Acute Effects of Contract-Relax versus Static Stretching on Strength Loss and the Length-Tension Relationship

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ABSTRACT

The purpose of this study was to determine the acute effects of static versus contract-relax stretching of the hamstring muscle on strength and the length-tension relationship. Isometric contract-relax stretching (60 s) resulted in greater strength loss than static stretching (3.7%) (p < 0.0001), which for both stretching interventions were most apparent at short versus long muscle lengths. Isometric contract-relax stretching also resulted in greater shifts in the length-tension curve than static stretching. The muscle length-dependent effect of contract-relax stretching on the stretch-induced strength loss (absolute torque in Nm) was assessed using a Stretch Technique (Static vs. Contract-Relax) by Time (pre vs. post stretching) by Angle (90°, 70°, 50°, 30°) repeated measures analysis of variance (ANOVA). The relative shift in the angle-torque relationship (length effect) was assessed by first expressing isometric torque values at each angle relative to the maximum torque at that angle and then assessing the relative shift in the angle-torque relationship. Effect of Stretch Technique (Static vs. Contract-Relax) and Angle were assessed using ANOVA. Mean±SD is reported in the text and table, and mean±SE is displayed in the figures.

METHODS - Continued

RESULTS - Continued

Figure 3: The stretch-induced strength loss after static stretching (SS) and contract-relax stretching (CRS) at four knee flexion angles. Strength loss was significantly greater after contract-relax stretching (11.7%) versus static stretching (3.7%). Stress was significantly lower at longer muscle lengths (Angle effect p = 0.001) with no difference in Angle effect between Stretch Techniques (Stretching Technique by Angle p = 0.85). Mean±SE displayed.

Figure 4. The angle-torque relationship for maximum isometric knee flexion contractions expressed relative to the angle at which peak torque occurred (pre and post) static stretching (SS) (A) and contract-relax stretching (CRS) (B). Time by Angle by Pressure (p < 0.001) indicates a rightward shift in the angle-torque relationship. This shift was not different between static and contract-relax stretching.

CONCLUSION

Since contract-relax stretching resulted in greater loss than static stretching without any greater benefit in terms of alteration in the length-tension relationship, it would be appropriate to use static hamstring stretching in preference to contract-relax stretching.

References

INTRODUCTION

Stretches-induced strength loss has been shown to be most apparent at short muscle lengths (1-4). This effect is thought to be associated with the length-tension curve, with greater shortening at a given muscle length during maximum voluntary contractions after stretching (3). Such an effect implies stretching increases tendon and aponeurosis compliance. Therefore, allowing greater shortening occurring during isometric contractions.

METHODS

Isometric hamstring strength was measured at 4 different knee flexion angles from short (90°) to long (30°) muscle lengths (Figure 2A). Effect of stretching (SS or CRS) was assessed by first expressing isometric torque values at each angle relative to the maximum torque at that angle and then assessing the relative shift in the angle-torque relationship.

RESULTS

Figure 2B: The shift in the angle-torque relationship expressed relative to the angle at which peak torque occurred (pre and post) static stretching (SS) (A) and contract-relax stretching (CRS) (B). Time by Angle by Pressure (p < 0.001) indicates a rightward shift in the angle-torque relationship. This shift was not different between static and contract-relax stretching.

ACUTE EFFECTS OF CONTRACT-RELAX VERSUS STATIC STRETCHING ON STRENGTH LOSS AND THE LENGTH-TENSION RELATIONSHIP

Isometric knee flexion strength

Maximum isometric knee flexion contractions were measured at 90°, 70°, 50°, 30° of knee flexion before (pre) and after (post) stretching. Subjects were encouraged to give maximal efforts during tests by a 4-s isometric knee flexion contraction at each joint angle. At each angle the initial torque prior to isometric contraction was recorded, and subsequently subtracted from the torque during maximum contraction. This torque represented the combination of joint mass and passive resistance to stretch. The corrected torque value for maximum contractions represents the contractile force production.

Stretching procedures

Static stretching: the knee was passively extended from start position (100°) to subject’s maximum ROM and held at that angle for 60 s with 6 repetitions and 15 s between stretches.

Contract-relax stretching: the knee was passively extended to subject’s maximum ROM, and subjects were then asked to do a 10 s submaximal isometric knee flexion contraction (70% of maximal), followed by 50 s with the leg maintained in the stretched position with 6 repetitions and 15 s between stretches.

Data processing and statistical analysis

Differences in stretching intensity (SS vs. CRS) and percent decline in resistance to stretch were compared between static and contract-relax stretching using paired t-tests. The muscle length-dependent effect of stretching techniques on the stretch-induced strength loss (absolute torque in Nm) was assessed using a Stretch Technique (Static vs. Contract-Relax) by Time (pre vs. post stretching) by Angle (90°, 70°, 50°, 30°) repeated measures analysis of variance (ANOVA). The relative shift in the angle-torque relationship (length effect) was assessed by first expressing isometric torque values at each angle as a percentage of the torque at the angle of peak torque. Then a Stretch Technique by Time by Angle repeated measures ANOVA was performed on the relative torque values. By expressing torque relative to the angle of peak torque, any shift in the length-tension curve can be assessed independently of the stretch-induced strength loss. Effect of Stretch Technique (Static vs. Contract-Relax) and Angle were assessed using ANOVA. Mean±SD is reported in the text and table, and mean±SE is displayed in the figures.