**Introduction**

- Stroke is a leading cause of disability and fourth cause of death for American adults. A stroke can result in balance dysfunction, gait deficits, and loss of postural control in individuals post-stroke.
- Common abnormal muscle activation patterns include hip extension/adduction/knee extension or hip flexion/adduction/knee flexion, making it challenging for individuals post-stroke to complete a step-up task.

**Purpose**

To quantify hip angles and force generation as a measure of muscle activation in controls and individuals post stroke during a step up task.

**Hypothesis**

Individuals post-stroke would generate an increased activation of paretic (P) hip musculature as the trailing limb during the step up task and a decreased activation when acting as the leading limb.

**Methods**

- Individuals post-stroke were recruited from the Clinical Neuroscience Research Registry. They were all community ambulators, able to step up and down a step up to 4" in height, and diagnosed with a unilateral brain lesion (>1 year). Age matched controls were also recruited.
- Demographic information: the Activity Balance Confidence (ABC) Scale, LE Fugl-Meyer, and the Step Test are shown in Table 1 (N=10; 5 controls and 5 individuals post-stroke).
- Experimental Procedure: Subjects were tested without an assistive device but with an Ankle Foot Orthosis (AFO) if applicable and were placed in an overhead safety harness (see Figure 1).

**Results**

**Table 1. Subject Demographics & Outcome Measures**

<table>
<thead>
<tr>
<th></th>
<th>Stroke (Mean ± SD)</th>
<th>Control (Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEX</td>
<td>♂=2; ♀=3</td>
<td>♂=3; ♀=2</td>
</tr>
<tr>
<td>AGE (yrs)</td>
<td>59.0 (7.6)</td>
<td>60.4 (5.0)</td>
</tr>
<tr>
<td>ABC (%)</td>
<td>84.3 (13.9)</td>
<td>98.0 (3.3)</td>
</tr>
<tr>
<td>LE Fugl-Meyer Score</td>
<td>20.4 (5.0)</td>
<td>33.8 (4.0)</td>
</tr>
<tr>
<td>Step Test (# steps/ 15 sec)</td>
<td>NP 11.5 (4.7)</td>
<td>&quot;D 19.0 (3.5)</td>
</tr>
<tr>
<td></td>
<td>P 8.1 (4.1)</td>
<td>ND 17.3 (3.7)</td>
</tr>
</tbody>
</table>

*D/ND= Dominant & Non-Dominant

**Figures 1a & 1b (top right)**: Activation of hip musculature in the leading limb was studied in P and NP limbs of individuals post stroke, as well as D and ND limbs in controls. Similarities in magnitude were observed for both hip angle changes and hip torque generation. However, there seems to be a timing difference as hip musculature activated later in the step up cycle when compared to NP or controls. No differences in hip angle or torque generation were found within controls.

**Figures 3a & 3b (bottom right)**: Activation of hip musculature in the trailing limb was studied in P and NP limbs of individuals post stroke, as well as D and ND limbs in controls. The trailing limb is loaded (weight bearing) in the first 40-50% of the step up cycle. Similarities in magnitude were observed for hip angle changes across all subjects. However, there seems to be a difference in magnitude of force generation at the hip when the trailing limb is loaded in both P and NP limbs compared to both limbs in controls.

**Conclusions**

- Differences in the timing of hip muscle activation suggest an early compensatory mechanism of the NP leading limb during a step cycle in individuals post-stroke. Similarly, it suggests a delay in the P leading limb.
- Hip extension torques seemed increased in P and NP over controls on the trailing limb when it was heavily loaded, which is consistent with the lower limb extension pattern characteristic of individuals post stroke, supporting our hypothesis.
- Limitations: Data presented here is part of a larger study; EMG data, hip kinematics, kinetics, torques generated at the knee and ankle were collected and are currently under review for both leading and side step tasks.

**Clinical Relevance**

Identifying deficits in hip force generation and timing of muscle activation that limit the ability of individuals post-stroke to successfully navigate stairs can help guide innovative physical therapy interventions and more effective cueing approaches.

**References**

