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COMPARISON OF HAMSTRING STRESS RELAXATION BETWEEN FLEXIBLE AND TIGHT YOUNG ADULTS

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SUMMARY

The purpose of the present study was to compare stress relaxation response of hamstring muscle measured at 20 and 30 s during passive stretch between tight or flexible subjects. Knee extension maximal range of motion (ROM_{max}) and passive torque of 36 untrained subjects, allocated into flexible and tight groups, were recorded by an isokinetic instrument at a 5°/s. Both groups performed 4 series hamstring static stretch with 30 second duration. In order to calculate the relative stress relaxation (RSR), passive torque measured at 20 s and 30 s was subtracted from peak of torque (PT), and then divided by PT. Results showed significant difference between groups for ROM_{max} (p<0,001). Relative Stress Relaxation (RSR) increased from 20 s to 30 s stretching for flexible (23.2 ± 3.5% for 25.4 ± 3,5%, p < 0.001) and tight groups (27.6 ± 8.7% for 32.6 ± 11.3%, p = 0.007). A difference between flexible and tight groups was found for RSR at 30 s (p = 0.014), but not for RSR at 20 s (p = 0.054).

INTRODUCTION

Stretches exercises are frequently included into sports training routines. Based on previous studies that evaluated viscoelastic properties of muscle-tendon unit (MTU) [1,2], coaches and physical therapists usually recommend that each muscle group should be stretched 2 to 4 times for a period of 20 to 30 s. These prescriptions are consistent with the results of previous studies which evaluated viscoelastic properties of muscle-tendon unit (MTU). Taylor *et al.* [3] performed 10 stretches on rabbits extensor digitorus longus and tibialis anterior muscle tendon unit (MTU), and showed that curves 1 and 2 were significant difference from the other nine curves and that no statistically difference was found in stress relaxation curves 4 through 10 relative to each preceding curve. The higher amount of stress relaxation took place in the first 12 to 18 s of stretch. Roberts and Wilson [4] performed a flexibility training with a load of 3 series of 15 s. Their results showed improvement in range of motion for hip flexion, knee flexion and knee extension. Even though this stretch regiment with durations between 12 and 18 s have been verified in animal and human studies, human data still scarce [5,6]. The stress relaxation response of MTU from flexible and tight individuals has not yet been compared, at the best of our knowledge. A difference in this MTU biomechanical response would raise the arguments for studying a specific stretch duration for each flexibility level.

The purpose of the present study was to compare stress relaxation response of hamstring muscle measured at 20 and 30 s during passive stretch between subjects classified as tight or flexible.

METHODS

Subjects: Eighteen male and 18 female volunteer participated in the study (body mass 67.2 ± 12.8 kg, height 169,8 ± 7.9 cm, age 24.2 ± 3.2 yrs, means ± SD). All subjects gave their informed consent to the procedures of the study. None of the volunteers performed regular flexibility training or had musculoskeletal injuries in the lower limbs, spine, and pelvis in the past 6 months.

Experimental Approach: Participants visited the laboratory twice at the same time of day (± 2 h) with 48 - 72 h interval. The first visit consisted of a familiarization trial and measurement of height, body weight and leg weight (for gravity correction). The subsequent visit consisted of the experimental trial.

A total of 62 volunteers participated in both sessions, and were classified based on knee extension range of motion (ROM) in the *Flexmachine* instrument. Volunteers with a ROM between 95 and 135° were considered as flexible and between 50 and 90° were classified as tight. Twenty six volunteers were excluded because had a ROM between 90 and 95° of knee extension (leaving 36 subjects for statistical analyses).

Instrumentation: The training and testing were performed on an isokinetic dynamometer called the *Flexmachine.* This device consists of 2 chairs connected laterally to a mechanical arm, which was used to measure the ROM of passive knee extension, resistance torque (RT) and electromyographic signal (EMG). For data acquisition was used an analog/digital converter from *Data Translation* (*DT BNC Box USB 9800 Series*). Signal collection and analysis were performed by using the *Dasylab* 10.0 software.

Experimental Trial: Experimental trial consisted of a pre-test and hamstring stretch. In the pre-test 3 repetitions of passive knee extension were performed until reaching maximal range of motion (ROM_{max}). This movement was performed at a speed of 5°/s with an interval of approximately 15 s between each repetition. Stretching consisted of 4 sets of 30 s of knee extension with an intensity of the stimulus of 90% of ROM_{max}. Torque measured at the beginning of stretch, at 20 s and 30 s were called Peak of torque (PT), torque at 20 s (T_20s) and torque at 30 s (T_30s), respectively. Relative stress relaxation at 20 s (RSR_20s) and 30 s (RSR_30s) were calculated by the following formula: RSR_30 = (PT - T_30s) / PT, due to great coefficient of variation (CV) of all torque variables.

