RECOVERY OF ELECTRICAL STIMULATION FORCE AFTER ONE-MINUTE OF MAXIMAL HOPPING AND CYCLING

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INTRODUCTION

Recovery of electrical stimulation force depends on a type of peripheral muscular fatigue. Low frequency force, designated to a low frequency fatigue, may recover in a few hours after the workout, while a recovery of a high frequency force, designated to a high frequency fatigue, ends in a few minutes after the workout (Cooper et al., 1988). Following the interval (5 x 300 m) and continuous (6 km at anaerobic threshold) run, both inducing the low frequency fatigue, the twitch force recovered in 10 minutes after the end of workout and run 23% and 16% over the initial level, respectively (Škof, 1993). On the other hand, the weight training with (SUB) maximal loads resulted in the high frequency fatigue (Strojnik and Mesesnel, 1994). The aim of the present study was to examine a recovery of electrical stimulation force at 20 Hz and 100 Hz stimulation after maximal hopping for one minute on a force plate and after 60 seconds Wingate test.

METHODS

Eleven students of physical education (age 22.9 + 3.9 years, height 176.1 + 4.1 cm, mass 71.8 + 3.7 kg) gave their formal consent and volunteered the study. After the standard warm-up procedure (10 minutes of stepping on 20 cm high bench at 0.5 Hz), the subjects performed maximal hopping on the force plate for 60 seconds (Bosco et al., 1983) and maximal cycling on Monark ergo meter (Model 818) for 60 seconds (Wingate test - WT). The tests were performed on separate weeks, on the same day and at the same day-time. Relaxed vastus lateralis muscle (VL) was electrically stimulated before and the 1., 2., 3., 4., 5., 6.,7., and 10. minute after the end of the workout. During the electrical stimulation the isometric knee torque was measured. Two transcutaneous stimulation electrodes (Axelgaard, Falbrook, CA) were placed over distal and middle part of VL of the right leg (Fig. 1). The amplitude of stimulation was three times of the motor threshold of the subject, which was established by 0.8 s long trains of electrical impulses delivered at 100 Hz. The amplitude was held constant during the both tests. The same train duration was employed during the measurements of isometric knee torque of relaxed muscle stimulated at 20Hz and 100 Hz. During the measurement,

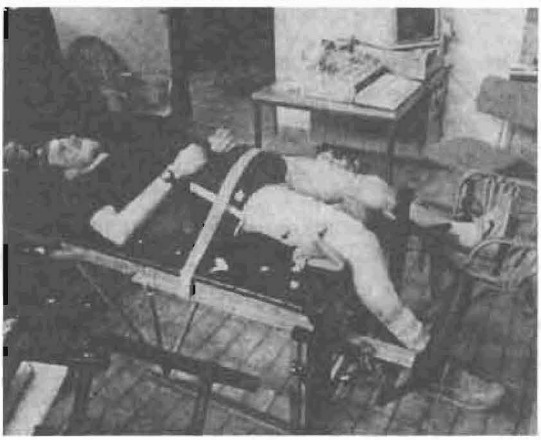

Figure 1. Position of subject before measurement.

the subjects lay on their backs with fastened hips and supported lumbar spine to prevent pelvic movements. The right leg was mounted into a measurement frame at 45 degrees knee angle (Fig. 1). For stimulation a custom made electrical stimulation device was employed. Statistical significance of differences between pre-workout and post-workout measurements were tested with a two-way student test for paired samples. Post-workout results were normalised to the pre-workout torque afterwards.

