Abstract

Introduction: Sport-related concussion research has gained traction, as college and university athletes make up 1/3 of reported concussions. Nearly 50% of reported concussions are diagnosed in American football players. Current diagnostic and monitoring tools in place include undergoing expensive brain scans, or completing the Sport Concussion Assessment Tool-5 (SCAT5). The SCAT5 tool is universally utilised for recognizing and monitoring the symptomatology of concussions, but currently lacks a sensitive, objective measure of balance disturbances.

Purpose: The aim of this study was to investigate in-shoe plantar pressure systems as a reliable, feasible, and objective measure of balance disturbance. Additionally the study sought to determine relationships between in-shoe plantar pressure systems measurements and SCAT5 symptom evaluations.

Methods: Healthy, non-concussed participants (N = 17) from the University of Stirling American football team (23 ± 6 years old) were recruited to the lab for two visits, 1 week apart. To test inter-day reliability and repeatability of in-shoe plantar pressure systems' measurements, each participant completed SCAT5 and a balance test on both visits, using the Pedar-X® system. The balance test consisted of 4 stances: stances 1 and 3 were bilateral, and stances 2 and 4 were unilateral. In addition, stances 1 and 2 were completed with eyes open, whereas stances 3 and 4 were completed with eyes closed.

Results: Symptom count (visit 1: 3±4; visit 2: 4±5) and severity (visit 1: 5±7; visit 2: 6±7) reported from SCAT5. Balance measurements, in millimeters, from visit 1 (stance 1: 3.6±4.0; stance 2: 7.1±5.0; stance 3: 4.0±4.9; stance 4: 16.1±10.8) and visit 2 (stance 1: 4.7±6.1; stance 2: 7.6±7.6; stance 3: 5.7±7.7; stance 4: 14.8±10.0) recorded by Pedar-X®. Pedar-X® had moderately acceptable CVs (18-24%) for stances 1, 2 and 4, and had excellent inter-day repeatability for stances 2 and 4 (ICC: 0.854, 0.857; *p<0.05*). There was no significant difference between visit 1 and visit 2 Pedar-X® balance measurements (t-test: *p>0.05*). Pedar-X® had a strong correlation (PCC - r-value: 0.605-0.787, *p<0.05* and Linear Regression - r-value: 0.27-0.40, *p<0.05)* with SCAT5 evaluated symptomatology.

Conclusion: This study has shown that Pedar-X® has moderate inter-day, intra-participant reliability, and excellent inter-day repeatability. Specifically stance 4 measurements have a strong correlation with SCAT5 symptom evaluations and have a positive linear correlation, indicating the ability to detect naturally occurring balance variance among participants.