CASE REPORT

Effect of Whole-Body Vibration on EMG root mean square signal in a Diabetic type 2 patient with Peripheral Neuropathymation to coronary disease patients

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Abstract

The aim of this study was to evaluate and compare Electromyography root mean square (EMGrms) signals before and after the application of Whole-Body Vibration (WBV) in a case of type 2 Diabetes Mellitus with peripheral neuropathy. EMGrms signals enhanced immediately, 5 minutes and 10 minutes after the application of WBV. These finding demonstrate that WBV at the frequency of 30 Hz and amplitude of 2 mm transmitted through a vibrating platform in static half squat position increased EMGrms activity of all muscle portions studied in a Diabetic type 2 patient with peripheral neuropathy.

Key-Words: Whole-body vibration, diabetes, electromyography, root mean square

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Introduction

Type 2 Diabetes Mellitus (DM) is a prevalent metabolic disease all around the world. As the disease progresses over time, neuropathy becomes a common complication. Up to 36% of individuals with non-dependent DM are affected by this condition.[1] Signs and symptoms of peripheral nerve damage may occur in up to 25% of patients with DM after 10 years. Several sensory systems are simultaneously affected in DM that impairs balance increases the risk of falling. Yet, proprioceptive deficits of foot and ankle are considered to be the primary sources of balance impairment in DM .[2] Muscle strength can also be impaired in patients with DM. Diabetic patients had a 17 and 14% reduction of strength of ankle flexors and ankle extensors, respectively.[3] Whole Body Vibration(WBV) is a new somato-sensory stimulation (SSS) type of exercise that has been emerged in sport training and rehabilitation during the last decade.[4,5] WBV increases muscular strength.[6-9] Muscle activity while exposed to vibration could be monitored recording root mean square electromyography (EMGrms) signal. Several studies have reported a significant increase in EMGrms signal of different lower body muscles after exposure to WBV compared with the same position without vibration.[10-12] These changes have been proposed to be due to an increase in neuromuscular activity. It is now obvious that sustained vibration applied to tendon or bulk of muscle can stimulate muscle spindles and elicit a reflex called Tonic Vibration Reflex (TVR) primarily through Ia monosynaptic and polysynaptic pathways.[13,14] To our best knowledge, there is not any study concerning the effects of WBV on EMGrms response in Diabetic type 2 patients with peripheral neuropathy. So the aim of this study was to evaluate the effects of a single session of WBV on EMGrms signals in a case of Diabetic type 2 patient with peripheral neuropathy.

Description of the Case

The patient was a 50-year old man with a 15-year history of type 2 DM and a sensation of tingling and numbness in feet from 10 years ago. His Body Mass Index (BMI) was 25.5 and Waist to Hip ratio was 0.86. He had moderate degree of neuropathy according to Michigan Diabetic Neuropathy Score (MDNS). Online EMGrms data were collected using Data Log, Biometrics, UK recording and acquisition system.

The signals of Gastrocnemius Medialis and Lateralis and Tibialis Anterior were recorded with bipolar surface electrodes (SXZ 230, Biometrics, UK) fixed longitudinally to the muscle belly in the dominant leg. Skin was shaved (if necessary) and cleaned with an alcohol wrap. First, subject was sitting at the edge of a plinth and was told to be completely relaxed and the baseline data from the muscles were recorded. Then, he performed three maximal voluntary isometric contractions (MVIC) over 5 seconds on the platform with 30 degrees knee flexion. Next, patient was exposed to WBV (Power-Plate, Next Generation, USA) with the frequency of 30 Hz and amplitude of 2 mm for one minute. During platform standing, patient was asked to distribute the body weight evenly on both legs and not to touch the hand grip. EMGrms data were collected immediately, 5 minutes and 10 minutes after the exposure to WBV.

As can be seen, all muscles showed an incremental pattern of EMGrms signal after the application of WBV. Among three muscles, EMGrms of Gasterocnemius Medialis maintained the incremental pattern of activity after 10 minutes of application of WBV.

