ACUTE EFFECTS OF STATIC STRETCHING AND PROPRIOCETIVE NEUROMUSCULAR FACILITATION ON THE PERFORMANCE OF VERTICAL JUMP IN ADOLESCENT TENNIS PLAYERS

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ABSTRACT

Introduction: Traditionally the flexibility exercises have been enclosed as part of the warm-up that precedes a tennis match. However, a controversy exists if the intensity of execution of flexibility would have influence on the athletic performance. The objective of the present study was to verify the acute effect of the static stretching and the proprioceptive neuromuscular facilitation (PNF) on the performance of jump in adolescent tennis players.

Materials and Methods: To participate on the experiment it was chosen nine young tennis players, being four of feminine sex and five of the masculine sex, with average age of 14.4 years-old, participants of a tennis school. The group had a warm-up participating of the activities of the tennis lesson and then they executed the jumps. After that a session of trainings of flexibility was carried through immediately after performing new jump.

Results: After statistical treatment, the results did not present significant change in the height of jump (p = 0.66 > 0.05) between the tests and post test and static and PNF stretching.

Discussion: Athletes, who directly need the muscular strength for power generation as the tennis players, seem to not being benefitted with exercises of passive stretching or PNF preceding the specific exercise.

KEYWORDS

Muscle Stretching Exercises, Articular Range of Motion, Proprioception.

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INTRODUCTION

The universal practice of exercises for flexibility has been accepted in order to prepare the athlete physically and mentally for the performance and minimize the risk of injuries. However, there are evidences supporting that flexibility exercises can be detrimental to the performance of strength.

Some variables such as volume and intensity of training may influence the direct generation of muscle strength after passive stretching. Exercises for flexibility, kept in the same angle for 45 s, result in reduction in passive tension (muscle stiffness) and intensity repeatedly imposed by work increases the muscular length.

Basically, this controversy is based on the lack of definition of the intensity of the effort employed. The flexibility exercises performed on a sub-maximum way at the upper limit of the maximum range of motion (stretching) do not present deleterious effects on neuromuscular performance. Moreover, the maximum exercises (flexing) that are performed with discomfort and/or even limited pain and with execution time (10 s to 15 s) higher than that used for stretching, for its characteristics should present different acute effects on strength and flexibility.

Another concern that every coach should consider is the choice of protocol to be used, as there are studies on the flexibility exercises that are dynamic that present benefits on the generation of strength.

Studies using protocols of static flexing showed results of decrease in performance on various manifestations of muscular strength, as well as also protocols of proprioceptive neuromuscular facilitation (PNF). In the study of review conducted by Shrier et al., to evaluate whether the pre-activity flexibility exercises of would provide
improvements in performance, it was found that, from the 23 articles analyzed, 22 of them suggested that there was no benefit to isometric strength, isokinetic torque and the jump.

Facing the current evidences presented, the question arises: Is adolescent athletes, the jump power is negatively affected if a work of flexibility is developed using static stretching or PNF? Therefore, the objective of this study was to verify the acute effects of static stretching and PNF on the performance in vertical jump of youth tennis players.

MATERIALS AND METHODS

Sample

After clarifications provided in oral and written display about the procedures relating to the study, and based on institutional determinations of 196/96 Resolution from the National Health Council, all selected individuals have formally expressed agreement to participate in the research, by signing the term of free and consented participation approved by the Ethics Committee of the PROCIMH on 06/20/08, under protocol number 0036/2008.

The sample was composed of nine students (four women and five men) from the School of Tennis in Rio de Janeiro, located in the district of Barra da Tijuca, in Rio de Janeiro. All trained the sport for more than 4 hours per week and participated in a program of physical preparation for at least 2 hours per week, training that included running, agility and various jumps. The athletes (age: 14±1 years-old; weight: 47.6±6.2 kg; height: 158±5 cm) had a minimum of two years of tennis practice and competed by the Tennis Federation of Rio de Janeiro. None had a history of injuries. The subjects were informed about the research and verbally encouraged to achieve the best possible performance during the tests.

To not distinguish sex and being able to use a single sample group, it was performed a Shapiro-Wilk test, which indicated the homogeneity of the group established (p> 0.05).

Procedures

Two tests were performed on separate days, with an interval of 48 h, at the same time in order to avoid circadian effects on the performance. The test used to measure the height of vertical jump was the Sargent Jump Test (SJT). After normally participating in their activities in tennis lessons, which covered technical and tactical exercises and games, for about 1 h, the subjects had a period of 15 min of recovery, seated before starting the tests. Three SJT were performed before and immediately after the techniques of stretching and PNF (flexing) were applied, consisting of five exercises for different muscle groups, including: quadriceps, ischium tibials, adductors, abductors, and triceps surae, in this order. The total volume was three series with 15 s of maintenance, made alternately between the body segments.

Day 1: It was measured the power of vertical jump, using the protocol of the SJT. After 5 min of rest, it was applied the technique of static stretching and then the same test was redone immediately after the application of stretching.

Day 2: The procedures in the first day were repeated, however the flexing technique used was the PNF. The method used was a process called scientific stretching for sport (3S), held in the following steps: Step 1 - mobilization of the body segment, until its limit of range; Step 2 - performing a maximum isometric contraction, for 8 s; Step 3 - forcing of the movement beyond the original limit, during the relaxation of the athlete’s muscles after contraction.

Statistical treatment

Descriptive statistics was calculated for the dependent variable (height of jump), showing the distribution within the parameters of normality. The statistical model used for analysis was the ANOVA for repeated measures. It was adopted p < 0.05 as level of significance.

