right popliteal angle and sit and reach test; (b) Correlation between the Computerized Photogrammetry assessing the Left Popliteal Angle and sit and reach test; (c) Correlation between the Computerized Photogrammetry assessing Right and Left Popliteal Angle.

Regarding SRT, is considered the most known and applied field test, besides being simple, easy to perform and require minimal training[11] and is shown to reliably measure the flexibility of hamstring muscles and lower back in men and women middle and old age, with moderate positive correlation to goniometry of the two regions.[20]

Thus, this study comprises SRT due to assess both the lumbar region and hamstring muscles [11] and Computerized Photogrammetry assessing popliteal

angle only in hamstring muscles,[10] it is believed that this led to the correlation data are rated as moderate.

CONCLUSION

Data from this study support the conclusion that the tests for the evaluation of flexibility of hamstring muscles in elderly (SRT and the Computerized Photogrammetry of popliteal angle) are complementary; do not correlate strongly besides presenting distinct characteristics. Moreover, it is necessary the joint application of both tests to assess the best way hamstring the flexibility of muscles.

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