

Introduction:

Vibration

Vibration stimulation is gaining popularity as a training method with the potential to elicit muscular performance adaptations similar to those produced by explosive strength training and power training. Studies on vibration have shown transient increases in muscle power output and chronic strength enhancement and significantly improved gait and body balance in elderly people. In addition, whole body vibration induced positive adaptations in peripheral blood circulation (increased blood volume and speed of blood flow), probably due to decreased blood viscosity and peripheral resistance and arterial vasodilatation. Additionally, vibration has the potential to activate large amounts of musculature during a movement, and appears to inhibit activation of antagonist muscles which would decrease the braking force during a movement. Other studies have shown that vibration may be able to influence the excitatory state of the peripheral and central structures of the brain, which could facilitate subsequent voluntary movements.

Targeted Vibration Training

Due to the conflicting results and potential side-effects of whole-body vibration, applying the vibration directly to the exercising muscle only has demonstrated performance gains more than 300% greater than conventional training. Therefore, researchers Dr Mileva and Dr Bowtell hypothesised that vibration applied during a single resistance-training session would promote larger acute increases in strength than those induced by an identical session performed in the absence of vibration. It was further hypothesized that vibration stimulus would provoke a greater response when training at lower contraction intensity, where a smaller percentage of muscle fibers would be voluntarily activated. To accomplish this, researchers compared the acute effects of vibration stimulus during and after high- (70% of one-repetition maximum (1RM) and low intensity (35% 1RM) knee extension exercise.

Methods

Nine healthy male adults completed four trials on a knee extension machine (Technogym UK Ltd) either with (Vibrex, Exoscience Ltd) or without superimposed vibration at low (35% 1RM) and high (70% 1RM) contraction intensities.

Results

The main finding of the study was that vibration applied during knee extension exercise improved the mechanical performance of the quadriceps muscles, as manifested by increased dynamic muscle strength and power. Additionally, peak torque was significantly higher during the vibrated than the nonvibrated trials.

The improvement in strength and power after vibration training could be explained by the finding that the median frequency of the quadriceps muscle electrical activity was significantly higher in the vibrated than nonvibrated trials. This suggests that vibration increases muscle fiber conduction velocity and/or increased recruitment of muscle fibers with faster conduction velocities such as fast powerful muscle fibres.

A very novel finding from this study is that superimposing the vibration-like stimulus during low-intensity exercise simulates the response induced by higher-intensity exercise, evidenced by increased electrical activity in the quadriceps muscle.

The increase in contraction force implies that reflex feedback from the muscle receptors in contracting muscle is increased. One might expect such increases in exercising muscle activation level to elevate the oxygen requirement, and vibration tended to increase the rate of muscle deoxygenation during exercise, which is indicative of increased oxygen utilization.

Conclusions

Neural adaptations are the earliest changes that occur in the exercised muscle (first 3–5 wk of a training program), permitting gains in strength and power without significant increase in muscle cross-sectional area. The acute enhancement of neuromuscular performance following vibration is probably related to an increase in the sensitivity of the stretch reflex. This would result in more rapid activation and training of a larger number of high-threshold motor units. Vibration-induced discharge of the muscle receptors also recruits previously inactive motor units into the contraction, as well as re-recruiting motor units that are already fatigued, and even increasing their firing patterns.

It is also an intriguing possibility that a chronic vibration training program may potentially increase the neuromuscular adaptations arising from light/moderate training. This would be of importance for individuals, such as the elderly, osteoporosis and rehabilitation where people are unable to complete more intense exercise programs.

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