154 THE EFFECT OF A NEW HIP OA BRACE ON THE SIT-TO-STAND MANEUVER
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Purpose: Asymmetric limb loading during sit-to-stand is employed by patients to avoid weight bearing through their painful limb. Chair rise functional performance is impaired and in the long-term overuse of the healthy side might lead to osteoarthritis of the unaffected joints. A new hip bracing concept for hip osteoarthritis (OA) has been designed to alleviate pain and improve function using the forces of a compressive pelvis belt and a stretched elastic strap around the OA thigh. The present study aims to test whether the brace immediately improves the asymmetrical leg loading while rising up from a stool and to examine its effects on upper body kinematics.

Methods: A sit-to-stand movement was performed three times by fourteen subjects with unilateral symptomatic hip osteoarthritis. The loading symmetry ratio (LSR) was measured to quantify the asymmetric limb effects on upper body kinematics. The three groups present differences in chair rise performance between the braced and the unbraced (control), randomly assigned, conditions.

Results: There was no significant difference in the loading symmetry ratio without and with the brace (0.79 ± 0.19 [0.68; 0.89] vs. 0.80 ± 0.14 [0.72; 0.88]). A ratio of 0.80 means that overall 20%BW on average was still weight bearing area decreasing pain and allowing greater recruitment of the hip extensors. It is also possible that the pelvic belt limits trunk flexion, reducing the forward momentum of the trunk thus necessitating a greater hip extension moment. If these changes were to persist in the long run, loading symmetry may be positively affected.

Conclusions: Loading symmetry ratio was not shown to be immediately affected by the brace in this short term study. Nevertheless the reduction in trunk flexion angle and velocity along with the changes in extension moment would appear to indicate improved control over the sit-to-stand maneuver. It is unknown if an increase in hip extension moment leads to a reduction in pain or vice versa. However one could speculate that small changes in the position of the femoral head within the acetabulum, caused by the device, after the femoracetabular weight bearing area decreasing pain and allowing greater recruitment of the hip extensors. It is also possible that the pelvic belt limits trunk flexion, reducing the forward momentum of the trunk thus necessitating a greater hip extension moment. If these changes were to persist in the long run, loading symmetry may be positively affected.

155 SUBJECTS WITH SEVERE KNEE OSTEOARTHRITIS REDUCE MEDIO-LATERAL FORCES DURING CAIT AT THE EXPENSE OF COMPREHENSIVE KNEE CONTACT FORCES
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Purpose: Aberrant knee joint loading has been identified as a potential factor affecting onset and progression of knee OA based on the external knee adduction moment (KAM). This study examines the knee joint reaction forces (KCF) during gait in healthy adults and subjects with increasing severity of knee osteoarthritis (OA) using subject-specific musculoskeletal simulations generated by OpenSim. KCF reflect the combined effect of intersegmental and musculotendon forces and are therefore potentially more representative for knee loading than KAM, a commonly used estimation of internal knee contact forces. We hypothesize that in subjects with increasing levels of OA involvement, the KCF are significantly altered due to the combined effect of aberrant movement dynamics, muscle coordination and joint geometry.

Methods: Thirty-five patients (women, mean age of 69.3) were recruited and separated into three groups: asymptomatic subjects with a Kellgren/Lawrence (K/L) grade of 0 (n = 11), subjects with early symptomatic knee OA having K/L grades of 1 or 2 (n = 14) and subjects with established knee OA with a minimum grade of 2+ (n = 10). Gait analysis consisted of level walking along a 10 m walkway at self-selected speed. An active 3D motion analysis system (Krypton, Metris) recorded the 3D position of reflective markers attached to the subjects according to an extended Helen Hayes protocol, at 100 Hz. A force plate (Bertec Corporation, Ohio, USA), embedded in the middle of the walkway, measured ground reaction forces and moments sampled at 1000 Hz.

OpenSim (Delp et al. 2007) was used to generate 3D, subject-specific simulations. The 3D model consisted of 24 degree-of-freedom (DOF) with the tibio-femoral joint modeled as a 2 DOF joint allowing flexion/extension and adduction/abduction, and 86 muscles. After scaling the model, an inverse kinematics was performed. A static optimization routine calculated the muscle force distribution and the resulting knee joint contact forces were calculated for the stance phase. KCF were normalized to body weight (BW). A one-way analysis of variance (ANOVA) with Tukey post hoc test evaluated if differences in the first and second KCF peaks were statistically significant between the 3 groups (p < 0.05).

Results: The three groups present differences in first and second peak total KCF. Although increased first peak loading was found in more established OA, this was not significantly different between the 3 groups (Table 1). Significant differences (p = 0.04) in the second peak KCF were confirmed between early and established OA subjects: for the established OA group, total KCF remained elevated throughout mid stance and the second peak was less pronounced (Figure 1).

Similar changes reflected in the proximo-distal component of the KCF, confirming a significantly increased second peak between in subjects with established OA compared to control subjects (p = 0.03) (Figure 2). In contrast, first peak of the medial-lateral component of KCF was elevated more in early OA patients, although not significant. Anterior-posterior components were similar for all groups throughout the stance phase.

Conclusions: We confirm excessive knee joint loading in subjects with established levels of OA involvement while subjects with early OA had similar KCF comparing to the control subjects. Interestingly, early OA subjects presented higher medio-lateral loading compared to established OA subjects, whereas the vertical loading was higher in established OA patients. Further research is needed to evaluate if these changes reflect a protective gait strategy adopted by established OA patients to minimize shear forces in the knee joint during gait.

Table 1

<table>
<thead>
<tr>
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<th>PEAK 1 (mean ± SD)</th>
<th>PEAK 2 (mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>3.93 ± 0.63</td>
<td>3.61 ± 0.70</td>
</tr>
<tr>
<td>Early</td>
<td>4.06 ± 1.20</td>
<td>3.28 ± 0.66</td>
</tr>
<tr>
<td>Established</td>
<td>4.30 ± 0.90</td>
<td>3.72 ± 0.73</td>
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</tbody>
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Figure 1. – Average KCF (normalized to BW) during stance phase across varying OA severities.