2010

Validity and Reliability of the Nintendo Wii in Measuring Standing Balance

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VALIDITY AND RELIABILITY OF THE NINTENDO Wii IN MEASURING STANDING BALANCE

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ABSTRACT

The purpose of this study was to determine the validity and reliability of balance measures using the Nintendo Wii Balance Board. Twenty-four male and female subjects participated in this study. Left-foot, right-foot and two-foot stances were used to assess balance. It has been shown that force platforms provide a quantitative, valid analysis of balance through measurements of center of pressure (CoP). Pearson-product moment correlation coefficients ($\alpha<0.05$) between mean CoP velocities and Wii Balance Board scores were used for analysis. The correlation coefficients between CoPx+y and trial one Wii scores for the two-foot, left-foot, and right-foot stances were 0.125, 0.086, and 0.254, respectively. This data suggested that the Wii Balance Board was not a valid measuring tool of standing balance. Reliability was not determined because validity was not established.

INTRODUCTION

Physicians and athletic trainers face a difficult decision when determining when an athlete can safely return to play following a concussion. Because the repercussions of poorly assessing concussions can be severe, objective measures become necessary in evaluation (Guskiewicz et al, 2000). Many studies have shown that balance and particularly postural sway are impaired following concussion (Cavanaugh et al., 2005; Guskiewicz et al., 2001). It has been shown that force platforms provide a quantitative, valid analysis of balance through measurements of center of pressure (CoP) (Teasdale et al., 1991; Ring et al., 1988). However, these platforms are expensive and lack of portability limits their usefulness outside of laboratory settings. The Nintendo Wii is a relatively cheap, portable, and objective piece of equipment that may be sensitive enough to assess balance.

PURPOSE

The purpose of this study was to determine the validity and reliability of balance measures using the Nintendo Wii Balance Board.

Wii Fit Plus ©2009 Nintendo.

EXPERIMENTAL DESIGN

Twenty-four apparently healthy subjects participated in this study. The mean age, height, and weight of female subjects (n=4) was 20±0.8 years, 163.5±6.3 cm, and 60.3±12.3 kg, respectively. The mean age, height, and weight of male subjects (n=20) was 24.4±8.0 years, 178.7±7.9 cm, and 90.7±15.5 kg, respectively.

Subjects performed a left foot, right foot, and a feet-together balance test on an AMTI 1000 Force platform with SIMI Force software (v6.2), as well as the Nintendo Wii using the Wii Fit™ Plus program © 2009 Nintendo and Balance Board. Three trials were performed on the Nintendo Wii and one on the force platform in a randomized order. Each subject was required to have bare feet and hands held on the hips during each stance. Each stance was held for 30 seconds. The Wii Fit™ Plus program yielded a balance score ranging from 0-100. The force platform measured forces and moments in each dimension. Center of pressure (CoP) was calculated according to Slobounov et al (2006); and the mean velocities of CoPx (medial/lateral) and CoPy (anterior/posterior) were used to analyze postural stability, calculated according to Karlsson & Frykberg (2000):

$$\text{Mean CoP velocity} = \frac{f}{n-1}\sum_{i=1}^{n-1}\sqrt{(CoP(i+1)-CoP(i))^2},$$

where *n* is the number of data samples and ƒ is the sampling frequency. The mean velocities of CoPx and CoPy are indicative of medial-lateral and anterior-posterior sway, respectively. Pearson product moment correlation coefficients were used to determine validity of the Nintendo Wii Balance Board against the force platform ($\alpha<0.05$). The reliability of the Nintendo Wii was calculated using the Kuder-Richardson Formula 20 (KR-20) ($\alpha<0.05$).

RESULTS

All correlation coefficients between mean CoP velocities and Nintendo Wii scores for each stance (see Table) were not significant ($\alpha<0.05$). The strongest correlation occurred between CoPx and Wii trial 3 for the right-foot stance (r=0.343). The weakest correlation occurred between CoPx+y and Wii trial 2 for the left-foot stance (r=0.002) (see Table).

Table 1. Correlation Coefficients of Mean CoP Velocities against Nintendo Wii Trials

	Two-Foot Stance			Right-Foot Stance			Left-Foot Stance		
	Wii 1	Wii 2	Wii 3	Wii 1	Wii 2	Wii 3	Wii 1	Wii 2	Wii 3
CoPx	0.129	0.098	0.137	0.295	-0.083	0.343	0.067	-0.04	0.257
CoPy	0.071	0.254	0.123	-0.111	-0.269	-0.121	0.060	0.117	0.223
CoPx+y	0.125	0.286	0.179	0.254	-0.129	0.297	0.086	0.002	0.328

DISCUSSION

The aim of this study was to validate the Nintendo Wii and accompanying Balance Board against an AMTI 1000 Force platform. This data suggested that the Nintendo Wii was not a valid measure of standing balance. There was little relationship between the Wii scores and mean CoP velocities as the highest correlation coefficient was 0.343. The KR-20 was not used because validity was not established. This counters the findings of Clark et al (2010) who concluded that the Wii Balance Board is a valid tool for assessing standing balance. It is possible that validation of a Nintendo Wii and Balance Board is dependent upon the individual construction and accuracy of each individual system. The Nintendo Wii and Balance Board could be used to measure standing balance, but validation of each Nintendo Wii and Balance Board is necessary before using the system as a balance measurement tool.

CONCLUSION

The findings of this study suggested that this Wii Balance Board was not a valid measure of standing balance. However, because of manufacturing idiosyncrasies, it is possible that other Nintendo Wii and Balance Board systems could be valid and reliable in measuring balance.

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Wii Fit Plus website, © 2009 Nintendo. http://www.wiifit.com/

ACKNOWLEDGMENT

This investigation was supported by a Summer Research Award from the University of Puget Sound.