Muscle Architecture of Gastrocnemius Medialis and Rate of Force Development during Different Stretching Protocols †

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Abstract: AIM: Rate of force development (RFD) of the leg extensor muscles is important for jumping performance. Static stretching has been shown to reduce explosive force generation, but little is known regarding changes in muscle architectural characteristics due to stretching and jumping performance alterations. The aim of this study was to determine the effects of two different static stretching protocols (20 or 60 s) on gastrocnemius medialis (GM) muscle architectural characteristics and RFD during jumping in a population with long-term flexibility training background. MATERIAL & METHOD: Twelve female professional ballet dancers (age, 25.3 ± 2.2 years) performed 5 days of testing using a single leg stretching and jumping design. RFD during one-leg countermovement jump and jump height were measured on the first visit. On the other four visits, dancers stretched their hamstrings, quadriceps and plantar flexors for 20 or 60 s per muscle group, in a counterbalanced order. Immediately after stretching, RFD and jump height were measured. Fascicle length (FL), pennation angle (PA), and muscle thickness (MT) at the medial and distal parts of GM were assessed at rest and during static stretching for each protocol, using ultrasonography. RESULTS: There was a main effect of time for FL, PA, and MT (p < 0.01) with no difference between stretching protocols, at the medial and distal parts of GM, in FL (p = 0.373 and p = 0.651, respectively), PA (p = 0.724 and p = 0.477, respectively) and MT (p = 0.314 and p = 0.444, respectively). Greater FL elongation was observed at the medial compared to the distal part of GM (p = 0.013) during the long stretching protocol. RFD significantly decreased after the long stretching protocol (p = 0.019), while it remained unchanged in the short stretching protocol (p = 0.061). Significant correlations were found between resting FL at the medial part of GM and RFD (r = −0.645, p = 0.05) and between fascicle elongation at the medial part of GM and CMJ height (r = 0.717, p = 0.01). CONCLUSIONS: The long static stretching protocol induced non-uniform adaptations along GM length and decreased RFD, suggesting that prolonged stretching durations should be avoided immediately before activities requiring rapid force production.

Keywords: fascicle length; force generation; countermovement jump; stretching; skeletal muscle ultrasonography; ballet dancers

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