Conclusion

Muscle activity while exposed to vibration could be monitored recording EMGrms. Changes seen in EMGrms after exposure to WBV can be attributed to neuromuscular activity (15). Based on the results obtained, it is possible to verify that WBV at 30 Hz and amplitude of 2 mm transmitted through a vibrating platform in static half squat position increased EMGrms activity of all muscle portions studied. To our best knowledge this is the first study collected EMGrms activity during application of a WBV stimulus from a commercially available platform in a Diabetic type 2 patient with neuropathy. Cardinale and Lim (10) suggest that vibration causes a strong pertubation that is perceived by central nervous system which modulates the stiffness of the stimulated muscle groups.

Finally, as confirmed by Moras *et al.*, EMGrms is a good method to monitor static training protocols performed over a commercial vibration platform that could be found in many gyms or training centers nowadays (15). However, further studies are needed to determine the EMG response to WBV in different body positions and also to compare other EMG analysis techniques such as wavelet analysis to obtain more detailed information of muscle activity patterns.

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ANNEX

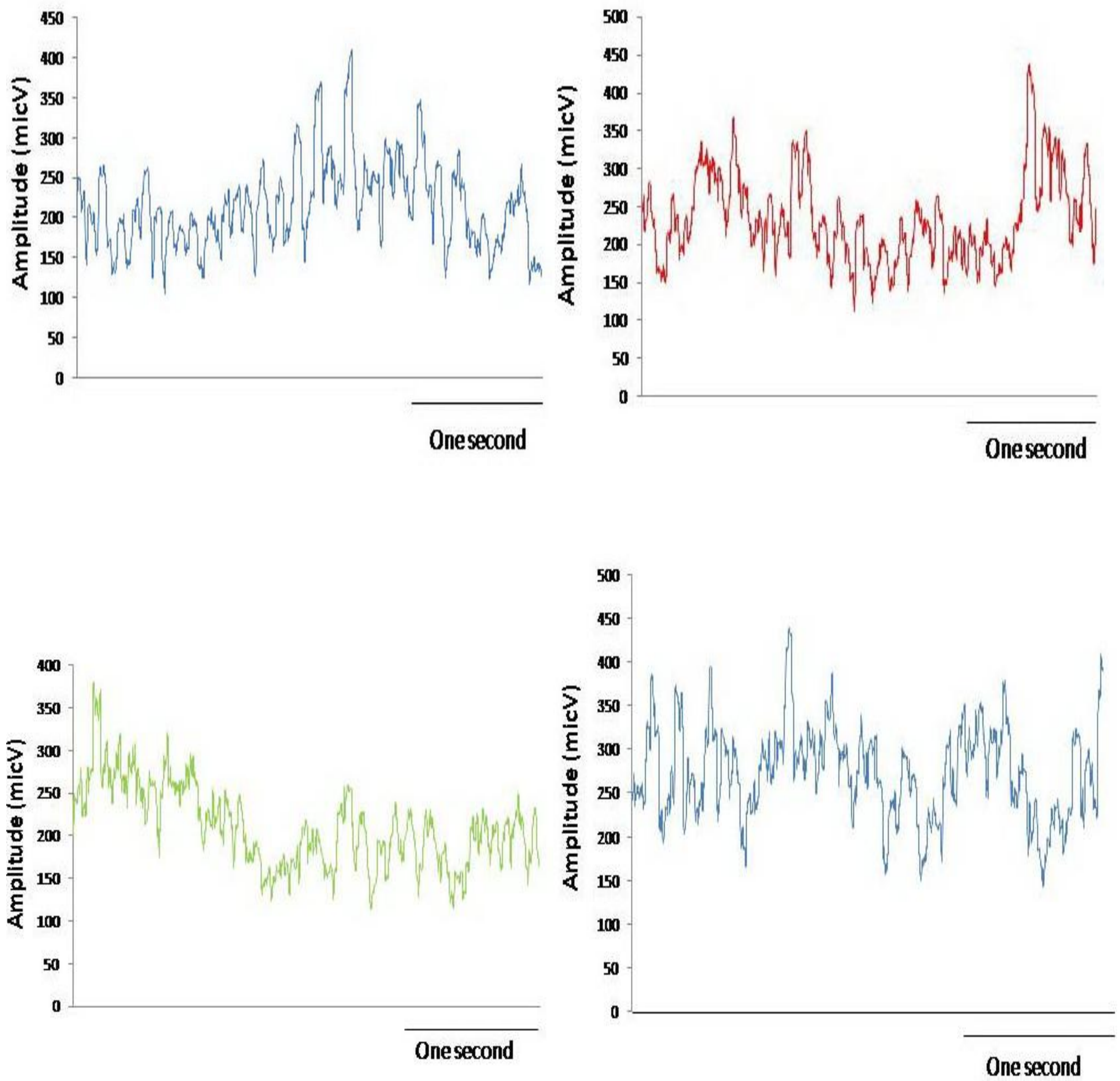


Figure 1. EMGrms signals of Tibialis Anterior muscle.

