

## **PREDICTING PATIENT-SPECIFIC GAIT MODIFICATIONS FOR KNEE OSTEOARTHRITIS REHABILITATION\***

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Gait modifications such as toeing out have been shown to reduce the second but not the first peak of external knee adduction torque curve. However, the magnitude of the first peak is most closely associated with osteoarthritis (OA) progression. This study uses dynamic optimization of a patient-specific full-body skeletal model to predict novel patient-specific gait modifications that significantly reduce both peaks of the knee adduction torque curve. A video-based motion analysis system and two force plates were used to collect gait data from a single knee OA patient walking at a self-selected speed of 1.4 m/s. A 27 degree-of-freedom dynamic, full-body skeletal model was then constructed for the patient. The joint positions and orientations in the body segments along with the segment masses, mass centers, and moments of inertia were calibrated to the patient's gait data using optimization. The resulting patient-specific model was used in a dynamic optimization to predict subtle gait modifications that reduce both peaks of the knee adduction torque curve. The cost function minimized the left knee adduction torque while tracking the experimental foot path, trunk orientation, joint torques, ground reactions, and center of pressure. For no change in foot path, the optimization predicted that a slightly flexed gait with added pelvis axial twist would reduce the first and second adduction torque peaks by 42 and 47%, respectively, comparable to high tibial osteotomy surgery. The patient attempted to learn the modified gait pattern over a 6 month time period by studying plots and animations of the optimization predictions. Upon retesting, the patient achieved 50 and 53% reductions in the first and second peaks, respectively, while walking at the same self-selected speed. These findings suggest that patient-specific dynamic optimizations can be used to design novel gait motions with potential therapeutic benefit.

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