sensormotor communication is dependent on the structural integrity of the underlying white matter (WM) tracts in the brain. However, there is little investigation that has examined associations of WM integrity of the brain with postural control variability and HRQOL. Determining these associations may help to establish neurophysiological mechanisms that cause altered postural control variability and decreased HRQOL.

**PURPOSE:** Determine if white matter integrity of the brain is associated with static postural control variability and HRQOL.

**METHODS:** Ten participants (5M, 8F; 23.8±4.5yrs; 164.6±7.1cm; 63.3±12.24kg) performed 3, 20-second trials of single-leg static balance on a force platform under an eye-open condition. Sample Entropy (SampEn) analysis was used to assess postural control variability. To assess corticospinal and cerebellar WM integrity, fractional anisotropy (FA) was quantified using diffusion tensor imaging collected on a 3-Tesla Siemens TIM scanner with a 32-channel head coil. HRQOL was assessed using physical and mental components summary (MCS) of the short-form SF-36 (SF-36). Pearson Product Moment Correlations were used to examine associations of corticospinal and cerebellar FA values with measures of postural control variability and HRQOL. Significance was set at a priori p<0.05.

**RESULTS:** Cerebellar FA was moderately correlated with SampEn in the medial-lateral direction (r=0.57, p=0.04). Corticospinal FA was moderately correlated with SampEn in the anterior-posterior direction (r=-0.72, p<0.01) and MCS of the SF-36 (r=0.68, p=0.02).

**CONCLUSION:** These findings indicate the potential for associations of WM integrity of the brain with postural control variability and HRQOL. Further study with a large sample size is needed to examine these associations in specific pathological condition in order to develop effective intervention strategies for individuals with clinical dysfunctions and disability.

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**2905 June 3 1:30 PM - 1:45 PM**

**Transcranial Direct Current Stimulation (tDCS) To Broca’s Area: Persisting Effects On Non-Verbal Motor Behaviors**

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**BACKGROUND:** Low-cost, portable, and user-friendly, transcranial direct current stimulation (tDCS) has been investigated as a novel therapy for treating various neurological impairments, including motor, cognitive, and speech deficits. tDCS passes a constant, weak electrical current between two electrode sponges—the anode and cathode—placed on the subject’s head; anodal tDCS modulates neuronal membrane potentials to facilitate neuronal activity. While a substantial body of literature has found that anodal tDCS to the primary motor cortex (M1) may elicit improvements in motor behaviors, few studies have examined whether stimulation to other cortical areas associated with motor output is able to produce similar or long-lasting effects. Although Broca’s area is associated with speech production and grammar acquisition due to cortico-striatal connections, it may also significantly contribute to motor planning/output even in non-speech tasks—especially in more complex tasks that require sequence-learning (Ullman, 2006).

**PURPOSE:** This study involved anodal tDCS stimulation of Broca’s area to observe the effects on non-verbal motor output.

**METHODS:** Twenty neurotypical young adults completed an experimental vs. sham testing session separated by 1 week. During each session, participants received one of two stimulation conditions: (1) 30 minutes of 1.0 mA of anodal tDCS to Broca’s area (FC5; cathode on right supraorbital) or (2) sham stimulation. During stimulation (or sham), participants completed two motor tasks: (1) a limits of stability dynamic balance task (Biodex Balance System) and (2) a simple choice reaction time task (MOART Reaction Time and Movement Time Panel).

**RESULTS:** Initial results indicate that subjects who received stimulation of Broca’s area first performed significantly better on simple reaction time, (p<0.05), dynamic balance time (p<0.05), and dynamic balance accuracy (p<0.001) when tested one week later compared to participants who received sham stimulation first.

**CONCLUSIONS:** These findings indicate that Broca’s area is also involved in non-verbal motor behavior. This persisting cortical motor response to stimulation has obvious implications for time consuming novel combined speech and movement therapy interventions.

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**2906 June 3 1:45 PM - 2:00 PM**

**Lower Extremity Injury Risk in Youth Female Basketball Athletes with and without a History of Concussion**

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Recent literature has identified a link between history of concussion and risk of sustaining a lower extremity injury in professional and collegiate male athletes. The Landing Error Scoring System (LESS) is a valid and reliable clinical movement assessment that is predictive of injury risk in youth athletes. Compared to males, youth female basketball players are at an increased risk of sustaining a lower extremity injury. It is unknown if female basketball athletes with a history of concussion are at increased risk for lower extremity injury.