RESULTS

After maximal hopping, the 20 Hz force increased over the initial level and was significantly higher from the 3rd until 7th (P<.05) minute after the end of workout (Fig. 2). Response after the Wingate test was opposite. One minute after the end of cycling, the 20 Hz torque decreased for 35% (P<.001) to be recovered already two minutes after cycling and showed some potentiation at fourth minute

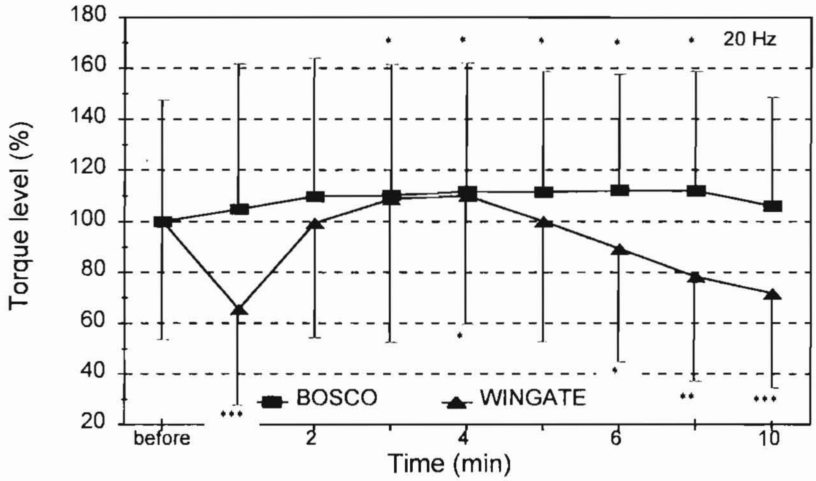

Figure 2. Relative changes of 20 Hz stimulation torque, where 100% denotes the workout level. Vertical bars coresponds to standard deviation (SD). Asterisks denote a statistically significant change according to pre-test state (*- P<0.05. ** - P<0.01, *** - 0.001).

(P<0.5). Torque during electrical stimulation with 100 Hz (Fig. 3) was smaller after hopping but higher after Wigate test. After the initial drop in the first minute after hopping, 100 Hz torque grew continuously till the end of observation time. At the 6th minute and thereafter, it became significantly greater (P<.05 - .001) than before hopping.

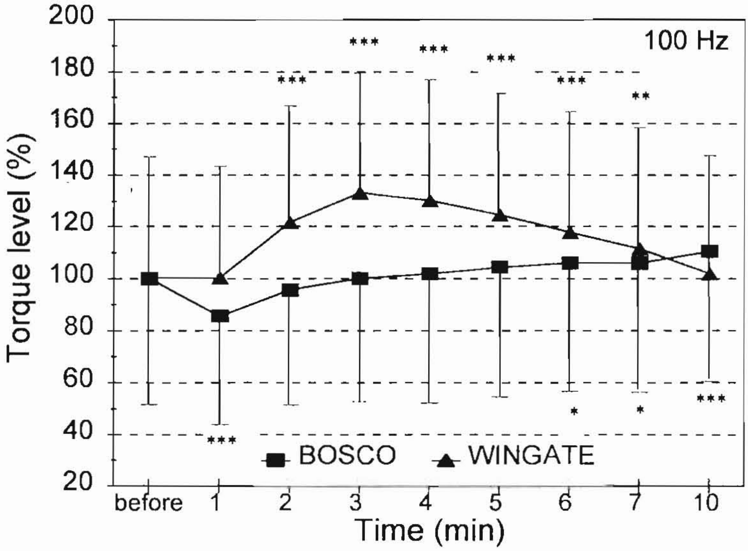

Figure 3. Relative changes of 100 Hz stimulation torque, where 100% denotes the workout level. Vertical bars coresponds to standard deviation (SD). Asterisks denote a statistically significant change according to pre-test state (*- P<0.05. ** - P<0.01, *** - 0.001).

CONCLUSION

Each activity in presented form resulted in its distinctive fatigue response: hopping in a high frequency fatigue and cycling in a low frequency fatigue. Even though, the recovery of electrical stimulation torque in the first few minutes seemed to have a similar time course: returning to the pre-workout level between the second and the third minute and displaying a potentiation afterwards, which was short at cycling but still rising after 10 minutes at hopping.

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