Acute Effects of Whole-Body Vibration on Soleus H-Reflex

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Introduction

Recent investigations suggest that whole-body vibration (WBV) training contributes to enhanced athletic performance[2,4] and improvement in functional ability in individuals with disabilities[1,3], yet the neurophysiological basis for these observed benefits has not been investigated. Whole-body vibration is thought to elicit muscular activity via stretch reflexes[2,4]. The subject stands on a platform that applies vertical sinusoidal vibration to the body and stimulates sensory receptors, specifically the muscle spindles. Muscle spindle activation results in reflex activation of the alpha-motoneurons thereby generating muscle contractions.

The spinal stretch reflex and its electrical analog, the H-reflex, are monosynaptic reflexes that participate in a wide range of human motor behaviors[5]. The soleus H-reflex is a reliable and well-studied indicator of lower limb spinal reflex activity. The H/M ratio (motor response from Ia sensory fibers / direct motor response) is used as an index of efficacy of transmission between the Ia sensory fiber and the alpha motor neuron.

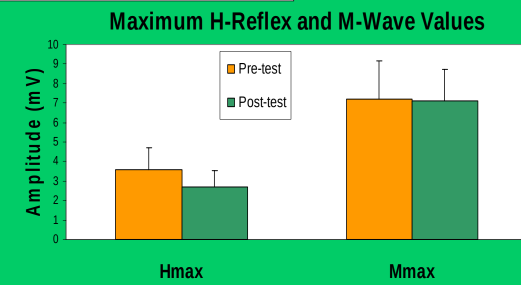
Modulation of spinal reflexes is necessary for normal motor performance and locomotor control[6]. It is known that modulation of the H-reflex is altered after neurological injury[7]. Therefore, modulation of the H-reflex by WBV would have clinical implications for use in the rehabilitation setting to improve functional performance. The purpose of this study is to determine the acute effects of WBV training on the soleus H-reflex in able-bodied subjects.

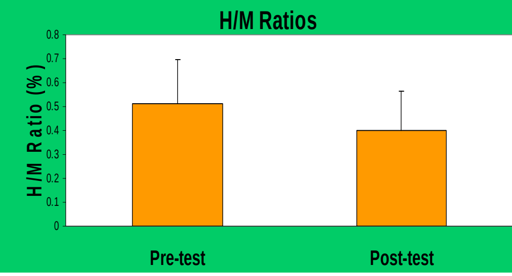
Methods

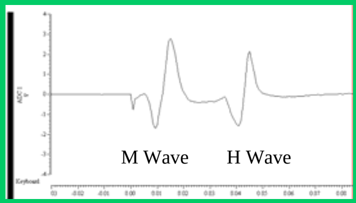
Ten healthy subjects aged 18-36 years (6 males, 4 females) participated in this preliminary study. *H-reflex testing:* Subjects were seated comfortably with the leg in a stable position and a knee angle of approximately 120 degrees. Subjects underwent soleus H-reflex testing of their right lower extremity. Percutaneous monopolar stimulation was applied to the tibial nerve (cathode placed on the popliteal fossa and remote anode on the patella; stimulus duration: 1ms; rate: one every 8 seconds). Surface EMG electrodes were placed in a bipolar configuration on the skin overlying the right soleus muscle (active electrode 4 cm below the inferior margin of the two heads of the gastrocnemius muscle and the reference electrode over the medial malleolus). Measurement of recruitment curves for H-reflexes and M waves were obtained before and after the WBV intervention. The maximum H wave and maximum M wave values were used to calculate the H/M ratio pre-and post-training for each subject. *WBV Intervention:* The subjects stood on a WBV platform (Galileo, Orthometrix, Inc.) for five minutes at 26 Hz. Subjects stood with their feet placed over the number 3 mark on the base of the platform and their hands gently placed on the support bar. *Analysis:* Pre- and post-test values of maximum H-wave and M wave amplitudes and H/M ratios were compared using paired t-tests.

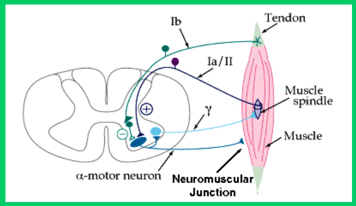
Results

A statistically significant decrease in maximum H wave amplitude (mean = 25%) was observed (t=3.547, $p<0.05$) following five minutes of WBV. No statistically significant change was detected in maximum M wave (t=.197, $p=.848$). Following WBV training, there was a statistically significant (t=2.87, $p<0.05$) decrease in the H/M ratio from 51% to 40%.









Reflex Arc

Galileo WBV Platform

H-Reflex Testing

Conclusions

The results of this preliminary study suggest that there are significant neurophysiological changes occurring acutely after WBV. These observed neurophysiological adaptations to WBV may indicate a reduction in the efficacy of transmission between the Ia sensory fibers and the alpha motor neuron. The evidence of acute H-reflex modulation resulting from WBV may have implications for use in the clinical setting. However, further studies must be conducted to examine other neurophysiological mechanisms that may contribute to observed functional benefits resulting from WBV.

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