Up left: before WBV Up right: immediately after WBV

Down left: 5 minutes after WBV Down right: 10 minutes after WBV

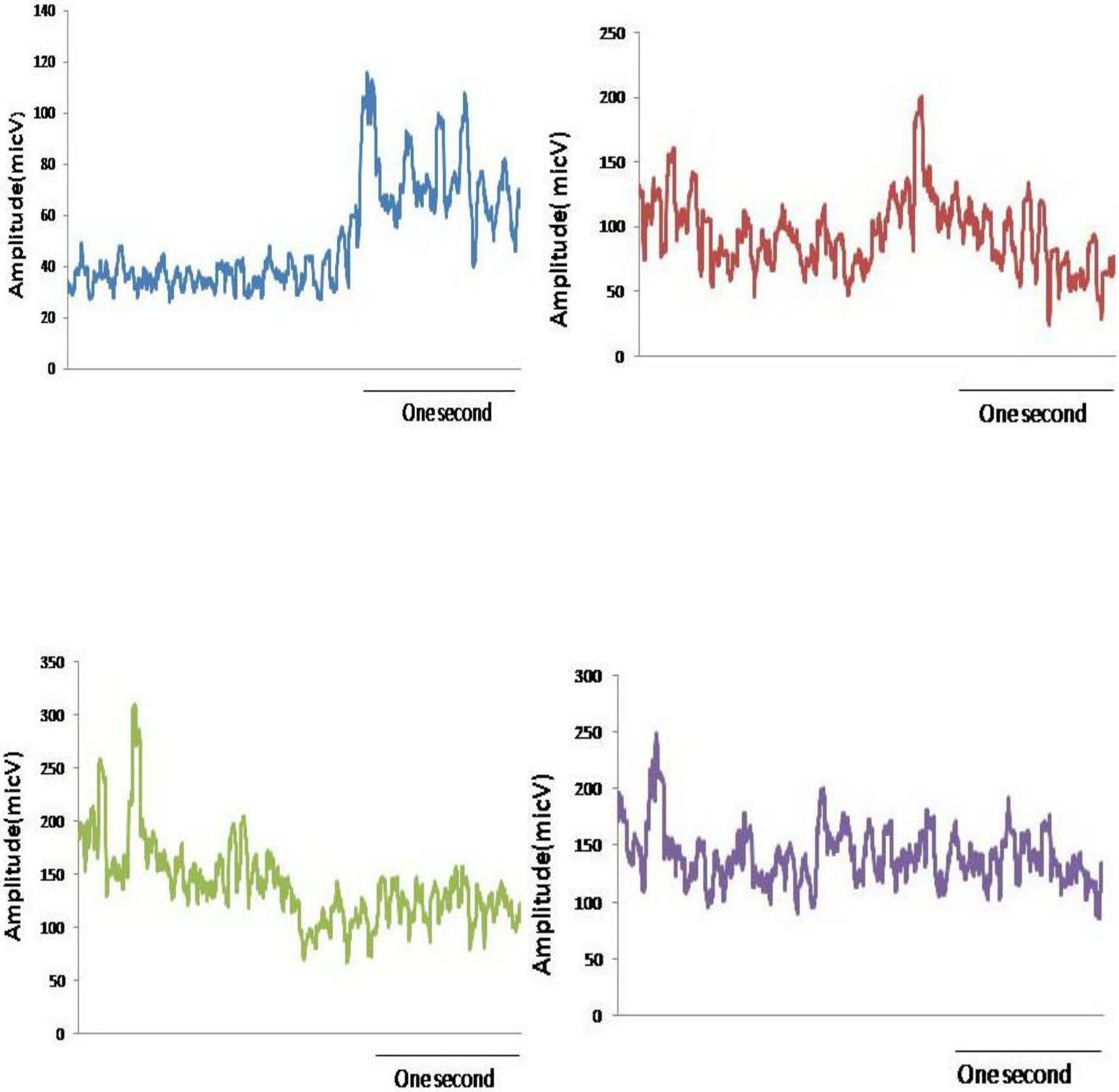


Figure 2. EMGrms signals of Gastrocnemius Lateralis muscle.