**PURPOSE:** To examine the relationship between concussion history and lower extremity injury risk in competitive youth female basketball players.

**METHODS:** Sixty-seven youth female basketball athletes volunteered to participate. Athletes were tested at the beginning (PRE) of the season using the LESS. Each athlete completed a pre-season injury history baseline questionnaire. A single rater blinded to concussion history graded the jump-landing task using the LESS at a later date. Nine youth female basketball players reported a previous history of a concussion (age: 13.2±2yrs, height: 163.8±4.0cm, mass: 53.9±8.2kg). An independent t-test was performed between LESS total score for athletes with and without a history of concussion (p=0.05). Chi squared analyses were performed between concussion history and individual errors of the LESS (p=0.05) and odds ratios were calculated.

**RESULTS:** There was no statistical significance between the LESS (p=0.05) (with concussion 6.2±2.5errors; without concussion history 6.7±3.2errors). There is a moderate association between concussion history and medial knee displacement at initial contact (Pearson chi-square: 1.15, odds ratio: 2.95, 95%CI=[0.684, 13.13]).

**CONCLUSIONS:** While previous literature suggests overall injury rates are higher following a concussion, lower extremity injury risk, as measured by the LESS, was not related to past history of concussion in this population. However, athletes who reported a history of concussion displayed medial knee displacement at initial contact at a greater rate compared to athletes without a history of concussion. Therefore, future research should investigate specific movement patterns associated with concussion history.

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**2907 June 3 2:00 PM - 2:15 PM**

**Adolescents With Convergence Insufficiency Exhibit Gait Stability Deficits Acutely After Concussion**

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Gait assessments assist in monitoring motor function and dynamic balance control recovery after concussion. Additionally, initial ocular deficits post-concussion are risk factors for developing persistent symptoms. Limited data exist, however, examining the association between gait and visual deficits post-concussion.
PURPOSE: We examined the post-concussion gait characteristics of adolescents who initially presented to a sport-concussion clinic with and without convergence insufficiency (CI) compared with a group of uninjured, healthy control participants.

METHODS: Patients were examined within 3 weeks of concussion (mean 9.1 ± 5.7 days post-injury). They completed a post-concussion symptom scale (PCSS) and underwent assessments of near point convergence (NPC) and gait measures. NPC was assessed by measuring the distance from the tip of the nose to the point where the patient reporting diplopia was moving a fixation target slowly toward their nose. CI was defined as a NPC distance > 5cm. Gait measures (gait speed, cadence, stride length, and double support time) were obtained using 3 inertial sensors while patients walked at a self-selected speed. Univariate ANOVAs were used to compare gait performance among those with CI, without CI, and uninjured controls.

RESULTS: Eleven patients presented with CI (mean age = 16.2 ± 2.8 years), 7 presented without CI (mean age = 14.2 ± 2.2 years). There were 37 healthy controls (mean age = 15.4 ± 5.7 years). Mean PCSS scores not significantly different between concussion patients with CI and those without (25.6 vs. 24.0). Those with CI had slower mean gait speed (1.04±0.11 m/s vs. 1.22±0.16 m/s; p=0.002) and slower mean cadence when covarying for gender differences [F(1,29)=5.716, p<.05, ƞ²=0.263].

CONCLUSION: Adolescents with CI post-concussion exhibited significant gait-related deficits compared with healthy controls, while those without CI did not display such deficits. Gait/vergence deficits present after concussion may be related to motor system dysfunction. Gait and vergence measures may each contribute useful information to multifaceted post-concussion evaluations.

2908 June 3 2:15 PM - 2:30 PM
Landing Kinetics Differences In Individuals With And Without A History Of Concussion
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PURPOSE: The current study aimed to evaluate differences in ground reaction forces between individuals with and without a history of concussion during a jump-cut maneuver. It was hypothesized that individuals with a history of concussion would show a greater variation in force as a function of time from the previous concussion.

METHODS: A total of 16 (8 males, 8 females) subjects were recruited. 8 had a self-reported previous history of concussions (5 males, 3 females), and 8 (3 males, 5 females) did not. Participants jumped with both feet a distance of 120% of their leg length, made contact with a force plate with their right foot and then leapt to the left or right landing on their left foot. Participants were informed which direction to jump prior to each trial. Five trials of each condition were performed and a mean was computed for ground reaction forces in the X,Y and Z direction.

