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ISOKINETIC EVALUATION OF HIP FLEXORS AND EXTENSORS MUSCLES IN ATHLETES OF RHYTHMIC GYMNASTICS

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SUMMARY

Rhythmic Gymnastics (RG) is a competitive sport that due to its aesthetic and technical requirements makes athletes seek to maximize their technical performance. Elements inherent to the sport are based on movements of hip extension, flexion and abduction, which explain the need for producing considerable levels of strength in different muscle lengths and speeds. The aim of the study was to evaluate the capacity of strength in flexors and extensors of the hip joint in a Brazilian team of GR. Five international level athletes of RG from 15 to 22 years old, participated in this study. Strenght of hip extensor and flexor muscles was evaluated from the peak torque measured using Biodex System 4 Pro isokinetic dynamometer Torque was evaluated during maximal concentric isokinetic voluntary contraction at six different angular velocities (30º/s, 60º/s, 120º/s, 180º/s, 240º/s and 300º/s) and during three maximal isometric voluntary contractions at eight different hip angles (15º, 30º, 45º, 60º, 75º, 90º, 105º and 120º). The widespread use of hip flexion and extension in RG seems to influence the muscle mechanical properties, resulting in a functional adaptation that tends to render homogeneous force production capacity in different joint angles and angular velocities. This homogenization is most evident in hip flexion, since this movement is trained extensively, either in larger or smaller lenghts and high or low speeds.

INTRODUCTION

Rhythmic Gymnastics (RG) is a competitive sport that due to its aesthetic and technical requirements makes athletes seek to maximize their technical performance, and require large extent in achieving explosive movements and maintenance of posture characteristics of the modality [1]. Allied to this, selection of gymnasts begins by seeking tall and thin girls with long legs and great flexibility [2]. Part of this concern with gymnasts´ body type came from elements inherent to the sport, which are based on movements of hip extension, flexion and abduction [3], making RG characterized by beauty and plasticity of movements executed, needing to produce considerable levels of strength in different muscle lengths, altering the capacity of muscle strength. Useful information is provided for biomechanical and physiological research and coaching relevant to understanting the occurrence of lower limb asymmetry [4]. Research has shown that RG athletes with a long term training presented bilateral asymmetry in circumference measure of the lower limbs due to exercises with the prevalence of the dominant leg [5]. However it´s not yet well understood the capacity of produce strength in these athlete´s lower limbs, specifically at the hip. The aim of the study was to evaluate the capacity of strength in flexors and extensors of the hip joint in a Brazilian team of RG.

METHODS

Five international level athletes of RG participated in this study. Their age ranged from 15 to 22 years old. The participants are members of a Brazilian club from the State of Santa Catarina. The initial evaluation was a questionnaire which has the purpose of gathering information about their age, time of experience in sport, hours per week training, dominant leg and sports injury history. After that, weight and height were measured. . Force of hip extensor and flexor muscles was evaluated from the peak torque measured using Biodex System 4 Pro isokinetic dynamometer (Biodex Medical Systems, Shirley, New York). Torque was evaluated during a maximal concentric isokinetic voluntary contractions at six different angular velocities (30º/s, 60º/s, 120º/s, 180º/s, 240º/s e 300º/s) and during three maximal isometric voluntary contractions of 5 seconds at eight different hip angles (15º, 30º, 45º, 60º, 75º, 90º, 105º e 120º). Paired Samples T Test compared torque values between both legs and One-way ANOVA ($p < 0,05$) was used to compare torque of hip flexors and hip extensors muscles among the eight different hip angles and six different angular velocities.

RESULTS AND DISCUSSION

The average age of athletes was 18,4 years old (±2,61), and 11,8 (±3,83) years of sport experience. The mean values of height, weight and Body Mass Index (BMI) were 1,66m. (±0,04), 55,83kg. (±4,78), 20,20 (±1,64), respectively. The athletes have trained 30 hours per week, only one of the subjects reported a past calf injury and all the subjects reported that their dominant leg was the right one.

Force-lenght and force-velocity relations have been used in different sports modalities to understand functional adaptation of muscles [6]. Figure 1 shows that the highest peak torque was registered at 90º of hip extension and 45º of hip flexion, for both sides. The lowest peak torque was registered at 15º of hip extension and 120º of hip flexion, for both sides too. Torque of hip flexor muscles remains almost unchanged in muscle lengths tested, especially in right hip, where no significant differences were found between the peak torque recorded in different angles.

