

Effect of Concussion History on Instrumented and Clinical Balance Performance

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Context: Studies of college-aged athletes suggest balance deficits may persist beyond apparent concussion resolution. However, the effect of concussion history on balance performance in high school athletes is unclear. The objective of this study was to determine if a history of concussion(s) affects performance on baseline balance exams. The researchers hypothesized athletes with a history of concussion(s) (CONC) would have significantly worse balance in single leg and tandem stances versus athletes without a history of concussion (NON-CONC). **Methods:** This retrospective study used de-identified data from 589 high school athletes (299 males, 290 females) who took baseline

BESS tests in mass baseline settings at several high schools. IRB approval was granted to use the clinically-collected de-identified data. Baseline BESS testing was conducted using the C3 Logix iPad application strapped to the participant's back. Errors in each stance were counted and recorded by the test administrator. Postural sway was recorded automatically by the application. De-identified data were exported and analyzed. The data were separated into two groups consisting of 469 NON-CONC athletes (age 15.13±2.52 years, 232 males, 237 females) and 120 CONC athletes (age 15.67±1.13 years, 67 males, 53 females). Outcome measures included BESS error scores and iBESS volumes (mathematical representation of three-dimensional sway) for each stance. Multiple t-tests were used to compare results between groups. A priori p-value was set at p<0.05. A Bonferroni correction to 0.003 was calculated to account for multiple analyses. **Results:** Descriptive data is presented in the table. Total BESS errors were significantly higher in the NON-CONC

group versus CONC. Single-leg stance on a firm surface error count was significantly higher in the NON-CONC group versus CONC. BESS errors in other stances were not significantly different. Double-leg stance on foam had significantly higher iBESS volume in the NON-CONC group versus CONC. All other iBESS findings were not statistically significant. **Conclusions:** The CONC group had statistically significant better balance in certain stances compared to the NON-CONC group. However, clinical significance is questionable due to low-moderate effect sizes and the differences between total BESS errors were within the reliable change index. A possible explanation is the CONC group in our clinical practice typically completes rehabilitation and multiple testing episodes before returning to sport; thus giving them more exposure to the BESS test than athletes without a history of concussions. The possible practice effect observed in the CONC group may obscure the presence of a persistent balance deficit.

Table 1. BESS Results

	BESS Errors			iBESS Volume		
	Concussion History	No Concussion History	p-value (effect size)	Concussion History	No Concussion History	p-value (effect size)
Double leg-firm	0.01±0.091	0.00±0.07	0.266	-4.88±1.15	-4.84±1.04	0.842
Single leg-firm	2.02±1.58	2.80±2.20	0.001* (0.454)	-0.14± 1.75	0.36±1.69	0.926
Tandem-firm	0.59± 0.98	0.67±1.08	0.401	-1.72± 1.59	-1.52± 1.48	0.304
Double leg-foam	0.06± 0.30	0.09±0.38	0.079	-2.08± 0.85	-1.75± 1.09	0.002* (0.343)
Single leg-foam	6.33± 2.18	6.63±2.09	0.615	1.96± 1.50	2.30±1.47	0.642
Tandem-foam	2.58± 2.42	3.11±2.35	0.340	1.09± 1.83	1.43±1.64	0.065
Total Error Scores	11.58± 4.91	13.31± 5.46	0.002* (0.333)	----	----	----

*Indicates a statistically significant difference