RESULTS: Exploratory factor analysis indicated that all force plate variables loaded on a single component with the exception of the mean force in the Z direction resulting from the left jump condition. Analysis of variance demonstrated a significant difference between control (M=366.9±65.6; Newtons) and concussed (M=25.6±24.0) individuals when the mean Z-force was calculated over the five trials [F(1,22)=7.462, p<.05, ƞ²=0.348]. Given that gender was unequally represented in each group, a follow up ANCOVA was performed and demonstrated that the gender differences [F(1,20)=9.212, p<.01, ƞ²=0.348] were present in all trials. A total of 90 concussive impacts were recorded during the five trials (20% 2909 June 3 2:30 PM - 2:45 PM
Gait And Cognitive Assessments Of Concussed Athletes During Dual-task Walking
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Dual-task (DT) scenarios, which increase cognitive load, may be a method of assessing gait abnormalities in concussed athletes during walking. This may be a means of objectively differentiating between healthy and concussed athletes during the acute phase of recovery.

PURPOSE: The purpose of this study was to examine the effect of DT scenarios on gait in concussed athletes (CA) within 48 hours of the concussive injury as compared to a group of healthy athletes.

METHODS: Gait parameters of 24 collegiate athletes (14 male, 10 female, age: 19.7±4.1 years) with concussions were assessed within 48 hours of the injury and a gender-matched control group that consisted of 24 (14 male, 10 female, age: 18.6±1.3 years) collegiate athletes using the GAITRite electronic walkway. All participants completed five DT gait trials which included mental math, attention, and spelling tasks. Gait velocity, cadence, average stride length, and right and left heel-to-heel base of support (HH BOS) values were measured, normalized to height, averaged, and further analyzed. The total answers for the separate DT scenarios and number correct were also assessed.

RESULTS: The normalized variables of gait velocity, average stride length, and both right and left HH BOS were not significantly different between groups. Normalized cadence was significantly greater in the CA group, at 105 steps/min, compared to the healthy athletes at 97 steps/min (p=.006). With regards to the cognitive tests, CA group provided significantly fewer total responses in months of the year (MOY) [t(23)=2.143] (p=0.05) and weeks of the week (DOW) [t(23)]=5.19, (p<.019) tasks, compared to healthy (MOY: 6.5±4.2 answers; and DOW: 8.4±3.4 answers). CA also had fewer correct responses (3.±2.0 answers) in the MOY task (p=0.005) compared to healthy athletes (6.1±4.2 answers).

CONCLUSIONS: The increased cadence exhibited by CA may be a function of decreased attention to the accuracy of the DT presented and more focus on the motor (gait) task. This is supported by the fact that the CA had fewer total responses in two DT scenarios (MOY and DOW), and in MOY had fewer total correct responses. These data suggest concussed athletes may have reduced capacity to perform a cognitive and motor task simultaneously.

2910 June 3 2:45 PM - 3:00 PM
The Effect Of Restricting Full Contact Football Practice On Repeated Head Impact Exposure
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(No relationships reported)

PURPOSE: Fears over the long term effects of repeated head impacts have resulted in sporting organizations to place restrictions on full contact football practice at the professional, collegiate and high school levels. Prior to the 2014 season, the Michigan State High School Athletic Association limited full contact practice to no more than 2 hours per week. This investigation sought to evaluate head impact exposure during interscholastic football prior to and following the rule change.

METHODS: As part of a larger investigation on head impact exposure and cognitive function, 41 athletes participated in the 2013 (n=26) and 2014 (n=24) seasons. Nine athletes participated in both years. Following informed consent/app, each athlete’s helmet was fitted with a Head Impact Telemetry (HIT) System encoder to monitor head impact frequency during all games and practices. Impact exposure was evaluated by player position for each year of the study.

RESULTS: In 2013, 15,398 impacts were recorded and 8,269 in 2014. In 2013, the average football athlete sustained 592+391 head impacts, compared to 345±236 in 2014. Overall, there was a 41.8% decline in head impacts between the two seasons. Quarterbacks had the largest decline (48.1%); followed by the Linemen (-37.3%); Receivers, Corners, and Safeties (-22.8%); and Tight Ends, Running Backs, and Linebackers (-18.5%).

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