Assessment of Anti-Saccades Within 24 to 48 Hours Post-Concussion

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Assessment of Anti-Saccades Within 24 to 48 Hours Post-Concussion

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Introduction

• ~90% of concussions involve oculomotor dysfunction (Thiagarajan, 2011; Ciuffreda, 2007)
• ~ 30 areas of the brain and 8 of the 12 cranial nerves are responsible for vision

• Saccade deficits (anti-saccades) are the most common type of oculomotor dysfunction (Cifu, 2015)
Saccadic Eye Movements

**Saccades**

- Rapid eye movements that bring a fixed point or area of interest (AOI) into the center of sight (Johnson, 2014)
  - Important for navigating safely through the environment

**Anti-Saccades**

- Reflexive saccade away from the fixed point or area of interest (AOI) (DeHaan, 2007)
  - Inhibitory signal consistently present as a cognitive rule that the participant must apply (Mullen, 2014)
Saccadic eye movements are readily recorded, quantifiable, and neural substrates are understood (Phillipou, 2013)

Anti-saccades may provide a fast, accurate, and reliable way to screen for concussion (Maruta, 2014)
  - May provide important information regarding the health and integrity of the brain post-concussion
Purpose

• To investigate anti-saccades (involuntary gaze deviations) between athletes post-concussion (PC) and matched controls (MC) during a dynamic, environmentally relevant task

1) Anti-saccades
2) Duration of anti-saccades
3) Average duration of anti-saccades
METHODOLOGY
Subjects

• 10 collegiate Division I athletes with a diagnosed concussion (PC)
  • PC tested within 24 to 48 hours of diagnosis
  • PC matched with healthy controls (MC)
  • MC matched based on position, gender, height, and weight
Participation Criteria

**Inclusion Criteria**
- Ages 18-30
- NCAA Division I athletes and cheerleaders
- No musculoskeletal injury
- No history of psychiatric illness or seizures
- Documented concussion (PC)

**Exclusion Criteria**
- Documented head injury within past 12 months
- LOC within past 6 months
- Diagnosis of learning disorders or ADHD
- Involved in NCAA sporting season (PC)
Design

- Exploratory research
- Prospective cohort
- Testing at one time point
  - 24 to 48 hours post-concussion
  - WiiFit Soccer Heading game using ASL Eye Tracker
- 3 trials (1 practice and 2 collection)
  - Each trial lasts about 60 seconds
Procedures

• WiiFit Soccer Heading game
  • Dynamic, environmentally relevant task
  • Athletes sway their body in a ML direction to head soccer ball coming down center, left, and right of the screen
    *NOT ACTUALLY HEADING SOCCER BALLS*
  • Athletes instructed to look at the center of the screen where the soccer balls are being kicked from (AOI)
  • Each gaze deviation away from where the balls are being kicked (AOI) is considered an anti-saccade
• Applied Science Laboratories (ASL) Eye Tracker
  • Applied Science Laboratory Desktop 7 Eye Tracking System (240 Hz)
  • Communicates with Vicon Nexus 1.8.5 8-camera motion capture system (Eye-Head Integration)
    ✷ Creates the 3 AOIs (center, left, and right)
  • Worn by athletes while playing the WiiFit Soccer Heading game to obtain anti-saccade (gaze deviation) data
ASL Eye Tracker
Tilt your body left and right to head the soccer balls flying at you.
Healthy

Please put down the Wii U GamePad.

Concussed

Please put down the Wii U GamePad.
Statistical Analyses

• One-Way ANOVA
  • Creates the 3 AOIs (center, left, and right)
  • PC vs MC

• N = 10 per group (PC and MC)
  • G*Power: 8-10
  • PC: 24 to 48 hours post-concussion
## One-Way ANOVA

<table>
<thead>
<tr>
<th></th>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>P-Value</th>
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</thead>
<tbody>
<tr>
<td><strong>Anti-Saccades</strong></td>
<td>PC</td>
<td>10</td>
<td>11.85</td>
<td>&lt;.001</td>
</tr>
<tr>
<td></td>
<td>MC</td>
<td>10</td>
<td>2.00</td>
<td></td>
</tr>
<tr>
<td><strong>Anti-Saccade Duration</strong></td>
<td>PC</td>
<td>10</td>
<td>8.90</td>
<td>.003</td>
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<tr>
<td></td>
<td>MC</td>
<td>10</td>
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<tr>
<td><strong>Average Anti-Saccade Duration</strong></td>
<td>PC</td>
<td>10</td>
<td>0.83</td>
<td>.002</td>
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<tr>
<td></td>
<td>MC</td>
<td>10</td>
<td>0.12</td>
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</table>
Anti-Saccades

Number of Anti-Saccades (#)

Healthy

Concussion

P < .001
Anti-Saccade Duration

Total Duration of Anti-Saccades (s)

Healthy

Concussion

P = .003
Average Anti-Saccade Duration

<table>
<thead>
<tr>
<th></th>
<th>Avg. Duration of Anti-Saccades (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Healthy</td>
<td>0.1</td>
</tr>
<tr>
<td>Concussion</td>
<td>0.8</td>
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</tbody>
</table>

P = .002
Conclusion

- Anti-Saccades are more prevalent in PC than MC
  - Anti-Saccades (p=.022)
  - Duration of Anti-Saccades (p=.020)
  - Average Duration of Anti-Saccades (p=.000)
- PC are unable to appropriately control their gaze during an environmentally relevant dynamic task
  - Potential oculomotor impairment 24-48 hours post injury and could be a candidate marker for concussion
References


5) Ciuffreda KJ, Ludham D, Thiagarajan P. Oculomotor diagnostic protocol of mTBI population. Am Optom Ass. 2011; 1-3


QUESTIONS?