

ACUTE EFFECTS OF VIBRATION STIMULUS ON HAND IN CONTROL ABILITY AND MUSCLE STRENGTH

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INTRODUCTION

Whole-body vibration has been proven that greater gain in muscle strength and neuromuscular function than conventional resistance training (Issurin et al, 1994; Bosco et al, 1999; Torvinen et al, 2002; Van den Tillaar, 2006). Tonic vibration reflex is a potential mechanism due to muscle spindle is induced by vibration stimulus (Bongiovanna & Hagbarth, 1990). The sensitivity of the γ -loop is considered to a major factor for motor control. The hypothesis is that vibration stimulus might increase control ability. Therefore, the purpose of this study was to investigate the influence of different vibration frequency on control ability, reaction time, grasp force, muscle activity, and flexibility in forearm muscles.

METHODS

10 college students, 5 males and 5 females, voluntary participated in this study. The cross-over of experimental design was used and each subject held a handy vibration dumbbell (TOVI, Tonic Fitness Tech. Inc., Taiwan) for 20 seconds at frequency of 15Hz (high group), at frequency of 12.5Hz (low group), and without vibration (control group), respectively. At least one day was taken between groups to avoid fatigue effect. The parameters were tested at pre-test (before vibration), post-test (10-seconds after vibration), and recovery-test (60-seconds after vibration). Control ability was defined as period of pick up three beans by using chop stick. Reaction time was defined as the time of wrist flexor recruited their motor units to light stimulus. Grasp force and EMG were tested when wrist did maximum isometric contraction. The wrist of range of motion was measured for flexibility. One-way ANOVA with repeated measure was used to compare difference among tests and groups.



Figure 1: Vibration stimulus by handy vibration dumbbell.

RESULTS AND DISCUSSION

The results indicated as follow. (1) The control ability was significant improvement at recovery-test after both vibration stimulus ($p < .05$). (2) Reaction time is no significant difference among tests in all groups ($p > .05$). (3) The control group induced muscle fatigue due to grasp force and muscle activity significantly decreased at post-test and recovery-test ($p < .05$). However, the grasp force of the low group significantly decreased with EMG significant increase at post-test ($p < .05$), but slight increased for grasp force and decreased for EMG at

recovery-test. The high group has similar change pattern with low group but no statistical difference. (4) The range of motion of wrist was significantly increased after three groups ($p < .05$).

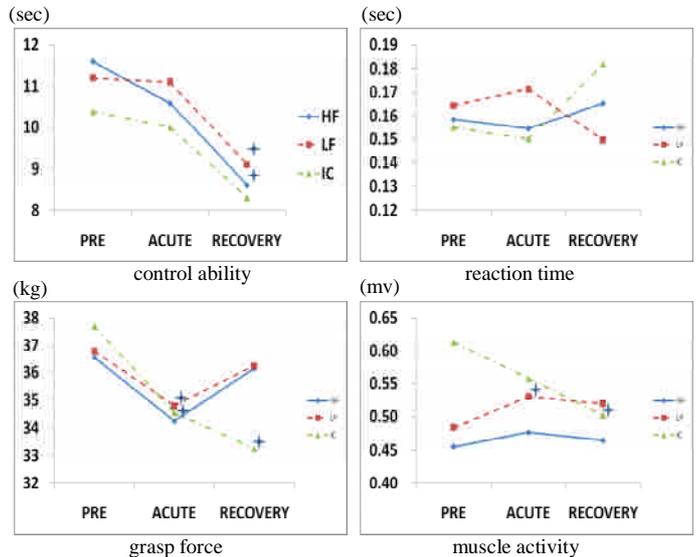


Figure 2: acute effects of vibration stimulus

Muscle fatigue plays an important role of movement control. As agonist muscles become fatigue, the force sensory receptors will be interrupted and influenced the judgment of force. The tonic vibration reflex is induced by activation of muscle spindle. It prevents the reduction in motor unit firing. As a result, the facilitation of sensory receptors will reduce the influence of muscle fatigue to improve the control ability. The motor unit pool was activated more rapidly during position task compared with the force task to lead to become fatigue easily to reveal force reduction, but with the vibration stimulation can change the motor unit discharging rate and recruit motor unit more effectively, even though prevent the reduction the firing rate of muscle spindle by this stimulation that shows the better muscle activity. An acute effect may be induced in control ability and muscle activity, handy vibration dumbbell has positive change in neuromuscular function as well as makes a fast and better way of warming up.

CONCLUSIONS

The conclusion is that vibration stimulus could get some benefits in forearm muscle compare to alone isometric contraction, such as improving control ability, recovery faster and increasing flexibility. The findings suggested that vibration by handy vibration dumbbell induced positive acute effect on fine motor muscle.

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