Linking Frontal Plane Mechanics during Stair Climbing to the Progression of Osteoarthritis in the Nonoperated Knee after Unilateral Total Knee Arthroplasty

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INTRODUCTION

There is an established pattern of progression of osteoarthritis (OA) in the contralateral knee after a unilateral total knee arthroplasty (TKA) 1. Alterations in movement strategies persist after initial TKA, which may increase the joint load of the non-operated limb and expedite the disease process. Persons with TKA have higher peak adduction moments during gait in the nonoperated limb compared to controls and the operated limb 2. This directly correlates to increased medial compartment joint loading 3. Abnormal muscle activation patterns and cocontractions are also implicated in OA development and progression 1 and may persist after TKA. While evaluations of joint loading have been conducted in walking, more demanding activities such as stair negotiation have not been assessed. We hypothesize that the knee adduction moment and medial cocontractions will be greater on the nonoperated limb compared to the operated limbs of persons with TKA and to control limbs.

METHODS

Subjects: Fifteen persons (8 women, 7 men, age 63.5 (7.9) years; height 1.7 (0.1) m; weight 89.7 (11.3) kg) 1 year after unilateral TKA, and 15 matched controls (8 women, 7 men, age 63.5 (7.9) years; height 1.7 (0.1) m; weight 85.0 (12.3) kg) who were able to ascend and descend stairs during stance phase.

Statistical Analyses: Comparisons of limbs and groups were made using ANOVA, with post-hoc t-tests, using SPSS 15.0 (SPSS, Inc.).

RESULTS

Figure (left): During stair ascent, the first peak knee adduction moment was greater in the nonoperated knee compared to controls (p<0.046), as was the second peak adduction moment (p<0.024).

DISCUSSION

Interestingly during stair descent, a different pattern emerged on the nonoperated limb: the second peak was an adduction moment, whereas the operated limb and the control limbs experienced an abduction moment. The adduction moment was accompanied by a greater VM-MG cocontraction; thus this pattern may represent overloading of the medial compartment of the knee. During stair ascent, the nonoperated limb had greater adduction moment compared to controls, and was also accompanied by greater VM-MG cocontraction.

During gait, frontal plane knee external adduction moments implied greater medial compartment loading, and we believe it occurred in these individuals during ascent and descent. Side-to-side comparisons in persons with TKA, and comparisons to controls have found that the first peak knee adduction moment was higher in the nonoperated limb compared to controls and the operated limb during gait 2. The greater medial cocontraction is consistent with other reports 3. Muscle activation patterns and cocontractions were implicated in OA development and progression 1 and 2, and attributed to the attempt to control greater medial laxity by any means possible.

Significant kinetic and neurologic alterations were seen in this cohort of subjects. The adduction moment has been found to be the best predictor of disease progression 1 and the excessive moments found in this sample suggest a pathological pathway of disease progression after initial TKA. Future work should include a longitudinal component with radiographic and functional assessments of disease progression.

REFERENCES: