Change in Baseline BESS Performance Among High School Athletes Following Sport Related Concussion

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Context: Balance may be impaired following sport related concussion. Therefore, it is recommended that baseline measures of balance performance are obtained to help clinicians determine concussion associated balance recovery post injury. While annual baseline assessments are recommended, resources are often limited in the high school setting, and it is not uncommon for baseline tests to be administered biannually. It is important for clinicians to understand how balance performance might change over those two years, especially with an intervening concussion, before relying on these baselines to inform clinical decisions. Therefore, our objective was to compare the change in baseline balance performance in high school athletes over a two year timeframe with and without an intervening concussion. **Methods:** This retrospective study used clinically collected de identified data from 420 high school athletes (236 males, 184 females, ages 15.4 ± 2.6) who participated in mass baseline testing settings at several high schools 630.6 ± 152.1 days apart. The study was deemed exempt the Institutional Review Board. Balance Error Scoring System (BESS) testing was performed using the C3Logix iPad application strapped to each participant's back. Test administrators manually counted and recorded errors in each stance while sway volume was recorded automatically by the application. Data were coded, de identified and exported from C3Logix and from separate electronic medical records (EMR) to confirm athlete match. The data were separated into two groups consisting of 390 non concussed athletes (age=15.4 ± 2.4 years), and 30 concussed athletes (age=15.2 ± 2.8 years). Group classification was determined through the documentation of concussion in the school's EMR. BESS error scores and iBESS volumes (mathematical representation of three dimensional sway) were utilized as outcome measures for each stance. Generalized estimating equations (GEE) were calculated using SPSS to determine if there was a difference between groups for each stance from baseline 1 to baseline 2. Significance level was set a priori at $p<0.05$. Power was determined through calculation of effect sizes. **Results:** In the concussed group, there were 283.3 ± 184.6 days from baseline one to injury and 364.2 ± 195.4 days from injury to re baseline. There were 630.6 ± 152.1 days between baseline assessments in the control group. The GEE results for total error count, error count and iBESS volume per stance were not significantly different between groups (Table). Small effect sizes indicate that any differences are likely of questionable clinical significance. Negative effect sizes present for both individual stance and iBESS volume indicate that the concussed group outperformed the control group in this study. **Conclusions:** Our primary finding demonstrated little change between BESS error scores and ellipse volume from baseline 1 to baseline 2 regardless of an intervening concussion. Clinically, the overall stability between baseline assessments found in this study suggest that balance may not need to be assessed biannually.

Table: Selected Results for Conditions and Variables					
	Non-Concussed		**Concussed**			
	Baseline 1 (SD)	**Baseline 2 (SD)**	**Baseline 1 (SD)**	**Baseline 2 (SD)**	**Significance**	**Effect Size (Cohen's d)**
Total Error Count	13.157 (0.272)	14.074 (0.301)	14.002 (1.179)	15.165 (0.858)	0.889	2.966
Double Leg Firm Error Count	0.019 (0.009)	0.024 (0.008)	0.004 (0.002)	0.001 (0.002)	0.474	2.829
Single-Leg Firm Error Count	2.592 (0.103)	2.966 (0.121)	3.019 (0.395)	3.268 (0.418)	0.770	1.879
Tandem Stance Firm Error Count	0.766 (0.063)	0.883 (0.634)	0.565 (0.189)	0.838 (0.226)	0.544	0.526
Double Leg Foam Error Count	0.125 (0.021)	0.170 (0.036)	0.250 (0.105)	0.236 (0.091)	0.656	1.563
Single Leg Foam Error Count	6.589 (0.105)	6.759 (0.111)	6.904 (0.389)	7.057 (0.302)	0.951	2.231
Tandem Stance Foam Error Count	3.060 (0.120)	3.255 (0.116)	3.259 (0.520)	3.785 (0.389)	0.617	3.487
Double Leg Firm Ellipse Volume	4.963 (0.055)	4.712 (0.059)	5.099 (0.151)	4.693 (0.162)	0.437	0.28
Single Leg Firm Ellipse Volume	0.225 (0.083)	0.201 (0.085)	0.198 (0.287)	0.620 (0.142)	0.263	4.671
Tandem Stance Firm Ellipse Volume	1.615 (0.082)	1.477 (0.088)	1.779 (0.263)	1.435 (0.309)	0.618	0.359
Double Leg Foam Ellipse Volume	1.963 (0.058)	2.004 (0.055)	1.777 (0.227)	1.643 (0.219)	0.535	4.619
Single Leg Foam Ellipse Volume	2.236 (0.079)	1.833 (0.071)	2.356 (0.275)	1.806 (0.247)	0.630	0.286
Tandem Stance Foam Ellipse Volume	1.320 (0.089)	1.489 (0.086)	1.459 (0.291)	1.634 (0.295)	0.988	1.884