ABSTRACT

Introduction: Gait biomechanics are associated with knee osteoarthritis (OA) structural progression, but no studies have included i) all three lower extremity joints, ii) nonfrontal plane factors, iii) temporal patterns of loading, and iv) progression from structural and symptomatic perspectives. This dissertation addressed gaps in the literature to determine whether we have identified and are targeting the most effective biomechanical variables in the development of conservative interventions to slow knee OA structural and symptom progression (i.e. progression to TKA).

Methods: 54 patients with knee OA underwent baseline gait analysis. Three-dimensional hip, knee, and ankle angles and moments were calculated. Waveform characteristics were determined using Principal Component Analysis (PCA), and knee adduction moment (KAM) peak and impulse were calculated. At follow-up 5-8 years later, 26 patients reported undergoing total knee arthroplasty (TKA). Unpaired Student’s t-tests detected differences in baseline demographic and gait characteristics between TKA and no-TKA groups. Receiver operating curve analysis determined discriminative abilities of these differences. Stepwise discrimination analysis determined which multivariate combination best classified the TKA group. Logistic regression analysis determined the predictive ability of the multivariate model.

Results: There were no baseline differences in clinical and spatiotemporal gait characteristics, but the TKA group showed significant gait biomechanical differences, including higher KAM magnitude (KAMPC1), less difference between early and midstance KAM (KAMPC2), higher KAM peak and impulse, reduced early stance knee flexion and late stance knee extension moments (KFMPC2), and reduced stance dorsiflexion moments (AFMPC4). The multivariate discriminant function with the highest classification rate (74.1%) combined KAMPC1, KFMPC2, and AFMPC4, with sensitivity of 84.6 and specificity of 71.4. A one-unit increase in the model score increased risk of progression to TKA six-fold.

Conclusion: Higher KAMPC1 scores suggest higher overall loading during gait. Lower KFMPC2 and AFMPC4 scores suggest inability to unload the knee and therefore sustained loading. Interventions reducing overall load and altering patterns of loading (i.e. increase unloading) may reduce risk of progression to TKA. Future research should determine how components of the discriminant model can be altered conservatively, and what impact alterations have on the risk of progression to TKA.