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Instrumented Balance Assessment: Normative Values and Descriptive Data for Acute, Sub-Acute, and Chronic Mild Traumatic Brain Injury Populations

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Keywords

mild Traumatic Brain Injury (mTBI), modified Balance Error Scoring System (mBESS)

Abstract

Balance deficits are common following mild Traumatic Brain Injury (mTBI) and can persist well beyond the standard recovery period. Recent advances in wearable technologies, such as inertial measurement units (IMUs), have increased utilization of instrumented balance assessments, increasing the sensitivity of common clinical balance tests. However, there are limited studies providing normative ranges for instrumented balance assessment to help characterize abnormalities in people with mTBI. The aim of this study was to provide normative ranges for healthy controls and populations of acute, sub-acute, and chronic mTBI. Instrumented data were derived from four studies where participants completed the modified Balance Error Scoring System (mBESS). Testing took place at either an athletic facility or in a laboratory at OHSU/VA. Data from 142 healthy participants and 169 people with mTBI were collected. The mBESS test consists of three standing conditions (e.g. two-feet, one-foot, tandem stance) completed with eyes closed. The primary outcome measurement was the medial/lateral Root Mean Square of sway (ML_RMS_Sway). ML_RMS_Sway was averaged across conditions. For healthy controls, the 25th percentile for average ML_RMS_Sway was 0.12m/s², 50th percentile 0.18m/s², and 75th percentile 0.25m/s². For people with mTBI, calculated percentiles were stratified by time since injury (acute <4 days), sub-acute (4 days-3 months), and chronic (>3months). For acute mTBI, the average ML_RMS_Sway was 0.13m/s² for the 25th percentile, 0.18m/s² for the 50th percentile, and 0.24m/s² for the 75th percentile. For the sub-acute group, the 25th percentile was 0.18m/s², the 50th percentile 0.27m/s², and the 75th percentile 0.41m/s². Finally, for the chronic group, the 25th percentile was 0.24m/s², the 50th percentile 0.35m/s², and the 75th percentile 0.46m/s². The control percentiles provide normative ranges for ML_RMS_Sway to assist clinicians in taking appropriate rehabilitation measures. Further analyses should be completed to determine any clinically or statistically meaningful differences between the mTBI and control ranges.