Measurement Properties of the Balance Error Scoring System Component of the C3 Logix Concussion Assessment Battery

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Context: Multiple domains are required to assess various aspects of brain function following concussion, including balance. The Balance Error Scoring System (BESS) was developed to provide clinicians with a portable means to assess balance when a force plate is not available. The accelerometer and gyroscope in Apple's iPad provide a validated, portable, objective measure of postural stability during BESS testing using the C3 Logix application. Although validated, other measurement properties must be established. **Objective:** To determine test-retest reliability, practice effects, and relationship of the C3 Logix BESS test to BESS errors. **Design:** Repeated-measures. **Setting:** Controlled laboratory. **Patients or other Participants:** 38 healthy, NCAA athletes (20 females, 18 males; age=20.1±1.4 years, height=166±18.5 cm, mass=71.3±12.6 kg). **Interventions:** Participants completed four, 6-stance BESS tests across two sessions, separated by 1 week. Stances included double-leg (DL), single-leg (SL) and tandem stance (TS) on both firm and foam surfaces. A belt secured the iPad over the sacrum. **Main Outcome Measures:** Independent variables included time (within or between test sessions). Dependent variables included BESS errors and iBESS volume, a mathematical representation of combined accelerations in the anterior-posterior, medial-lateral and rotational planes. Intraclass correlation coefficients (ICC) were calculated for BESS errors and iBESS volume to determine within-session and 1-week test-retest reliability. A repeated-measures ANOVA and paired samples t-tests post-hoc analysis were used to determine differences between BESS errors and iBESS volume over time. Pearson correlation was used to assess the relationship between BESS errors and iBESS volume. **Results:** Across test conditions, within-session reliability ranged from acceptable to excellent for errors ($ICC_{(2,1)}$=0.76-0.93,p<0.001) and was excellent for iBESS volume ($ICC_{(2,1)}$=0.76-0.93,p<0.001). One-week test-retest reliability was acceptable for errors ($ICC_{(2,1)}$=0.80(95%CI:0.62-0.90,p<0.001) and excellent for iBESS volume ($ICC_{(2,1)}$=0.91(95%CI:0.82-0.95,p<0.001). ANOVA revealed a significant difference (p<0.05) between errors and iBESS volume over time. Post-hoc analysis revealed BESS errors were significantly higher in trial 1 (11.5±5.4) compared to trials 2 (9.2±4.4), 3 (8.8±4.0) and 4 (8.1 ± 3.3). A significantly higher error count was also found in trial 2 (9.2±4.4) compared to trial 4 (8.1±3.3). Post-hoc analysis revealed iBESS volume was significantly greater in trial 1 (-5.9±5.6) compared to trials 2 (-7.6±5.5), 3 (-7.3±5.8) and 4 (-7.5±5.2). Pearson correlations revealed a significant, moderate-strong, positive relationship between errors and iBESS volume, in the SL firm(r=0.44), TS firm(r=0.63), TS foam(r=0.61) and total stance(r=0.41) conditions. **Conclusions:** Acceptable to excellent test-retest reliability was established for the C3 Logix BESS test. Compared to traditional BESS errors, iBESS volume allowed for increased within-session and 1-week test-retest reliability, a reduction of practice effects after 2 trials compared to 3, and a more sensitive measure of balance for DL stance conditions. The C3 Logix BESS test may provide clinicians with a more reliable and sensitive assessment of balance compared to the traditional BESS test. **Word Count: 450**