

CHANGES IN THE SHAPE OF TORQUE-ANGLE RELATIONSHIP IN ANKLE DORSIFLEXOR FOLLOWING VOLUNTARY ECCENTRIC EXERCISE

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KEY WORDS: human, skeletal muscle, eccentric contraction, force-length relationship.

INTRODUCTION: It has been generally accepted that exercise involving unaccustomed eccentric contraction results in micro muscle damage leading to a so-called delayed onset of muscle soreness (DOMS). Considering that the extent of micro muscle damage be different when the exercise is performed in different muscle length (short vs. long), based on the “popping” sarcomeres theory (Morgan, 1999), this study aimed to test the effect of muscle length of eccentric exercise on the shape of torque-angle relationship.

METHOD: Twelve healthy volunteers were randomly assigned into two groups: one for exercising at short muscle length (ankle angle between -10 and 5° , anatomical zero position at 0° ankle angle) and the other for exercising at long muscle length (ankle angle between 0 to 15°). The subjects performed 120 maximum voluntary eccentric ankle plantarflexions (10 reps \times 12 sets with 30-sec rest between the sets), exercising the tibialis anterior muscle. 1/2-hour before and 1/2-hour after the exercise, we obtained torque-angle relationship of the ankle dorsiflexor muscle using a dynamometer. From the obtained torque angle relationship, we estimated the optimum joint angle using a 3rd-order polynomial curve.

RESULTS: The optimum ankle joint angles, where the peak dorsiflexion torque occurred, were shifted (over all $3 \pm 1^\circ$) toward a greater ankle joint angle (Fig. 1), regardless of the muscle length in which the eccentric exercise was performed.

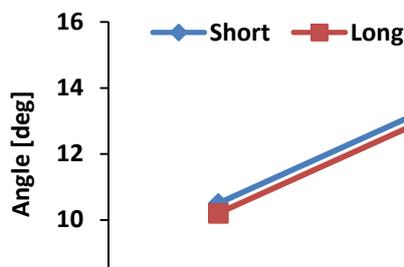


Figure 4. Optimum ankle joint angles before and after eccentric exercise at different muscle lengths (short vs. long)

DISCUSSION: In previous studies, the shifts of the optimum joint angle of $\sim 7^\circ$ for the hamstring and $\sim 15^\circ$ for the elbow flexor were observed. For the ankle dorsiflexor muscle, this study demonstrated overall $\sim 3^\circ$ shift of the optimum joint angle following eccentric exercise. It indicates that at least for voluntarily contracting human ankle dorsiflexor muscle, the prediction of popping sarcomere theory, i.e. the eccentric exercise induced micro muscle damage should be more severe in longer muscle length, is not correct. In future studies,

the exploration of in-vivo muscle fiber behaviour during eccentric exercise may provide further information.

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Acknowledgement

This work was supported by the Korean Research Foundation Grant funded by the Korean Government (MOEHRD, Basic Research Promotion Fund) (KRF-2007-314-G00015).