Screening Tools

Automated Assessment of Postural Stability System for On-Field Evaluations of Balance Impairment Following Concussion

Impaired balance caused by traumatic brain injury (TBI), including concussion/mild Traumatic brain injury (mTBI), and musculoskeletal injury, are highly relevant to fitness for duty. The gold standard for assessing static postural stability is the Balance Error Scoring System (BESS), which requires administration by properly trained clinicians and is susceptible to bias (*Onate, Beck, and Van Lunen 2007*). Researchers from Temple University (Philadelphia, Pennsylvania) designed and implemented a portable system, called the Automated Assessment of Postural Stability (AAPS), for on-field evaluations of balance impairment by personnel with minimal training (*Napoli, Glass, Tucker, et al. 2017*). The AAPS is a computer system based on inexpensive off-the-shelf components and custom software (Figures 1 & 2). Its main innovation is the balance error detection algorithm that has been designed to acquire data from a Microsoft Kinect sensor and convert them into clinically-relevant BESS scores, using the same detection criteria defined by the original BESS test. To assess the AAPS balance evaluation capability, 15 healthy subjects (seven male, eight female) were simultaneously evaluated by AAPS and BESS (*Napoli, Glass, Ward, et al. 2017*). The results show that the AAPS error detection algorithm can accurately and precisely detect balance deficits with performance levels that are comparable to those of BESS tests conducted by experienced medical personnel. Specifically, agreement levels between the AAPS algorithm and the human average BESS scores ranging between 87.9 percent (single-leg on foam) and 99.8 percent (double-leg on firm ground). Analysis of Variance test did not detect statistically significant differences between AAPS and BESS scores. These results underscore the value of using the AAPS, which can be quickly deployed in the field and/or in outdoor settings with minimal set-up time. The AAPS also has the capability of recording multiple error types and their time course with extremely high temporal resolution. These features are not achievable by humans, who cannot keep track of multiple balance errors with such a high resolution.

By providing automated and computerized BESS calculation, removing the need for clinicians to administer the test, AAPS will increase the capability of performing balance impairment assessment and return to duty evaluation for Service members.

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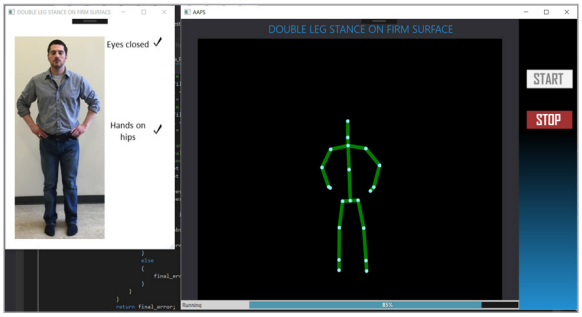

FIGURE 1: Screenshot from the Automated Assessment of Postural Stability (AAPS) software. Subjects are prompted to hold poses from the standard BESS test; skeleton tracking is used to score balance deficits. (Figure used with permission from the authors)

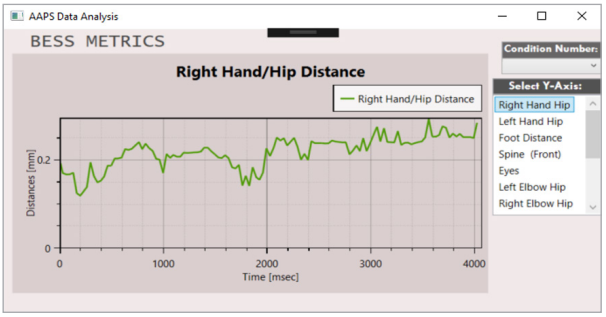

FIGURE 2: In contrast to the conventional BESS in which errors are binary (present or absent), the AAPS gives continuous error measurements versus time. (Figure used with permission from the authors)

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