Walking while Talking: Relationships among Motor-Cognitive Dual-Tasks, Functional Performance and Structural MRI

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Introduction

- Greater than 45% of individuals with multiple sclerosis (MS) report cognitive dysfunction and 85% report gait dysfunction that interferes with daily functioning. (Kelleher et al. 2010; Amato et al. 2010)
- Impairments in mobility and cognition contribute to declines in everyday activities that require simultaneous motor and cognitive functioning (e.g. motor-cognitive dual-tasks (MCDT)). (Fritz et al. 2015a)
- Our lab has previously shown relationships among dynamic posturography and walking measures and among tract-specific measures of the brain corticospinal tract (CST) and walking measures in MS. (Fritz et al. 2015b; Fritz et al. 2015c)

Objective

To explore the relationships among motor function (i.e., posturography, walking), cognitive function, MCDT ability and tract-specific MRI measures.

Methods

<table>
<thead>
<tr>
<th>RRMS</th>
<th>Age (years)</th>
<th>Gender</th>
<th>Symptom Duration (years)</th>
<th>EDSS</th>
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<tbody>
<tr>
<td>N=9</td>
<td>47.9 ± 14.9</td>
<td>7F; 2M</td>
<td>11.1 ± 6.1</td>
<td>2.5 [1-4]</td>
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- **Walking Measures**: Timed Up & Go (TUG), Timed 25 Foot Walk (T25FW), Walk Velocity
- **Static Balance Measures**: Eyes Open, Feet Together (EOFA, EOFT)
- **Dynamic Balance Measures**: Anterior-Sway (AP-Sway); Medial-Lateral Sway (ML-Sway)
- **Cognitive Measures**: Symbol Digit Modality Test (SDMT)
- **Dual-Task Measures**: TUG Cognitive, Walking While Talking Test (WWTT); EOFA-Cognitive; EOFT-Cognitive
- **MRI Measures**: 3T MRI with Diffusion Tensor Imaging for Fractional Anisotropy (FA) and Mean Diffusivity (MD) and Magnetization Transfer Imaging for Magnetization Transfer Ratio (MTR) (Reich et al. 2006 & 2007; Zackowski et al. 2009)

Results

**Better MCDT performance is associated with improved:**

**A. Dynamic Balance**

- **Cortical Spinal Tract MD**
  - \( r = 0.67; p = 0.047 \)

**B. Cognition**

- **Symbol Digit Modality Test**
  - \( r = 0.67; p = 0.049 \)

**C. CST Integrity**

- **Corticospinal Tract MD**
  - \( r = 0.67; p = 0.047 \)

**Motor Relationships to MCDT**:
- Individuals with less AP sway perform poorer on:
  - TUG Cognitive (Figure A)
  - WWTT-Complex (\( r = -0.76; p = 0.02 \))

**Cognitive Relationships to MCDT**:
- Poorer performance on SDMT was associated with:
  - Slower TUG Cognitive (Figure B)
  - Increased TUG DTC (\( r = -0.67; p = 0.07 \))

**MRI Relationships to MCDT**:
- Increased CST MD was associated with poorer TUG Cognitive (\( r = -0.67; p = 0.047 \)) (Figure C) and WWTT Complex (\( r = 0.72; p = 0.0286 \)) performance.
- Poor performance on EOFA-Cognitive was associated with reduced CST MTR

Conclusion

- Assessment of MCDT may be a useful addition to the clinical exam as it provides information on both structural integrity and functional performance.
- This work:
  - Highlights the specificity of AP sway as a marker for walking function
  - Provides new evidence of the relationship of dynamic posturography to MCDT performance and CST integrity.

References

- Fritz et al. Neurorehabilitation and Neural Repair. 2015b.

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