[Annual Meeting Abstracts: H-22 – Free Communication/Poster: Musculoskeletal Mechanics and Landing Mechanics]

Mathematical Modeling of *In Vivo* Isometric Force Response of Skeletal Muscle due to Duty Cycle

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Isometric force response of skeletal muscle is a well documented method of measuring performance. Over a sequence of isometric contractions, skeletal muscle will begin to fatigue from a failure in the excitation-contraction coupling (E-C coupling) process. It is unclear how isometric force changes with varying recovery time intervals (duty cycles) both between and during the contractions. PURPOSE: To model the *in vivo* isometric force response of skeletal muscle. METHODS: Testing was performed on the dorsiflexor muscles of Sprague-Dawley rats (n = 18) via needle electrodes placed across the peroneal nerve. Animals were randomly assigned to a short duty cycle group (10 sec), long duty cycle group (5 min), or medium duty cycle group (1 min). Each group performed a series of seven isometric contractions that were recorded in real-time. The force data for each contraction was discretized into ten points to model changes in real-time. Each group of ten points was designated as a set in the model. Each set was modeled with both a power law and decay curve to cover the most probable force response. To maintain a continuous equation, the power law and exponential curves were combined with an exponential weighting function, which preserved the best curve fitting properties from both the power law and exponential curves. To add set variability to the model, the coefficients which fit in the power law and exponential curve fitting methods for each contraction were fit to the sets using the polynomial curve fitting method. RESULTS: All three groups exhibited a similar pattern of isometric force drops between the contractions, but the degree and shape of these decrements was directly affected by duty cycle. The 5 min group showed moderate drops in force both between sets and within sets. The 1 min group showed similar results to the 5 min group with slightly more force decrements both between and within sets. The 10 sec group exhibited the most dramatic changes compared to the other groups. The weighting function remained constant between groups and within all contractions and was critical for maintaining an accurate model for the 10 sec group. CONCLUSION: Combinations of the power law and the exponential curve fits with the weighting function resulted in an accurate model of isometric behavior over seven isometric contractions using different duty cycles.