

Abstract

Effects of fatigue on the electromechanical delay during the relaxation phase: partitioning the contributors

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Aim. Similarly to the contraction phase, also during the relaxation phase a latency between the cessation of muscle electrical activity and muscle mechanical return to resting condition can be observed (R-Delay_{TOT}). By a combined electromyographic (EMG), mechanomyographic (MMG) and force (F) analysis, R-Delay_{TOT} can be partitioned non-invasively into an electrochemical and two mechanical components. The aim of the study was twofold: (i) to assess the reliability of the measurement of R-Delay_{TOT} components; and (ii) to evaluate the effects of fatigue on R-Delay_{TOT} components.

Method. During tetanic stimulations, EMG, MMG and F signals were recorded from the *gastrocnemius medialis* muscle, both before and after fatigue. The time lag between EMG and MMG ripple cessations (R-Δt EMG-MMG_R, electrochemical component of R-Delay_{TOT}), between MMG ripple cessation and the onset of force decay (R-Δt MMG_R-F, first mechanical component of R-Delay_{TOT}), and between the onset of force decay and the maximum MMG negative peak (R-Δt F-MMG_{p-p}, second mechanical component of R-Delay_{TOT}) were calculated. For statistical analysis, a one-way ANOVA for repeated measures was utilised with post-hoc multiple comparisons. Reliability analysis was also performed.

Results. Before fatigue, R-Δt F-MMG_{p-p} was the major contributor (61.9±1.7 ms, about 75%) to R-Delay_{TOT}, while R-Δt EMG-MMG_R and R-Δt MMG_R-F accounted for 16% (13.3±1.2 ms) and 9% (7.5±1.0 ms), respectively. After fatigue, R-Δt EMG-MMG_R and R-Δt MMG_R-F increased by about 41% and 67%, respectively ($P < 0.05$), whereas R-Δt F-MMG_{p-p} did not change. The reliability of the measurement was from high to very high (range from 0.705 to 0.959) both before and after fatigue.

Conclusion. These findings indicate that the present combined approach can provide reliable measurements of the different R-Delay_{TOT} components during muscle relaxation. Fatigue altered the processes between neuromuscular activation cessation and the beginning of force decay, but had no effects on the second mechanical component, which is determined by cross-bridges detachment rate and series elastic components release.

References.

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