Using ClearEdge™ to Assess The Effects of Subconcussive Events on Neurocognition and Balance


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Hypothesis
Mild traumatic brain injury (mTBI) or concussions are an increasingly high-profile public health issue1. Men’s lacrosse is a collision sport that has been historically underrepresented in concussion research even though it has almost as great of a concussion risk as football2. Concussions tend to be difficult to diagnose and manage due to high heterogeneity in presentation1 and lack of a universal diagnostic tool3.

Our study examined the effects of repetitive subconcussive impacts on the neurocognitive function of men’s collegiate lacrosse players. We hypothesized that athletes who received more impacts throughout the season would have decreased neurocognitive function at postseason compared to preseason, as shown by ClearEdge™.

Methods
- 17 NCAA Division II collegiate men’s lacrosse players were enrolled prior to their 2019 season.
- Athletes wore Athlete IntelligenceCue™ Sport accelerometers in helmets to measure impacts.
- ClearEdge™ testing assessed athletes’ concussion symptoms, cognitive ability and balance at preseason (baseline), midseason, and postseason.
- Neurocognitive function was tested using ClearEdgeDANA™: simple reaction time (SRT), procedural reaction time (PRT), Go-No-Go (GNS) and simple reaction time part two (SR2).
- Balance and stability were tested using ClearEdgeMotion™ using the Edge™ Sensor, which measures subtle changes in balance.
- Performance in concussion research was automatically recorded in the ClearEdge portal for later analysis.

Data Analysis
Change over the pre-, mid-, and postseasons in each of ClearEdge test outcomes was compared using the repeated measures analysis of variance followed by the pairwise comparisons with the preseason as a reference. For all the statistical tests, significance was evaluated with α = 0.05.

Results
- Decrease in neurocognitive function, balance and stability over the course of the season.
- Procedural Reaction Time (PRT) decreased significantly from preseason to postseason (p-value = 0.006).
- EOSM (Simple Balance) decreased significantly across our three testing periods (p-value = 0.039).
- Composite aggregate stability measurement (ASM), a metric comparing performance on varying balance challenges.
- ASM scores decreased significantly from preseason to postseason (p-value = 0.005).

Conclusions
- ClearEdge™ performance scores show a statistically significant decline in neurocognitive function and balance across the course of the season.
- Significant declines were noted in PRT, ASM, and EOSM across our three testing periods.
- Limitations in the study prevent correlation of cognitive decline to the number of impacts sustained by each athlete possibly due to athlete compliance issues.
- Athletes wore two different model helmets and experienced difficulty transferring and charging Cue™ Sport accelerometers.

Further investigation and experimental design is required to better understand these findings and further assess the number of subconcussive impacts and a decline in balance and neurocognitive function.

Significance
- Sports-related mTBI can be detrimental for collegiate athletes who are still developing regions of their brains.
- By having a better understanding of injury patterns and symptomatology caused by head trauma in men’s collegiate athletics, physicians and medical personnel can detect head injuries earlier and more accurately.
- The sequelae of mTBI extend beyond performance on the field; function in school, work, social and emotional relationships can also be compromised.

Helping physicians understand and identify the complexity of concussion symptoms and their toll on an athlete’s physical, social and emotional well-being will allow them to take a more holistic approach during treatments and guide osteopathic treatment models.

Acknowledgements
A special thank you to my physician mentors, Hallie Zwiibel D.O. and Matthew Heller D.O. for the opportunity to work on this project. I would also like to acknowledge Min Kyung-Jung Ph.D. for performing the statistical analysis and Simon Katz for assisting in data collection. Funding from this study came from an NYIT In-House Grant.

References
There are a series of 8 balance tests included in ClearEdge Motion. The proctor/HCP is required to read quoted instruction word for word to the patient and to monitor the patient’s stance throughout the assessment. If the patient is unstable a test may be skipped by selecting “Skip Test”.

Proctor/HCP should be spotting the patient during the more difficult tests.
Figure 1:
Procedural Reaction Time performance scores of one collegiate athlete across the course of the 2019 Men’s Lacrosse Season.
Figure 3: ClearEdge™ DANA summary from one collegiate athlete highlighting the significant change in Procedural Reaction Time over the course of the 2019 Men’s
ClearEdge™ Performance Score Averages from Pre- to Post-Season

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<th>Preseason</th>
<th>Midseason</th>
<th>Postseason</th>
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Figure 2: Graph highlighting ClearEdge™ performance score averages that showed a significant decline from pre- to post-season