DIVISION OF STATISTICS
Colloquium

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TITLE: **A Curved Muscle Model of the Lumbar Spine**

DATE: **Friday October 7, 2016**
TIME: **2:00 p.m.**
PLACE: **DUSABLE HALL 212**

Abstract

Accurate estimates of trunk muscle geometry including the muscle line of action are essential to the development of biologically-assisted models capable of accurately documenting spinal tissue loads. Currently most biomechanical models of the spine employ straight-line muscle approximations for computational efficiency. However, this straight line of action assumption is thought to violate the physiological reality of the lumbar spine and would provide an inaccurate estimate of spine tissue loading especially during asymmetric complex exertions. Hence, the objective of this study was to develop personalized curved muscle geometry and integrate this information into a biologically-assisted spine model using an individual's anthropometric measures, trunk kinematics, kinetics, and muscle activities. Three major steps were conducted to meet this goal. First, based on magnetic resonance imaging data from thirty subjects (10 male and 20 female) reported in a previous study, a polynomial regression analysis was conducted to estimate the muscle moment-arms and physiological cross-sectional areas through thoracic/lumbar spine as a function of vertebral level, gender, age, height, and body mass. Second, the model structure was developed to include curved muscle geometry, separation of active and passive muscle forces, and personalization of muscle properties. Lastly, model fidelity of the curved muscle model through the entire lumbar spine was evaluated for 24 subjects (13 males and 11 females) during a wide range of complex dynamic lifting exertions. In general, curved muscle model predicted at least 80% of the variability in spinal moments, and less than 15% of average moment matching error across levels. The compression and anterior-posterior shear load significantly increased as trunk bent more, whereas the lateral shear load significantly increased as trunk twisted more asymmetric during lifting tasks. The results of this study indicate that a curved muscle representation in the biologically-assisted model is an empirically reasonable approach to accurately estimate spinal moments and spinal tissue loads of the lumbar spine. This advancement is expected to help quantify risk exposure more accurately, improve patient health and enable the development of interventions that could mitigate risks in occupational jobs.