Statistical Analyses: For comparing ROM_{max}, PT, age, height and weight between groups an Independent t-test was performed. A Two-way ANOVA (group x time) was performed to compare relative stress relaxation between groups. An alpha level of $p \leq 0.05$ was considered statistically significant for all comparisons.

RESULTS AND DISCUSSION

Independent t-test showed no significant difference for age, height and weight between flexible and tight groups (Table 1).

Table 1: Descriptive statistics and Independent t-test for age, height and weight.

	Age	Height	Weight
Flexible	24,5 ± 3,1	170,3 ± 7,4	66,3 ± 10,5
Tight	23,8 ± 3,2	169,3 ± 8,3	68,1 ± 14,9
P	0,375	0,582	0,573

Independent t-test showed significant difference for ROM_{max} between flexible (104,5 ± 7,5°) and tight (73,3 ± 8,5°) groups (p<0,001). This result shows that despite homogeneity in groups for age, height and weight, flexibility levels differ between studied groups.

Relative Stress Relaxation (RSR) increased from 20 s to 30 s stretching for flexible (23.2 ± 3.5% for 25.4 ± 3,5%, p < 0.001) and tight groups (27.6 ± 8.7% for 32.6 ± 11.3%, p = 0.007). A difference between flexible and tight groups was found only for RSR_30s (p = 0.014) (Figure 1). No significant difference was found for RSR_20s between groups (p = 0.054). McHugh *et al.* [7] found a stress relaxation of 14.4 ± 2.2% for 45s static stretch of hamstring MTU, while Gajdosik [8] showed a 15.71% decrease in torque for untrained male within a 60 s static stretch. The present study corroborates with the above cited studies, once they show that static stretch produce a significant increase of stress relaxation in human MTU. Gajdosik [8], however, had a slight smaller torque reduction than this study for similar stretch intensity and longer duration. This difference may be due to distinct muscle group studied and measuring protocol. Magnusson *et al.* [6] supported this affirmation, when showed a 33% reduction in this variable for a passive static hamstring stretch. The bigger reduction found on their studied can be justified by the longer stretch duration performed (90s). Even though, previous studies [7-9] had untrained subjects as volunteers, they did not compared subjects with different flexibility levels. The flexibility level may be another reason for difference in stress relaxation between studies. Furthermore, the present study, shows that flexible and tight groups have significant stress relaxation during a 30 second static stretch, which corroborates with previous studies [3,7-9]. Tight group had a bigger stress relaxation than flexible group, therefore, flexibility level might influence magnitude of biomechanical response of the MTU. The rate of stress relaxation was shown to differ between groups, as there was a significant difference only at 30 s. Future studies should investigate the influence of flexibility level and MTU biomechanical behavior on stretch duration.

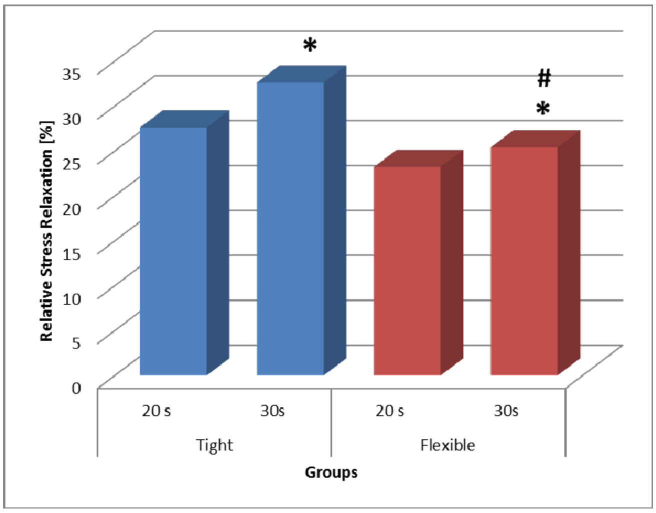

Figure 1: Relative stress relaxation at 20 and 30 seconds for flexible and tight groups.
* Difference within groups between 20 and 30 s.
# Difference between groups for 30 s.

CONCLUSIONS

Rate of stress relaxation vary between flexible and tight subject for a 30 s hamstring static stretching.

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