COMPARISON OF EMG ACTIVITY WITH DYNAMIC MOVEMENT AND STATIC POSTURE ON VIBRATION PLATFORM

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The aim of this study is to investigate the difference among dynamic movement and static posture on vibration platform as well as no vibration. For this purpose, six healthy male subjects were recruited in this study. Each subject was instructed to maintain four situations: dynamic movement with vibration (frequency: 40 Hz, amplitude: 1 mm), and no-vibration; static posture with vibration (frequency: 40 Hz, amplitude: 1 mm), and no-vibration. Result showed statistically significant increase at EMG rms of whole body vibration treatment and EMG rms value of dynamic movement was significantly larger than that of static posture ($P<.05$). In conclusion, dynamic movement can carry into better effect than static posture in training rectus femoris. Secondly, standing on a vibrating platform in squat-stand movement or half-squat posture elicits higher EMG responses in rectus femoris muscle.

KEY WORDS: vibration, movement, posture, EMG

INTRODUCTION:

Mechanical vibrations applied to the muscle belly or tendons have been shown able to elicit reflex muscle contractions. Many researches had presented different designs of vibration training which would make different training results (Mester et al., 2003). Marco (2003) had done a study regarding the static posture on vibration platform, the subjects were asked to stand in half-squat position on the vibration platform (knee angle 100^o) with three vibration frequencies (30, 40, 50Hz) and no-vibration. The results indicated that standing on the vibration platform in half-squat posture elicits higher EMG responses in vastus lateralis muscle as compared with without vibration. Issurin (1994) had done a study regarding dynamic movement on vibration platform, twenty-eight male athletes served as the subjects to investigate the effect of vibration stimulation on training for maximal strength. It was found that maximal strength increased by 49.8%. Above studies designed two different methods to process vibration training, and both gained the positive effect in muscle contraction. But none study was done to compare the training effect between dynamic movement and static posture on platform. The aim of this study is to investigate the difference among dynamic movement and static posture on vibration platform as well as no vibration.

METHOD:

Six healthy male subjects were recruited in this study (24+0.58 y, 174.2 +3.9 cm, 69.8 +3.7 kg, Dominant leg: left). Each subject was instructed to maintain four situations: dynamic movement with vibration (frequency: 40 Hz, amplitude: 1 mm), and no-vibration; static posture with vibration (frequency: 40 Hz, amplitude: 1 mm), and no-vibration. The vibration training facility was Zenpro ™ platform. Dynamic movement was defined as Fig1, subjects had to do the squat-stand movement and knee joint flexion at 110 deg. to 150 deg. Metronome was used to control the velocity of dynamic movement (one repetition two seconds). Static posture was defined that subjects maintain the knee joint flexion at 130 deg. (an isometric contraction during the trials). Each test had three trials, and each trial lasted 30s, followed by a rest phase of 120s. Subjects were asked to grab the handle of vibration platform to make the lower leg stable and eliminate unnecessary factors. During the experiment, EMG of left rectus femoris, EMG of right rectus femoris, angle of left leg were collected.

Data Analysis: Two way ANOVA was used to compare the activity of EMG (software: SPSS14). The level of significance was set at $P< .05$.

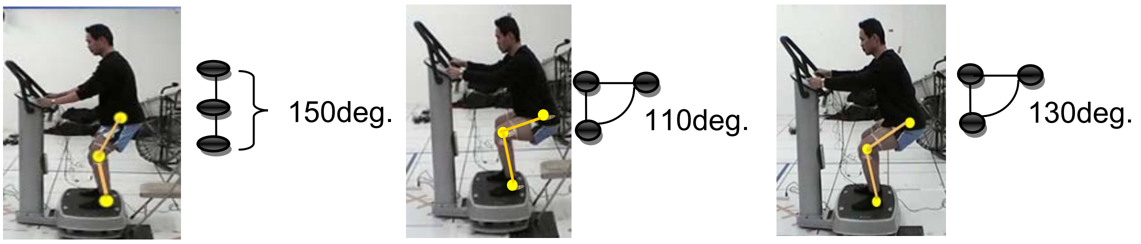

Figure 1: The angle definition of dynamic movement and static posture on vibration platform.