Up left: before WBV Up right: immediately after WBV

Down left: 5 minutes after WBV Down right: 10 minutes after WBV

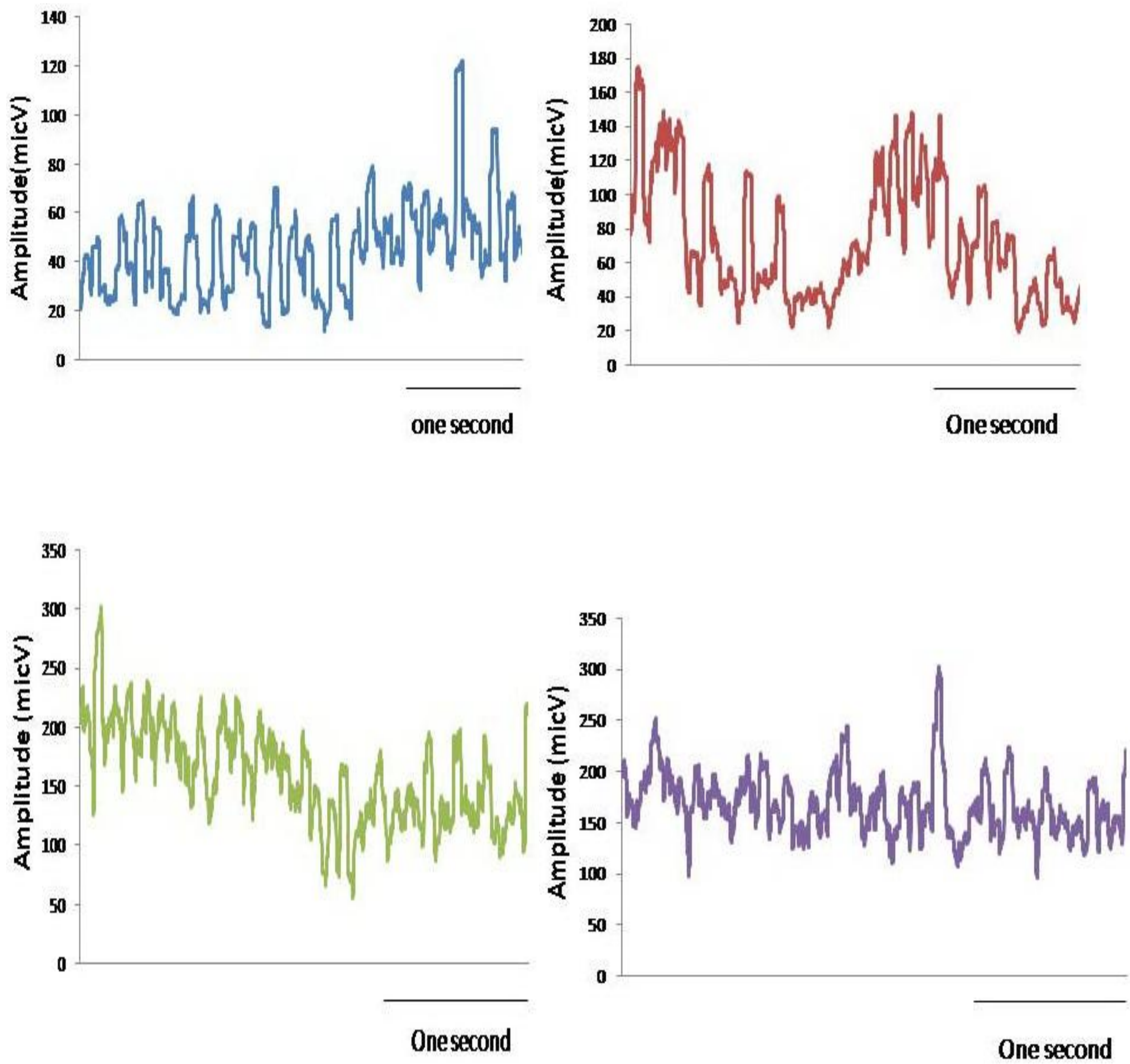
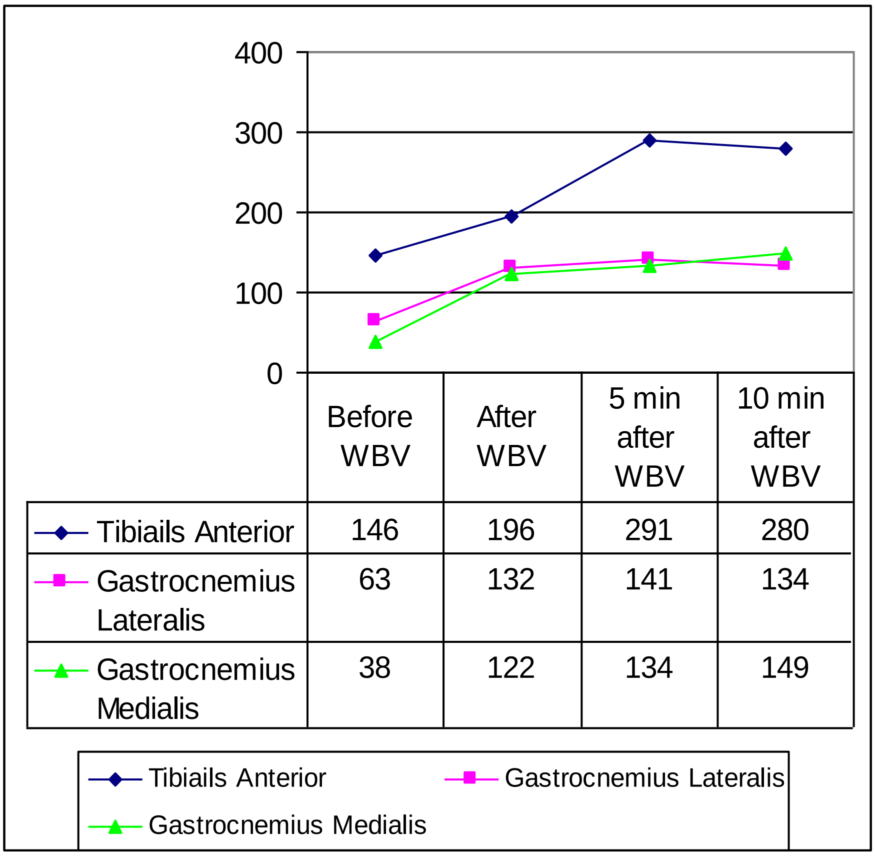


Figure 3. EMGrms signals of Gastrocnemius Medialis muscle.

Up left: before WBV Up right: immediately after WBV

Down left: 5 minutes after WBV Down right: 10 minutes after WBV

Alteration of EMGrms signals are shown in Figure 4.



	Before WBV	After WBV	5 min after WBV	10 min after WBV
Tibiails Anterior	146	196	291	280
Gastrocnemius Lateralis	63	132	141	134
Gastrocnemius Medialis	38	122	134	149

Figure 4. EMGrms alterations in Tibialis Anterior, Gastrocnemius Medialis and Lateralis.