INTRODUCTION
Individuals with unilateral transfemoral amputation (UTFA) may regain some degree of independent ambulation by wearing a prosthesis. However, previous studies show that they still experience gait asymmetries (Jaegers et al., 1995, Sjodahl et al., 2002). The asymmetry limits walking ability and also leads to secondary physical conditions, such as joint pain and osteoarthritis in both limbs (Gailey et al., 2008). Recent evidence indicates that adaptation of gait symmetry on a split-belt treadmill can be transferred to over-ground walking in people with stroke (Reisman et al., 2009). This suggests that gait training using a split-belt treadmill is a potential training method to assist the recovery of gait symmetry. Thus, the purpose of this study is to identify the effects of a split-belt treadmill gait training (STGT) program on symmetric walking in people with UTFA.

METHOD
Subjects: A 35 year-old woman (height: 160cm, weight: 45kg) with congenital UTFA participated in this study. The subject used a suction socket prosthesis with Total Knee and a Talux foot.

Apparatus: Split-belt treadmill (Bertec, Co., OH) and ProtoKinetics Zeno Walkway (ProtoKinetics, Havertown, PA) were utilized for gait training and testing, respectively.

Procedures: The subject completed a 2-week STGT program (3 sessions/week, 30 minutes/session). Over-ground walking was examined prior to training (baseline), after completing the STGT program (posttest), and 1 month after completing the training program (retention). A 6-minute walk test was also performed to assess changes in exercise tolerance over the three test periods.

Data Analysis: Step length, swing phase, and double limb support phase symmetries were analysed by calculating a symmetry Index (%): [(prosthetic side – sound side) / 0.5(prosthetic side + sound side)] x 100. Note that 0% indicates a perfect symmetry and negative values represent that the subject took a longer step or a prolonged phase time with the sound leg compared to the prosthetic one.

RESULTS
The subject demonstrated improvements in gait symmetries during comfortable walking following the STGT training (Table 1). Step length symmetry changed from 2.7% to -0.5% after training and the change was maintained at 1 month follow-up. Double limb support phase symmetry also improved from 7.2% to 2.6% following training and the improvement was retained at the retention test. Swing phase symmetry changed from 20.3% to 17.3% after training, but the change was not maintained at the retention test.

<table>
<thead>
<tr>
<th>Symmetry Index</th>
<th>Baseline</th>
<th>Posttest</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step Length</td>
<td>2.7±1.5</td>
<td>-0.5±2.5</td>
<td>-1.3±2.0</td>
</tr>
<tr>
<td>Swing Phase</td>
<td>20.3±0.8</td>
<td>17.3±1.4</td>
<td>21.7±1.5</td>
</tr>
<tr>
<td>DLS Phase*</td>
<td>7.2±8.9</td>
<td>2.6±11.0</td>
<td>-0.2±9.2</td>
</tr>
</tbody>
</table>

Table 1. Changes in gait symmetry indices (%) over three tests. *DLS phase: double limb support phase

Exercise tolerance (6-minute walk distance) noticeably increased from 454.4m to 577.7m following training. The distance was fairly preserved at 1 month follow-up (525.4m) (Figure 1).

DISCUSSION
The preliminary results of our study show that a person with UTFA could improve gait symmetry following a short term gait training using a split-belt treadmill. The results are comparable to a previous stroke study (Reisman et al., 2009). Moreover, the improvement in gait symmetry might help increase the level of exercise tolerance during over-ground walking.

CONCLUSION
Adaptation of gait symmetry during STGT can be carried over to over-ground and also increase exercise tolerance in a person with UTFA.

CLINICAL APPLICATIONS
The STGT could be utilized as a potential treatment approach to improve the efficiency of walking in people with UTFA.

REFERENCES
GAIT SYMMETRY IN TRANSFEMORAL AMPUTEES

Seok Hun Kim¹, Kyle B. Reed¹, Jason T. Kahle¹, M. Jason Highsmith¹,²
University of South Florida¹, James A. Haley Veterans’ Hospital²