INTRODUCTION:
The quality of life of patients having undergone a total hip arthroplasty (THA) improves following surgery, especially with regards to pain and limitation of one's role (e.g., work, other regular daily activities) due to physical problems. However, it has been shown that a patient's gait during level walking does not return to normal after total hip replacement surgery. Accordingly, abnormal hip joint mechanics may also occur during stair ambulation – a frequently performed daily activity, given that it is a more difficult task than level walking. These abnormal mechanics may affect return to normal function as well as affect other joints. The purpose of this study was to determine whether hip joint mechanics during stair ascent and descent return to normal after THA.

METHODS:
Fifteen participants having undergone a unilateral THA by means of a lateral approach (7 women, 8 men; age: 64.9 ± 6.9 yr; BMI: 27.3 ± 5.1 kg/m²) and 15 healthy control participants (7 women, 8 men; age: 63.4 ± 4.3 yr; BMI: 25.1 ± 2.9 kg/m²) performed several trials of stair ascending and descending. All THA participants were tested 6 to 15 months post-surgery and had no other lower joint pathology. Informed written consent, approved by the institution's research ethics board, was obtained from each participant.

A nine-camera motion analysis system (Vicon Motion Systems, Oxford, UK), numerous retro-reflective markers affixed to the participants, as well as two force platforms (Kistler, Models 9286A and 9286AA, Amherst, NY), were used to collect three-dimensional (3D) kinematic and kinetic data. The participants were instructed to ascend and descend the staircase without using the handrail, which was present. The stairway had three steps of 17.8 cm in height and 28.0 cm in depth, of which the first and second steps were each instrumented with a force platform. Three successful trials were recorded for each task from each participant for subsequent analyses.

One-way ANOVAs were performed to determine the effect of THA on the peak 3D hip angles, internal moments and power, as well as the range of motion (ROM), during the foot-strike to foot-strike (FS-FS) cycle of the tasks. Statistical significance was established at alpha (α) < 0.05.

RESULTS:
Statistically significant results for 3D peak hip joint angles, moments and power, as well as ROM during stair ascent and descent are presented in Table 1. Data not presented were found to be similar between groups.

Table 1. Means (standard deviations) of statistically significant hip kinematic and kinetic variables between THA and healthy control participants ascending a 3-step staircase.

<table>
<thead>
<tr>
<th>Variables</th>
<th>THA</th>
<th>Controls</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak adduction angle (°)</td>
<td>6.25 (4.61)</td>
<td>11.24 (3.51)</td>
<td>0.002</td>
</tr>
<tr>
<td>Add/abduction ROM (°)</td>
<td>11.14 (3.34)</td>
<td>16.81 (5.09)</td>
<td>0.001</td>
</tr>
<tr>
<td>Peak int rotation moment (Nm/kg)</td>
<td>0.125 (0.087)</td>
<td>0.231 (0.064)</td>
<td>0.001</td>
</tr>
<tr>
<td>Peak power generated (W/kg)</td>
<td>1.017 (0.338)</td>
<td>1.353 (0.296)</td>
<td>0.007</td>
</tr>
</tbody>
</table>

*Occurs at time of transition from double to single support phase during stance phase of gait cycle (FS-FS).

DISCUSSION:
Results from the present study show that hip joint mechanics during both stair ascent and descent do not return completely to normal following THA surgery. Specifically, differences were observed when the participants were making the transition from double to single support phase (i.e., foot-off (FO) of contralateral foot) of the gait cycle during stair ascent. Compared to a group of healthy participants, the THA patients executed this transition with less hip adduction, a smaller hip ROM, and less generated power. This might be due to a reduced functionality of the glutei and tensor fasciae latae muscles as they are responsible for hip abduction and internal rotation. Our results agree with those of Foucher et al., which also revealed that THA patients ascended stairs with a reduced internal rotation moment.

Table 2. Means (standard deviations) of statistically significant hip kinematic and kinetic variables between THA and healthy control participants descending a 3-step staircase.

<table>
<thead>
<tr>
<th>Variables</th>
<th>THA</th>
<th>Controls</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak flexion angle (°)</td>
<td>38.82 (4.78)</td>
<td>43.19 (4.99)</td>
<td>0.021</td>
</tr>
<tr>
<td>Flex/extension ROM (°)</td>
<td>28.33 (3.42)</td>
<td>31.99 (2.15)</td>
<td>0.002</td>
</tr>
<tr>
<td>Peak abduction angle (°)</td>
<td>7.01 (2.09)</td>
<td>5.16 (2.79)</td>
<td>0.040</td>
</tr>
<tr>
<td>Peak ext rotation angle (°)</td>
<td>5.58 (2.96)</td>
<td>8.62 (3.59)</td>
<td>0.017</td>
</tr>
<tr>
<td>Peak rotation moment (Nm/kg)</td>
<td>0.069 (0.061)</td>
<td>0.115 (0.057)</td>
<td>0.041</td>
</tr>
<tr>
<td>Peak power generated (W/kg)</td>
<td>0.350 (0.187)</td>
<td>0.753 (0.272)</td>
<td>0.010</td>
</tr>
</tbody>
</table>

*Occurs at time of transition from double to single support phase during stance phase of gait cycle (FS-FS); **Occurs during middle portion of swing phase; ***Occurs at foot strike; ****Occurs at FO.

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REFERENCES: