The relationship between the knee adduction torque and medial contact force during gait

Dong Zhao [a], Scott A. Banks [a,b,c] , Kim Mitchell [c],
Darryl D'Lima [d], Clifford Colwell Jr [d], Benjamin J. Fregly [a,b]
[a] Department of Mechanical & Aerospace Engineering, University of Florida, Gainesville, USA
[b] Department of Biomedical Engineering, University of Florida, Gainesville, USA
[c] The Biomotion Foundation, Palm Beach, USA
[d] Shiley Center for Orthopaedic Research & Education at Scripps Clinic, La Jolla, USA

Adverse mechanical loading of the knee, and in particular high medial contact force, is believed to contribute to the development of knee osteoarthritis. Noninvasive *in vivo* measurement of medial compartment contact force is not yet available. Consequently, the peak external knee adduction torque during gait has been identified as the best candidate to serve as surrogates for internal medial compartment contact force. This paper investigates the relationship between the knee adduction torque and *in vivo* medial contact force and medial to total contact force ratio during gait. The adduction torque curve of a subject during overground gait was obtained with a motion capture system. The corresponding internal contact forces were calculated from data provided by an instrumented knee implant capable of measuring total axial force. An equation for partitioning total force into medial and lateral contact forces was determined using fluoroscopic data collected from the same subject performing treadmill gait. During overground gait, the peak measured axial load was 2.45 BW with a corresponding peak predicted medial compartment load of 1.51 BW. The peak knee adduction torque was 2.53 %BW×H. The medial contact force and adduction torque curves exhibited similar trends. Statistically significant correlations were found between the adduction torque and both the medial contact force and the ratio of medial to total contact force. The Pearson correlation coefficient of adduction torque vs. medial force was 0.85 and for adduction torque vs. medial to total force ratio 0.87. The results showed that knee adduction torque measured externally is an accurate predictor for internal medial compartment contact force and a strong correlation also exists between adduction torque and medial to total force ratio.