BESS Scores Observed in Real-Time Versus Slow-Motion Video Recording

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Abstract. The Balance Error Scoring System (BESS) is a subjective clinical balance assessment frequently used by various healthcare providers. The test consists of three different stances (feet together, tandem, and single leg) that are each 20 seconds long. An administrator carefully observes and records the number of pre-defined balance or stability errors committed by the test subject. However, it is unclear if test administrators are able to observe all errors committed by the subject in real-time. 53 subjects were scored in person and recorded on video for slow-motion access while performing two series of BESS trials by an experienced BESS rater. No significant difference between means in overall total score in real-time or slow-motion (9.8 ± 6.7 and 9.7 ± 5.5 errors, respectively) were reported. Results of this study suggest that experienced BESS raters score balance errors consistently whether the test is in real-time or recorded and viewed in slow-motion.

1. Introduction

This study addressed the absence of research associated with accuracy of BESS testing in real time. Balance is defined as postural equilibrium, the act of maintaining the body to a state of static or dynamic control [1]. The central nervous system (CNS) utilizes three sensory inputs, the somatosensory, visual, and vestibular systems to maintain position and motion of the body [2, 3, 4, 5]. The somatosensory system is made up of proprioceptors and mechanoreceptors that process information from ligaments, joint capsules, and musculotendinous tissues located in the human extremities [5, 6, 7]. Visual sensory inputs help humans understand the depth of proprioception allowing the body to adapt to surroundings. The inner ear translates balance information to the vestibular system to maintain equilibrium [8]. If one of these systems were not able to properly send information to the CNS sensory re-weighting would occur causing the remaining functions to compensate [9].

Athletics and activities of daily living all require the ability to maintain balance in order to coordinated musculoskeletal responses. BESS was created to be a low-technology cost- and time-effective method to evaluate the complexity of the CNS on balance in both athletic and clinical settings when there is limited access to expensive high-technology units with longer testing durations [8] Approximately eight studies were done using video recordings, but none showed evidence to slow-motion analysis. The purpose of this study was to analyze the correlation between raw data and slow-motion recorded data to see if there were errors not recorded or too many errors recorded. A positive correlation was found; therefore, health care providers should continue scoring BESS in real-time.

2. Methods

43 subjects (60.0±6.76 yrs) participated in BESS test. Volunteers were informed of experimental procedures and risks involved, and then completed an informed consent form approved by WSU IRB. Demographic and anthropometric data including subjects' age, ht, wt, and center of mass were recorded. Every subject performed a familiarization trial immediately followed by an experimental trial. Each trial consisted of six 20sec tests of 3 stances [bipedal, non-dominate single-leg stance, and tandem standing (heel-to-toe with non-dominate foot behind the dominant foot)]. Before subjects were tested, we instructed them on BESS performance. For each test condition, subjects were asked to close their eyes, hold hands on hips, and maintain the appropriate stance. Each subject was instructed that if at any time they fell out of the position, they were to return to the test position as quickly as possible. The subjects were positioned approximately 15 feet away from the test administrator. An iPad was placed on a table 3ft off the ground to record the subjects. All trials were scored using BESS scoring protocol completed by a Certified Athletic Trainer (ATC). The ATC recorded errors during the live BESS assessment trial and again in slow-motion using the video recordings. An error was credited if the subject moved according to the criteria listed in Table 1.

Table 1

BESS Scoring Errors

- Moving the hands off of the hips
- Opening the eyes
- Step, stumble, or fall
- Hip flexion or abduction greater than 30°
- Lifting the forefoot or heel off of the testing surface
- Remaining out of testing position for more than 5 seconds

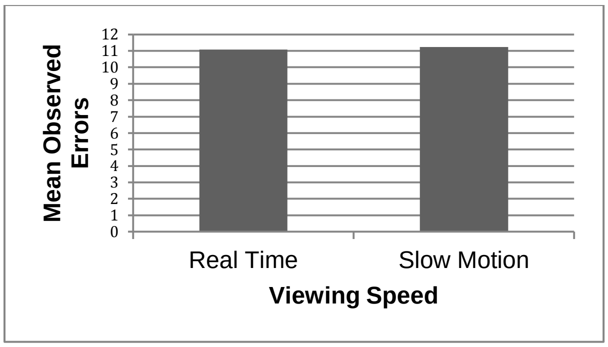
The maximum amount of errors that can be recorded for any single condition is 10; worse total score equaling 30 when the three test scores are tabulated. If a subject were to commit multiple errors simultaneously the test administrator could only record one error.

3. Results

Paired sample t-test was used to compare overall mean scores in real-time (9.8 ± 6.7 balance errors) and slow-motion (9.7 ± 5.5 balance errors) BESS. No significant difference was found between the means in the overall total score. Experienced BESS raters score balance errors consistently whether the test is in real-time or recorded and viewed in slow-motion.

Graph 1

Mean Observed Errors



4. Conclusion

Our results conclude that healthcare professionals should not worry about recording or using slow motion play back while BESS testing to find all errors. There was no significant difference in the BESS total score mean at normal speed or slow speed. Therefore, healthcare professionals should remain with normal speed testing.

5. References

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