Background

- A Floor Reaction Orthosis (FRO) aims to counteract excessive knee flexion in the stance-phase of gait in Cerebral Palsy (CP)
- Since a conventional FRO is stiff, it obstructs ankle push-off
- A more spring-like FRO could potentially enhance ankle-push off power, as it can store and release energy

Purpose: to evaluate the mechanical properties of a newly developed hinge with adjustable springs within a test FRO

Materials & Methods

- A special test FRO with integrated hinge was constructed
- Five springs of different stiffness* (i.e. 0.02; 0.18; 0.50; 0.48; 1.28 Nm/deg) and Range of Motion* (ROM) (i.e 15; 15; 10; 10; 5 deg) were tested (Fig. 1)

The spring’s mechanical properties were measured with BRUCE (Fig. 2):

- Range of Motion [deg]
- Stiffness [Nm/deg]
- Threshold [Nm]
- Hysteresis [%$E_{STOR}$]

<table>
<thead>
<tr>
<th>Spring</th>
<th>ROM [deg]</th>
<th>Stiffness [Nm/deg]</th>
<th>Threshold [Nm]</th>
<th>Hysteresis [%$E_{STOR}$]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>13.7</td>
<td>0.02</td>
<td>0.9</td>
<td>33.6</td>
</tr>
<tr>
<td>Green</td>
<td>14.0</td>
<td>0.24</td>
<td>2.5</td>
<td>30.8</td>
</tr>
<tr>
<td>White</td>
<td>8.7</td>
<td>0.52</td>
<td>5.5</td>
<td>35.6</td>
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<tr>
<td>Yellow</td>
<td>10.6</td>
<td>0.64</td>
<td>7.6</td>
<td>31.9</td>
</tr>
<tr>
<td>Red</td>
<td>4.2</td>
<td>1.71</td>
<td>17.8</td>
<td>30.6</td>
</tr>
</tbody>
</table>

Discussion & Conclusion

- Results of this study generally correspond to the manufacturer’s technical specifications
- Hysteresis results in a loss of energy that potentially could have enhanced ankle push-off power
- Nevertheless, the energy return of the spring-hinged FRO might be more beneficial than a stiff FRO, in which no energy can be stored
- Reduced stiffness of the spring-hinged FRO might compromise its function to promote knee extension in stance

In future research, we will study the effects of the mechanical properties of a spring-like FRO on gait in children with CP

*Technical specifications as reported by the manufacturer