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THE ROLE OF EMG ACTIVITY AND ELASTIC ENERGY REUSE IN THE KNEE EXTENSOR MUSCLES DURING CONCENTRIC CONTRACTIONS

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Introduction

Pre-activity prior to the shortening of muscle has a significant role in the enhanced performance of concentric contractions (McBride, 2008). Elastic energy reuse in the musculotendinous system is also documented to be one of the main contributors to the higher work output (Wilson & Flanagan, 2008). However, it is not clear which factor is more important regarding positive dynamic work. We aimed to define the role of EMG activity and elastic energy storage during pre-tension of the knee extensor muscles on the mechanical characteristics of muscle shortening.

Methods

20 young (20.75 ± 1.2 yrs) subjects volunteered for this study. Maximal voluntary isometric contraction (MVC) of the knee extensor muscles was measured at the optimal angle for each subject. After that they performed concentric contractions with different pre-tension levels from an individually optimized angle to full extension. The shortening phase of every contraction had to be performed as fast as possible. The pre-tension levels were set at 20, 40, 60, 80 and 100% of the MVC and had to be reached in two different ways: as quickly as possible (F) and with no time constraint (S). Torque, knee angle and angular velocity were measured by Multicont II dynamometer. EMG activity was also recorded from the vastus lateralis and - medialis muscles in each task.

Results

The positive mechanical work in the first 10 degrees of shortening was significantly higher in F than in S when the pre-tension was 20, 40 and 60% ($p < 0.05$). Between 15-35 degrees after the release the differences in work output were not significant anymore ($p > 0.05$). Similar results were observed in the EMG activity during these periods. Moreover, the EMG activity was significantly higher before the release in F compared to S at 20-80% pre-tensions ($p < 0.05$). However, mechanical work increased linearly as a function of the pre-tension level during F and S ($R > 0.9$, $p < 0.05$).

Discussion

The effect of activity level and elastic energy reuse of the muscle could be separated via this method. It seems that the explosive execution of pre-tension causes significantly higher EMG activity before shortening. This primarily affects the early phase of muscle shortening and has significance at lower pre-tension levels. However, elastic energy can increase the positive work significantly via the higher pre-tension level, which provides more elastic energy storage.

References

McBride JM, McCaulley GO, Cormie, P. (2008) J Strength Cond Res 22(3): 750-7.
Wilson JM, Flanagan EP. (2008) J Strength Cond Res 22(5): 1705-15.

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