Assessing the Relationship between Symptom Severity and Gait Performance in Chronic mTBI Before and After Rehabilitation

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Introduction

• Up to 53% report symptoms >1 year (Nelson et al., 2019; Fino et al., 2016)

• Subtle gait deficits observed up to 1 month post-mTBI

• Reports on gait characteristics in mTBI are variable (Fino et al., 2018)
Gait is more than just Speed

- Variability 24.1%
  - Double Support Time SD
  - Stride Length SD
  - Foot Strike Angle SD
  - Single Support Time SD
  - Stride Time SD

- Gait Model 80.8%

- Rhythm 19.9%
  - Double Support Time
  - Stride Time
  - Single Support Time

- Pace 19.4%
  - Stride Length
  - Gait Speed
  - Foot Strike Angle

- Turning 17.4%
  - Turn Duration
  - Turn Velocity

(Stuart et al., 2020)
Why Does Dual-Tasking Matter?

• Simulates “real-world” demands for gait

• Overburden compensatory mechanisms

• Different ways to test dual-task in the lab
Aims

• 1) Determine the differences in gait domains between symptomatic, chronic mTBI and healthy control groups

• 2) Examine the relationship between symptoms and gait domains in the mTBI group

Preliminary Results

• Explore the possible effects of rehabilitation on symptoms and gait domains, and their relationship
Methods – Gait Characterization

• Opal inertial sensors (APDM Inc.)
• Self-selected, “normal” pace
• 13 meter walk, 2 minutes
• Under Single- & Dual-Task conditions

Gait
- Cadence
- Stride Velocity
- Stride length
- Arm Swing
- Double Support
- Ranges of Motion
- Asymmetry
- 53 parameters

Turning
- Duration
- Speeds
- Number of steps
- Step time
- 7 parameters

Transitions
- Duration
- Speeds
- Accelerations
- Ranges of Motion
- First step time
- 7 parameters
Methods – Symptom Reporting

• The Sport Concussion Assessment Tool (SCAT) 3
  • 22 symptoms
  • Likert scale 0-6 (higher = worse)
  • Self-rated

Queensland Brain Institute, University of Queensland
Participants

- Inclusion Criteria: self reported balance & complaints of dizziness for >3 months post mTBI

- Exclusion Criteria: a history of injury, surgery or medical condition that would impair cognition or motor ability, beyond a mTBI

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>mTBI</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>58</td>
<td>67</td>
</tr>
<tr>
<td>Gender (F)</td>
<td>36</td>
<td>45</td>
</tr>
<tr>
<td>Age (yrs)</td>
<td>37.3 (12.4)</td>
<td>39.7 (11.6)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>171.2 (9.7)</td>
<td>167.8 (19.7)</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>75.0 (18.9)</td>
<td>83.6 (30.3)</td>
</tr>
<tr>
<td>Time from mTBI (yrs)</td>
<td>NA</td>
<td>1.0 (12.8)</td>
</tr>
<tr>
<td>Total Previous mTBIs</td>
<td>NA</td>
<td>1.0 (10.0)</td>
</tr>
<tr>
<td>SCAT 3 Total*</td>
<td>1.8 (3.9)</td>
<td>38.4 (23.0)</td>
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* Indicates p < 0.05
mTBI Affects Multiple Domains, Especially DT

<table>
<thead>
<tr>
<th></th>
<th>ST</th>
<th>DT</th>
<th>Control</th>
<th>mTBI</th>
<th>Cohen’s d</th>
</tr>
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<tbody>
<tr>
<td>Cognitive Acc (%)</td>
<td>98.8 (4.2)</td>
<td>98.5 (1.7)</td>
<td>97.4 (6.3)</td>
<td>95.3 (8.1)</td>
<td>0.27</td>
</tr>
<tr>
<td>Pace</td>
<td>0.16 (0.49)</td>
<td>0.37 (0.80)</td>
<td>-0.15 (0.94)</td>
<td>-0.35 (0.86)</td>
<td>0.42</td>
</tr>
<tr>
<td>Variability</td>
<td>-0.11 (0.48)</td>
<td>-0.14 (0.71)</td>
<td>0.11 (0.56)</td>
<td>0.17 (0.99)</td>
<td>0.42</td>
</tr>
<tr>
<td>Rhythm</td>
<td>0.07 (0.14)</td>
<td>0.10 (0.27)</td>
<td>-0.08 (1.23)</td>
<td>-0.11 (0.37)</td>
<td>0.17</td>
</tr>
<tr>
<td>Turning*</td>
<td>0.37 (0.85)</td>
<td>0.36 (0.61)</td>
<td>-0.36 (0.88)</td>
<td>-0.34 (1.04)</td>
<td>0.85</td>
</tr>
</tbody>
</table>

ST = Single-Task
DT = Dual-Task
SCAT 3 Total Symptoms Are Related To Gait Domains, Particularly with Dual-task Gait

ST = Single-Task
DT = Dual-Task

* p < 0.01
Can Rehabilitation designed to reduce symptoms improve gait performance?

(Fino, et al., 2017)
Rehabilitation May Affect Domains Differently

Gray lines connect participants across time.

Gait Speed

* Indicates p < 0.05

Turn Velocity
Is Change In Gait Speed Related to Change in Symptoms?

Pearson’s $r = -0.51; p < 0.01$
• Persistent gait deficits exist in chronic mTBI across gait domains, especially under dual-task

• Symptoms related to every gait domain except ST Pace at baseline

• Preliminary results: observed changes in gait and symptoms are related

• A more comprehensive gait assessment may improve rehabilitation outcomes in people with chronic mTBI
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University of Iowa
Li-Shan Chou
Pearson’s Correlations r values for NSI Total score (Left) and NSI Somatic score (Right) with the ST and DT gait domains (within chronic mTBI group only). * indicates $p<0.01$; ** indicates $p<0.003$. 