Changes in Youth Football Athletes' Oculomotor Task Metrics Across Three High School Seasons of Play

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Introduction

Mild traumatic brain injury (mTBI), the disruption of brain function resulting from an impact, is a common, costly, and under-reported condition (1-3). 30% of those under 25 experience TBI and a common mechanism of injury is contact sports (4). Objectively diagnosing/supporting this population through return-to-play protocols is a critical component in mitigating future injuries and supporting recovery. Current methods are largely subjective and present opportunities to exacerbate injuries through misdiagnoses or premature return-to-play. Developing objective assessment modalities would improve diagnostics and aid understanding of underlying mechanisms of injury. To address this void in objective assessment modalities, eye-tracking is investigated as a quantitative mTBI assessment method to measure oculomotor function (5). Oculomotor task metrics, including latency and gain from pro- and antisaccade tasks, may facilitate objective observations of potential relationships between head impact exposure and mTBI.

Methodology

High school football athletes participated in an on-going prospective study examining relationships between exposure and oculomotor response. This analysis investigates a sub-cohort (n=3) that examined changes in oculomotor function spanning from initial baseline assessments prior to their freshman season and final assessments before their senior season. An industry standard eye-tracking platform (EyeLink 1000; SR Research) assessed oculomotor function. Eye-movements were measured as participants completed a pro- and antisaccade task. Data were collected at 1000 samples/sec, participants' heads were stabilized, and a 9-point calibration procedure was administered. The prosaccade task entails focusing on a stimuli/target, then moving to a new stimuli location upon prior stimuli disappearance (single block of 28 trials). The antisaccade task entails fixating on a central target and looking to a mirrored position of the new target position while resisting prosaccade movements upon target re-appearance (single block of 25 trials). All data prior to the first year was combined and compared to data acquired prior to the fourth year. Oculomotor task metrics included comparing latency: time elapsed after stimulus presentation and when saccade initiation occurs, initial gain: angular displacement traveled in the initial saccade, and end gain: total angular displacement upon position stabilization at event end (Figure 1). Differences in task metrics across seasons are compared with paired t-tests and significance level of 0.05.

Summary of Results and Current Conclusions

No statistically significant differences were found across three seasons of play for the prosaccade metrics. Statistically significant differences were observed in initial ($Avg_{initial} =$ 95.62%, Avg_{final} =79.02%, $StDev_{initial}$ =86.30, $StDev_{final}$ =47.66,p<0.05) and end gain ($Avg_{initial}$ =102.05%,Avg_{final}=81.91%,$StDev_{initial}$=47.03,$StDev_{final}$=33.03p<0.05) for antisaccade tasks, but not for latency ($Avg_{initial} =$ 304.8msec, Avg_{final} =283.0msec,

$StDev_{initial}$=145.3,$StDev_{final}$=177.8,p=0.236). Differences in antisaccade gain exhibited hypometric responses previously observed in healthy populations and more prominently within clinical populations (6-8). Extents to which head impact exposure is associated with these hypometric findings requires additional stratification of each athletes' exposure and would benefit from a comparison with non-contact controls. Additionally, these hypometric findings have been observed in individuals with ADHD which is a potential confounder. Current limitations of this prospective study include the exploratory sample size, pooling participant data in assuming similar participant exposures and lacking control populations. Future works will incorporate weekly exposure survey data and head impact kinematics to stratify participants by individualized exposure.

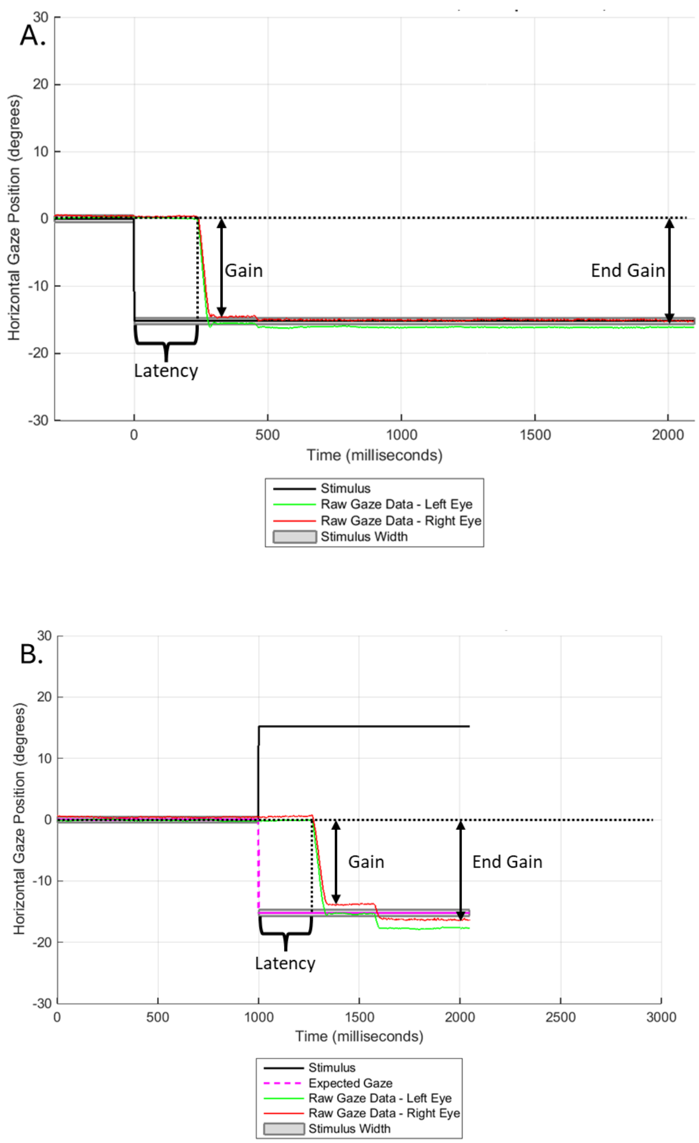

Figure 1. Eye-tracking data from A) Prosaccade and B) Antisaccade tasks.

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