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The effects of body weight on the soleus H-reflex modulation during standing

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ABSTRACT

Objective: We examined how the soleus H-reflex is affected by the changes in limb loading by testing subjects on a body weight support system during standing.
Design: Twenty-two healthy subjects (10 males and 12 females) were recruited for this study. The size of the soleus H-reflex was measured in six different limb loading conditions: 100%, 90%, 80%, 70%, 60%, and 50%. One-way repeated measure ANOVA was used ($p < 0.05$) to compare the H/M ratios among the six different load conditions.
Results: The amplitudes of the soleus H-reflex decreased significantly as the amount of body weight load decreased.
Conclusions: Findings of this study suggest that the levels of body weight load in pre- and post-test conditions should be consistent when H-reflex testing is adapted as an outcome measure of rehabilitation intervention for patients with central nerve system lesion such as partial body weight supported gait training.

1. Introduction

The Hoffmann reflex (H-reflex) is a monosynaptic spinal level reflex that is evoked by percutaneous electrical stimulation of large diameter afferent fibers in innervating nerve (Palmieri et al., 2004; Trimble et al., 2001; Zehr, 2002). The H-reflex has commonly been used to indirectly assess the level of excitability in the spinal motoneuron pool in various postures and during voluntary movements. The H-reflex matches the level of muscle activation to the functional requirement of the muscle during a specific posture, task, or phase of movement (Trimble et al., 2001; Zehr, 2002). Previous studies have shown that the magnitude of the H-reflex in a person is greater in sitting compared to standing positions (Capaday and Stein, 1986, 1987).

Measurement of the H-reflex has been used as an assessment of the nervous system for various neuromuscular diseases (Bakheit et al., 2003; Hodapp et al., 2009; Knikou et al., 2009; Lo et al., 2009; Phadke et al., 2007; Stewart et al., 2004; Trimble et al., 2001), as well as for the assessment of diverse therapeutic interventions, such as surgeries, medications, therapeutic modalities, and exercise training (Palmieri et al., 2004). As an example, Trimble et al. reported that the amplitude of the soleus H-reflex of persons with incomplete spinal cord injury decreased after training (Trimble et al., 1998). However, these studies did not take into account the possible effect of the amount of limb loading on the soleus H-reflex before and after the intervention. Because of this, it is not clear if the decreased soleus H-reflex after the body weight supported treadmill training was produced by a true recovery of the nervous system or by the compound effect of decreased limb loading.

Increased muscle tone in the affected limbs, which is caused by enhanced α-motoneuron excitability in the spinal cord, is a well recognized motor impairment found in patients with central nerve system (CNS) injuries (Knikou et al., 2009). Therefore, if an intervention training method in patients with CNS lesions was effective, the level of excitability in the spinal motoneuron pool would need to decrease after training. The level of excitability is indirectly represented by the H-reflex amplitude. Based on this hypothesis, the H-reflex has been used in several studies as a tool to examine the neurological effectiveness of interventions for stroke (Bakheit et al., 2003; Knikou et al., 2009; Lo et al., 2009; Stewart et al., 2004; Trimble et al., 1998, 2001), spinal cord injury (Phadke et al., 2007), and cerebral palsy (Hodapp et al., 2009).

In recent years, several researchers have tried to evaluate whether the amplitudes of the soleus H-reflex are affected by changes of limb loading in standing using various experimental procedures, the findings of these experiments were also varied (Ali and Sabbahi, 2000; Field-Fote et al., 2000; Hwang et al., 2004; Miyoshi et al., 2003; Nakazawa et al., 2004; Phadke et al., 2006). Therefore, the present study was conducted in order to examine how the soleus H-reflex is affected by gradual changes

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