RESULTS

After evaluation of the descriptive statistics shown in Table 1, it can be observed that the pre-tests showed higher values than the tests, both from static work as from PNF. It was also verified a greater variability of the data after the PNF, different from the averages found after static

<table>
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<th>pre-static</th>
<th>post-static</th>
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<th>post-PNF</th>
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<tr>
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<td>2.189</td>
<td>2.356</td>
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</table>
Stretching and between pre-tests that remained constant. After static stretching occurred after a decrease of 0.7% in height of jump; after the flexing with PNF it was verified a decrease of 4.6%. The non-significant test of Mauchly (p = 0.111) allowed the use of ANOVA for repeated measures of type III. However, both for analysis of static work and for the PNF, it was found statistical significance (p = 0.603) between pre-tests and post-tests (Graphic 1).

**DISCUSSION**

The results of this study enhance the discussion on whether or not the use of flexibility in the warm-up, because, unlike the majority of studies found, it was found no statistically significant difference in height of jump after implementation of flexibility work, although not existing a small decrease.

One of the reasons that may explain the fact that no reduction occurs in the height of jump after static stretching is the intensity of the flexibility work used. Perhaps the intensity of the protocol used in our study may not have been sufficient to cause a significant change of muscle rigidity, not changing the rate of muscle activation and its reflex sensitivity. Corroborating this hypothesis, the study of Yamauchi & Ishii\(^2\) showed that static stretching of the lower limbs, divided into 30 s by muscle group, before a test of muscle power of lower limbs, despite the tendency to decrease, showed no statistically significant difference. As in the study of Unick\(^2\), the work of stretching and not the flexing, showed no decrease in the ability to generate muscle power in lower limbs, supporting the hypothesis that the practice of stretching, unlike flexing does not cause loss of this capacity.

Knudson et al.\(^2\) show us that there was no significant change in the vertical speed of the jump in the durations of the concentric and eccentric phases as a result of static stretching, although 55% of the subjects obtain lower vertical speeds and 45% of subjects do not present any change after treatment, suggesting that stretching before activities such as vertical jump results in small decreases in performance in some subjects.

Galdino et al.\(^25\) showed that the performance of a routine of passive flexing exercises (higher intensity) resulted in a decrease of 7.07% in average value between the first and second jump, being this difference decreased to 4.42% between the 1st and 3rd jump, to 5.89% in the 4th jump and 4.71% in the 5th jump, all showing significant difference. It can be observed in this research, that the negative effects on the strength seem to be temporary, as corroborated by other studies\(^14,24,26,27\). In the current study, although the difference is not significant, after the flexing work using the PNF it was found a decrease of 4.6% in height of the jump, confirming the study of Galdino et al.\(^25\).

In the same direction, in research conducted by Bradley et al.\(^28\) it was verified that the height of vertical jump decreased immediately after the use of static stretching and PNF (4.0% and 5.1%, p < 0.05) and still that the jump was not affected after an interval of rest, giving that their results may be due to the volume used and changes in neuromuscular and mechanical properties of muscles. However, Gil et al.\(^29\) verified the acute effects of different volumes - three and six series - of passive flexing on the full strength and obtained as a result a no significant difference between the different volumes over the maximum strength.

With this, it seems very likely that the difference in the intensity of the flexibility work, bigger or lesser, that is, flexing or stretching, respectively, interfere differently on the manifestation of muscle power with the flexing being harmful and stretching apparently not having significant acute effect.

However, the real causes of loss of muscle power by the practice of flexing still need further studies to identify the fundamental factor of this decrease, whether acute or temporary, as Power et al.\(^4\) have shown that static stretching decreased the maximum voluntary contraction of the quadriceps, but found no difference in height of jump.

Another important point to be emphasized is the group of subjects used, as in this literature review it was not found other work with subjects with such profile: competing adolescent tennis players of both sexes. Corroborating this work, Unick et al.\(^21\) in research with 16 trained women, present result without loss of performance after treatment with static and ballistic stretching and cite the use of athlete women, with extensive experience in jumps, as probable cause of the results found because it is not yet clear in the literature the influence of flexibility training on the jump power in people with extensive experience of training. It is worth thinking that as few articles studied individuals with training experience, the neural and mechanical responses, such as maximal voluntary activation and stiffness in the muscle-tendon unity may show different behaviors for this population.

It can also be discussed that in this investigation, the subjects practiced their warm-up for approximately 1 h,
with specific activities for the tennis, which may have influenced the obtained result. This fact is against the findings of Woolstenhulme et al. who treated their subjects with specific warm-up for basketball and found no significant difference in height of jump immediately after flexibility work. In the same way we can present the data from Young & Behm that include jumps in the warm-up of running and found improvements in vertical jump, which was different from the warm-up that consisted only of stretching.

Although not presenting statistically significant loss in power of jump after the use of static stretching, especially PNF, the results showed tendency to decrease. Thus, the athletes who directly need muscle strength to generate power, such as tennis players of the current research, appear not to be benefited from exercises of passive stretching or PNF preceding the vertical jump. As the whole idea of sports training is the improvement of physical capacity with the least amount of time and energy possible, this practice does not seem recommendable by us.

It is recommended that further studies be conducted with larger groups and application of different methods of stretching, flexing and warming up, as well as different forms of manifestation of muscular strength in order to ensure a better understanding of the subject and its practical applications in sport.

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