Eccentric training induced short term adaptation

Tihanyi József

Department of Biomechanics, Faculty of Physical Education and Sport Science, Semmelweis University, Budapest

INTRODUCTION
Numerous studies investigated the effect of eccentric training and muscle stretch on muscle mechanics and hormonal profile. It is well documented in the literature that muscle stretch causes delayed onset of muscle soreness (DOMS). It is generally believed that DOMS induced by eccentric exercise causes myofibrillar damage. In most of the studies reduced muscle force generation was reported due to the stretch which remained depressed for several days or in some cases several weeks. Also, it was reported that the repeated eccentric exercises resulted in lower force reduction and the DOMS symptoms were less severe. Recently, Yu et al. (2004) demonstrated that DOMS is rather the onset of remodelling of miofibrils which initiates the muscle adaptation, i.e., sarcomerogenesis. We assumed that strenuous eccentric exercises applied during several days does not result in major decrease in torque production despite to a supposed disturbance of the myofiber cross-striated band pattern because of the repetitive eccentric work and the short-term neural adaptation.

METHODS
Ten healthy trained men with a mean age of 21.5±1.3 years volunteered to the study. The subjects performed eccentric knee extension in sitting position in an electric motor driven dynamometer (Multi-Cont) during seven consecutive days. For five subjects the knee extensors were stretched 6 times 30 repetitions in an angular displacement of 30 degrees with 5.2 rad/s speed (SF). Five subjects performed eccentric contraction 6 times 15 repetitions with a range of motion of 60 degrees and 1.05 rad/s speed (LS). The average eccentric torque performed during each training session were calculated. Isometric and eccentric torque-time curves, angular displacement during eccentric contraction were recorded before and after each training session. At the test exercises electrical activity of the vastus lateralis and vastus medialis muscles was also recorded and analyzed later. A 100 ml venous blood sample was collected from the ante-cubital fossa, pre- and post exercise on the first day, and post-exercise on days 2, 3, 4, 8 and 11. Serum samples were stored at ±20 °C prior to measurement (in duplicate) of creatine kinase (CK) and lactate dehydrogenase (LDH) activity, testosterone (T) and cortisol (C) concentration.

RESULTS
The subjects reported mild muscle soreness during the first two-three days. The CK level increased 3.8 folds after 24 hours and remained elevated till the end of the training session for both LS (854.4±450.0 IU) and SF (686.7±209.3 IU) groups. After three day rest the CK level retained to the baseline. The daily average torque production during stretch (Mec) increased gradually from the first (207.6±34.3 N) to the last treatment (262.7±66.7 N). In the third day Mec was significantly greater compared to that at the first training day (229.6±33.3 N). The Mec was significantly less for LS group at the second training, but significantly greater at the third training compared to the baseline mean. The SF group performed greater Mec in each daily training compared to the mean of the first training. The difference became significant at the third training. However, there was no significant difference between the two groups in percentile improvement calculated at the last training. Maximum isometric torque (Mic) was significantly depressed at the end of the first and second training with 26% and 15%, respectively. Thereafter Mic increased gradually and after the third training levelled the baseline. At the last test the subjects produced significantly higher Mic (12 % improvement) than prior training. The improvement for SF group was 7 % greater than for LS group. The electrical activity during isometric contraction increased gradually and the iEMG values were significantly greater for both SF and SL group compared to the baseline value. The post-exercise testosterone was significantly depressed in the first day for LS and during the first three training session for SF. The cortisol was slightly, but not significantly upregulated for both groups during the seven day treatment. The T/C ratio decreased gradually and reached the lowest level after the third training session (20.5 % decrease for LS and 41.6 % decrease for SF) and remained unchanged.

DISCUSSION
The results of the study indicates that the torque production capacity is not necessarily decrease due to strenuous eccentric exercise if the training is carried out several consecutive days because of the short-term neural adaptation can compensate the negative effect of the disturbance of the myofiber cross-striated band pattern on the force generating capacity. Probably longer stretch might resulted in more severe DOMS and It seems that remodelling of miofibrils or initiating sarcomerogenesis due to muscle stretch is not directly associated with the alteration of the anabolic and catabolic hormonal profile.

REFERENCES