RESULTS:

Whole-body vibration treatment lead to an significant increase of EMG rms value of two leg rectus femoris muscle compared with baseline values ($P < .05$) collected in the no-vibration condition (see Fig 2). The EMG rms value of dynamic movement was significantly larger than that of static posture ($P<.05$). EMG activity of left rectus femoris had showed the positive effect of muscle contraction with vibration, and it was significantly larger compare to no-vibration (see Fig 3). The EMG activity of right rectus femoris had no significant difference between vibration and no-vibration which might be related to the effect of dominant leg.

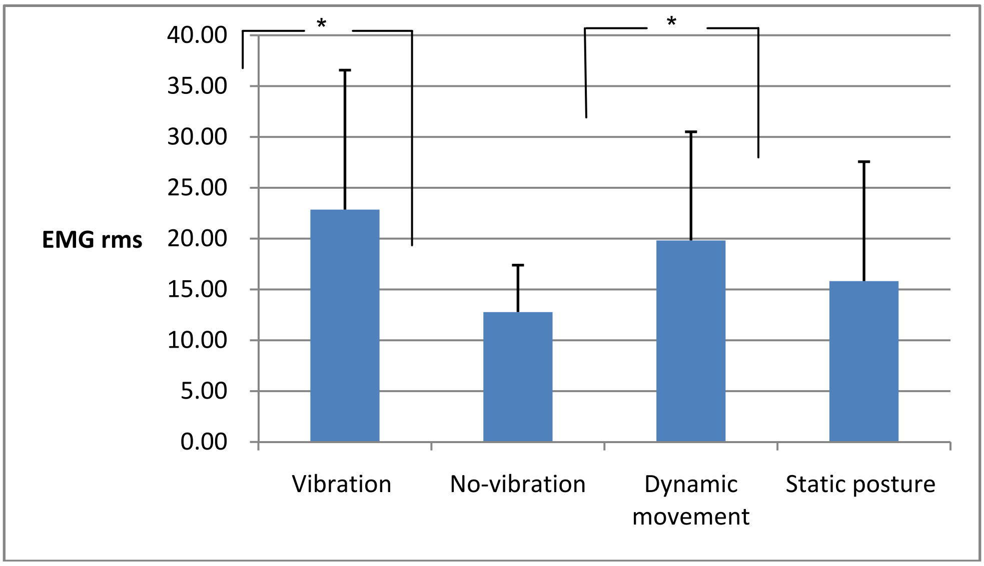

Figure 2: Main effect of EMG rms (normalized by MVC) of two leg rectus femoris with vibration, no-vibration, dynamic movement and static posture.

DISCUSSION:

The results of the present study demonstrated a significant increased EMG activity in rectus femoris muscle at both dynamic movement and static posture when subjects standing on a vibration platform. As expected, the vibration treatment showed the statistically significant improvement for two leg rectus femoris. During vibration of muscle contraction, it would recruit more muscle fibers by muscle neurone than no-vibration of muscle contraction. Lebedev & Peliakov (1991) pointed out the possibility that vibration may elicit excitatory flow short spindle-motorneuron connections. Romaiguere et al. (1993) found that neuronemuscles remained potentiated for 10 seconds after the removal of vibration stimulus. In this study, subject had rest period of 120 s after vibration stimulus. Therefore, any effect of vibration treatment that are observable in the present results are not residual effect of vibration. Dynamic movement showed a statistically significant increase on muscle EMG for two leg rectus femoris. Dynamic movement could elicit more muscle neurone activity to recruit motor units than static posture. The EMG activity of left rectus femoris with vibration was significantly higher compared to no-vibration, but The EMG activity of right rectus femoris didn't show the same trend. The reason of this result might be the effect of dominant leg since all the subjects' dominant legs were left. The center of mass would place more on left leg when subjects standing on the platform. It would stimulate neuronemuscle to recruit more motor units at left leg. There was also more power transmitted by vibration when subjects do the movement with vibration. Therefore, EMG activity of left rectus femoris was significantly larger in vibration compare to no-vibration. The training effect of dominant leg might be different which should be further studied in the future.

