151 QUANTIFYING THE RELATIONSHIP BETWEEN JOINT LOADING COST OF LOCOMOTION AND WALKING SPEED IN SUBJECTS WITH MODERATE KNEE OSTEOARTHRITIS

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Purpose: Tibiofemoral or knee osteoarthritis (OA) is a leading cause of physical disability in elderly Americans and increased loading across the knee joint has been found to significantly correlate with increased pain complaints as well as incidence and progression of the pathology. Although previous investigations have found reductions in various indicators of knee joint loading with reduced walking speed, stride length is also likely decreased resulting in an increased number of steps and therefore episodes of joint loading to ameliorate the same distance. The joint loading cost of locomotion, which we define as joint loading per stride length, and its relationship with walking speed will be investigated in this study.

Methods: Nine OA and 15 control subjects walked on an instrumented split-belt treadmill at a control speed (1.0 m/s), self-selected speed, and fastest tolerable walking speed with data from the more symmetrical limb in the OA subjects and a randomly selected limb in the control subjects selected for analysis. The 1st and 2nd peak knee adduction moments were selected as indicators of joint loading and calculated for four gait cycles at each of the walking speeds. The joint loading cost of locomotion was assessed by dividing each indicator by stride length and the relationship between the joint loading cost of locomotion and walking speed was determined for each subject via a linear regression analysis. The slope of the regression equation characterized the relationship between the two variables and group mean slopes ± 95% confidence interval were calculated to quantify the relationship between the joint loading cost of locomotion and walking speed for each group. Additionally, t-tests were utilized to investigate differences in the group relationships with alpha set at 0.05.

Results: OA and control subjects did not differ in age, height, weight, or BMI. OA subjects chose significantly slower self-selected (1.11 ± 0.13 vs. 1.33 ± 0.12 m/s) and fastest tolerable walking speeds (1.54 ± 0.21 vs 1.81 ± 0.28 m/s) (p<0.05). The mean slope ± 95% confidence interval was less than zero for all joint loading indicators signifying a significant reduction in the joint loading cost of locomotion with increasing walking speed for both OA and control subjects (Figure 1). Additionally, the OA subjects reduced their joint loading cost of locomotion at a significantly faster rate than control subjects when considering the knee adduction impulse; however no differences between the groups were seen when considering the peak knee adduction moments.

Figure 1. (a) Linear regression analysis applied to sample OA subject (b) The relationship between knee joint loading cost of locomotion and increasing walking speed for OA (shaded) and controls (hatched).

Conclusions: Although previous studies have suggested persons with OA are able to reduce knee joint loading with decreased walking speed, after accounting for the distance traveled in a gait cycle, results suggest increasing walking speed is a more effective gait modification to reduce cumulative knee joint loading. Furthermore, data suggest if OA subjects were to increase their self-preferred walking speed to match the control group, they would reduce cumulative knee joint loading experienced during ambulation by 6-19% depending on the joint loading indicator selected.

152 PELVIC MOVEMENTS ARE RESTORED TO REFERENCE VALUES DURING STAIR CLIMBING BUT NOT DURING STEPPING ONE YEAR AFTER UNI-COMPARTMENTAL KNEE ARTHROPLASTY: A SECONDARY ANALYSIS OF A RANDOMIZED CONTROLLED TRIAL

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Purpose: Studies have found that patients with medial knee osteoarthritis use compensatory strategies during walking to minimize the load of the medial knee compartment. Compensatory strategies are less well investigated during more advanced functional tasks such as stair climbing and stepping.

We have recently found that patients with end-stage medial compartment knee osteoarthritis scheduled for a medial uni-compartment knee arthroplasty (UKA) demonstrate increased pelvic movements during stair climbing and stepping compared with persons without knee problems. The patients in the previous study were participants in a randomized controlled trial, where they were randomized to either home based exercise or progressive resistance training after UKA. The primary outcome was leg extension power. The aim of this secondary analysis of the randomized controlled trial was to evaluate if patients one year after UKA would reach reference values of pelvic movements during stair climbing and stepping.

Methods: The study population consisted of 40 patients with a mean age at surgery of 66±8 years. Patients were included in the study if they were scheduled for UKA and lived no more than 40 km away from the hospital. Patients with rheumatoid arthritis and neurological conditions that could affect functional performance were excluded. Patients were randomized to either eight weeks home based exercise or eight weeks progressive resistance training initiated within one week postoperative and performed twice a week for eight weeks. Patients were age- and gender-matched with 29 controls with no limitations in walking and no previous major surgery in their hips or knees.

One year after surgery, motion analysis of pelvic movements during ascending and descending a stair case (step height 16.5 cm) and step (block height 30 cm) was recorded. The pelvic movements were derived from an inertial sensor with gyroscope (Inertia-Link®). The controls performed the same functional performance tests to create reference levels of pelvic range of motion. Patients and controls were compared using multiple regression analysis, adjusted for gender, age and body weight.

Results: One year after UKA patients reached reference levels of pelvic range of motion during stair climbing, while pelvic movements during step ascending and descending in the sagittal plane were still significantly different from the reference levels (p < 0.02) (figure 1 and 2). There were no statistically significant differences between the home based exercise and progressive strength training group in pelvic movements at one year follow up.

Conclusions: Patients exhibit less pelvic compensatory movement one year after UKA and rehabilitation compared to before UKA Pelvic movements were comparable to reference levels during stair climbing. Nevertheless, the patients still exhibited compensatory pelvic movement during the more challenging task of stepping, which was evident regardless of rehabilitation program.

Figure 2. Pelvic range of motion: Sagittal plane ascending and descending. Reference group: Pre operative. One year follow up. Sagittal plane ascending (red) and descending (blue).