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Acute and residual effects of vibratory stimulation on explosive strength in elite and amateur athletes

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Fourteen elite and 14 amateur athletes were subjected to vibratory stimulation during bilateral biceps curl exercises of explosive strength exertion. The athletes performed two separate series of three sets of exercises in random order. The second set of one series was administered with superimposed vibration of 44 Hz and an acceleration of about 30 $m \cdot s^{-2}$ transmitted through the two-arms handle to the arm muscles. The mechanical power of each repetition was measured by the 'Power Teach' instrument. The maximal and mean power values for each set were automatically recorded and shown on the screen. The acute effect was evaluated as the difference between the mean and peak power output in the second (with vibratory stimulation) and first (without vibratory stimulation) sets. Similarly, the residual effect was taken to be the difference between the power values of the third (after vibratory stimulation) and the first (before vibratory stimulation) sets. The results were subjected to a repeated-measures analysis of variance with group as a between-participants factor. The results showed that exercise mode (with *vs* without vibratory stimulation) resulted in a significant immediate effect for mean power and for maximal power. The factor group (elite *vs* amateurs) resulted in a significant effect for maximal power only. The increase in explosive strength exertion attributed to vibratory stimulation was 30.1 and 29.8 W (10.4% and 10.2%) for maximal and mean power respectively in the elite group, and 20.0 and 25.9 W (7.9% and 10.7%) respectively in the amateur athletes. Vibratory stimulation resulted in an insignificant residual effect.

Keywords: acute effect, amateur athletes, elite athletes, explosive strength, vibratory stimulation exercises.

Introduction

Vibration applied to muscle or tendon induces a non-voluntary muscular contraction termed the 'tonic vibration reflex' (Eklund and Hagbarth, 1966). The voluntary impetus increases such a muscular contraction, and thus the maximum voluntary contraction can be facilitated (Matyas *et al.*, 1986). Moreover, vibratory stimulation combined with a substantial voluntary effort was shown to elicit movement in neuromuscular patients who were unable to contract their paretic muscles (Hagbarth and Eklund, 1966). The technique is widely used in neurophysiology and physiotherapy (Granit, 1970; Bishop, 1974). Attempts to use vibratory stimulation in the training of athletes have been undertaken only recently (Nazarov and Spivak, 1987). A substantial increase in muscle strength was observed after 3 weeks of vibratory stimulation strength training when compared with regular strength training (Issurin *et al.*, 1994).

Explosive strength, or the ability to develop force within a very short time, is of primary importance in many sports. Typical exercises for explosive strength training are characterized by fast muscular contractions with an external load of about 50–70% of maximal strength (Vrijens, 1990). The immediate effect of such exercises can be assessed by the power which an athlete can generate in a movement. Several additional training techniques have been used to accentuate power training: the quick release technique, pre-stretching of active muscles before contraction, electrical stimulation and biofeedback. The objectives of these techniques are to improve upon previous achievements, to facilitate motor learning effects and to enhance muscular capacity (Torrey, 1985). Based on the results of a previous study (Issurin *et al.*, 1994), it is likely that similar outcomes may also be achieved using vibratory stimulation.

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