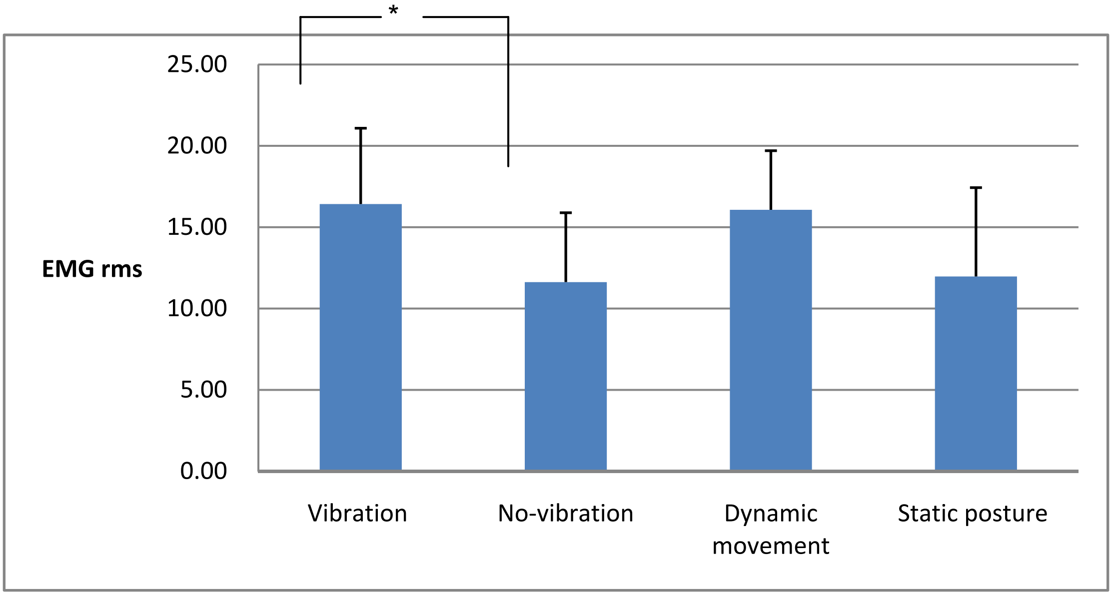

Figure 3: Main effect of EMG rms (normalized by MVC) of left rectus femoris with vibration, no-vibration, dynamic movement and static posture.

CONCLUSION:

In conclusion, the result of this study show that dynamic movement can carry into better effect than static posture in training rectus femoris. Secondly, standing on a vibrating platform in squat-stand movement or half-squat posture elicits higher EMG responses in rectus femoris muscle as compared with the same situation without vibration being transmitted. Vibration training is an effective training method to induce more motor units activation as well as various other factors if it is properly designed. To train the rectus femoris, the study suggests that people could take dynamic movement to process, and it would have better effect with vibration.

REFERENCES:

Issurin VB, Liebermann DG & Tenenbaum G. (1994). Effect of vibratory stimulation training on maximal force and flexibility. *Jonrnal of Sports sciences*.12, P561-566.

Lebedev M. A.& Peliakov A. V. (1991) Analysis of the interference electromyogram of human soleus muscle after exposure to vibration(in Russian). *Neirofiziologia* , 23 , 57-65.

Marco Cardinale and Jon Lin.(2003) . Electromyography Activity of Vastus Lateralis Muscle During Whole-Body Vibration of Different Frequencies. *Journal of Strength and Conditioning Research*, 17(3), P621.

Mester, J., Spitzenpfeil, P.,Yue, Z., 2003. Vibration loads: potential for strength and power development. In: Komi, P.V. (Ed.), *Strength and Power in Sport, second ed. Blackwell Science*, Oxford, pp. 488-501.

Romaiguere, P., J. Vedel, and S. Pagni. (1993). Effect of tonic vibration reflex on motor unit recruitment in human wrist extensor muscles. *Brain Res.* 602:32 -40.