INTRODUCTION

Whole body vibration has been identified as a significant risk factor in the etiology of low back pain and low back disorders [1-2]. Previous research has demonstrated changes in a variety of measures of lumbar neuromotor control with the exposure to vibration both during and after exposure [3-4]. These include increases in time to muscular response after sudden loading, increases in magnitude of motion after sudden loading, and increases in measures of proprioceptive errors [3-4]. The changes suggest that the neuromotor response is compromised by vibration exposure and that this compromise could lead to a greater risk for injury. However, the methods used to assess these changes have all been made in the laboratory and require a good deal of setup making them impractical for the industrial setting. As vibration exposures in the laboratory settings are more uniform and simplified relative to occupational exposures, there is a need to examine these effects in the occupational setting. The goal of this project was to develop a dynamic measure of lumbar neuromotor control that could be used easily in the workplace.

In a previous study, exposure to vibration was found to increase seated sway during exposure to vibration applied to the erector spinae musculature [5]. Since sway measures only require a force plate, such a measure could be used to test subjects in the workplace pre and post the workday. However, the previous study only looked at during vibration effects with a higher frequency exposure than typical in the workplace. Therefore, the goal of this study was to examine this measure post-exposure to a vibration at frequencies closer to the occupational setting.

METHODS

Seven subjects (5 male, 2 female, weight 69 ± 11 kg, height 1.72 ± 0.05 m) participated in this study. Subjects with a history of low back pain and neuromuscular deficit were not allowed to participate. This study was approved by the human subjects committee, Univ. of Kansas-Lawrence. The subjects were tested under two conditions: before and immediately after whole body vibration exposure. For the testing, the subjects were instructed to sit on the force plate (Bertec, Columbus, OH) with hands on their lap and to let their feet and lower legs hang freely. An NI USB 6210 16-bit A/D board was connected to the force plate for the data acquisition and force plate data was collected at 100 Hz.

Three types of measures were assessed: 1. Quiet seated sway, 2. Tracking of a simple linear motion with center of pressure (COP), and 3. Tracking of a rotational motion with COP. For seated sway, the subjects were instructed to sit quietly on the force plate for 3 minutes with eyes closed. Subjects kept their hands on their laps and their feet were allowed to dangle freely.

For the tracking tasks, the COP was calculated and displayed on a computer screen (Fig. 1). Subjects were instructed to match their displayed center of
pressure with a target that moved in 3 patterns: linear anterior-posterior (AP), linear medical lateral (ML), or circular. Each pattern was collected at a rate of 5s/cycle for 10 cycles.

Prior to the start of the experiment, the seated subjects were allowed to practice following the target until they were comfortable with the task. During the data collection, feedback was provided for the first 5 cycles of each pursuit task. During the last 5 cycles of each pursuit pattern the subjects were asked to continue following the pattern without feedback of their COP. This collection was performed before and after vibration exposure.

For the vibration exposure, the subjects were exposed to 20 minutes, seated, whole-body, random vibration (WBV) using a shaker table (Ling Electronics, Anaheim, CA). The random vibration profile was created to match the average vibration data collected from 3, 20-minute assessments of vibration exposure of a dump truck driver. Vibrations above 3 Hz (the lower frequency limit of the shaker table) were included in the creation of this profile. During the WBV period, subjects were also instructed to put their hands on their lap and to let their feet and lower legs hang freely.

RESULTS AND DISCUSSION

No significant differences were observed in mean sway speed during stable seated sway (p=1.0). There were no significant differences observed for the error in slope (p=0.214) or peak to peak (p=0.093) values for linear patterns. Errors were calculated by subtracting target position from actual COP. Nor were significant differences observed in the error of radius (p=0.165) or theta (p=0.543) for the circle pattern. However, examining the results of the circle task identified that iteration was significantly different (p=0.012) for the radius error and approaching significance (p=0.128) for the angle theta when examining repeatability.

CONCLUSIONS

Presently, the task created does not demonstrate a difference in the proprioceptive control of trunk posture resulting from WBV. A closer examination of the individual iterations identifies that the iterations progressively increase in differences for the circle pattern. This is believed to be a result of each successive iteration being further removed from the feedback condition. As the task is designed now, it is unable to provide useful information; however, it may be possible to adjust the task such that it would be sensitive to differences resulting from WBV. Based on the results of this study it would be recommended to remove the stable seated sway and increase the iterations of the pursuit patterns. This would allow for more iterations of the pattern and allow for alternating between feedback conditions. The observed trends may be strengthened with a larger sample size.

REFERENCES


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