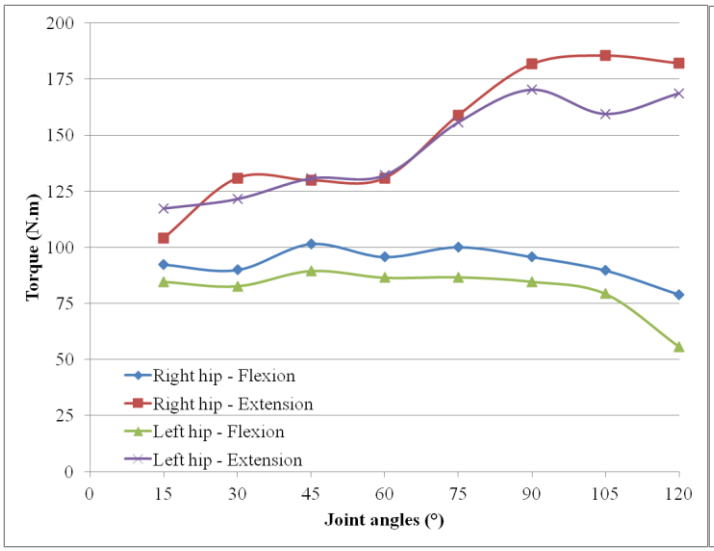

Figure 1. Torque- angle relation.

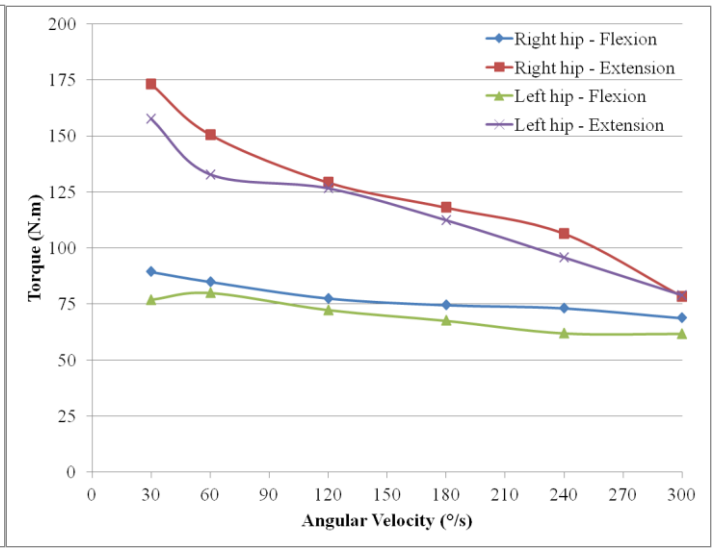

Figure 2. Torque-velocity relation.

Left hip flexor muscles presented significant differences on torque between 45º and 120º, and 60º and 120º. The differences found were exactly between the angles which were recorded the highest peak torque, 45 ° and 60 °, and the angle tested when hip flexors were in shorter lenght 120º), which seems to follow the mechanical properties of muscle, agreeing with findings already demonstrated by Herzog et al. [7]. When comparing hip flexion movement of both sides, it can be noted that the dominant side (right) presents characteristics that indicate a specific functional adaptation of RG. This is because the dominant leg is the one that plays most body elements in RG, in which is crucial force production in different angles and large amplitudes in performance of movements and postures for maintaining characteristics of the modality [1].

In extension movement, there were significant differences only in the right hip, in torque produced between the angles 15 º and 105 º, and 15 º and 120 º, i.e. the extreme lengths tested, which are unfavorable for force production. Nevertheless, the use of dominant limb seems to generate some adaptation, after all, only the right leg showed significant differences. Paired Samples T Test showed that there were differences in torque between legs only at 75º hip flexion. This seems to differ from the idea that there could be a difference between the force y of lower limbs in athletes with longer training [8].

Torque-velocity relationship is shown in figure 2. Paired Samples T Test showed that differences between legs force were in hip flexion at 30º/s and hip extension at 60º/s.

There was a great variation in the range of force observed at different angles and speeds tested in extension, significant difference was found between torque of both legs, i.e. the extension movement between speeds 30º/s and 240°/s, 30°/s and 300°/s, 60°/s and 300°/s. In flexion, there´s no significant differences in torque among the speeds, as well as found in Bay et. al. study [9. This could be explained by the fact that there is no emphasis on an isolated work of hip extension at great speeds in training differently from hip flexion that had an specify direction, due to the elements of balance, kicks and jumps which require higher speeds in its execution [2]. However It´s possible that the flexors of hip have good adaptability for fast movement, contrary what happens with the extensors [9].

CONCLUSIONS

The widespread use of hip flexion and extension in RG seems to influence the muscle mechanical properties, resulting in a functional adaptation that tends to render homogeneous force production capacity in different joint angles and angular velocities. This homogenization is most evident in hip flexion, since this movement is trained extensively, either in larger or smaller angles and high or low speeds. These data provides important information for the coach for designing muscular strength training protocol.

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