PROJECT SUMMARY (See instructions):

The goal of this project is to critically evaluate the ability of musculoskeletal models to predict muscle and joint contact forces in the knee reliably during walking. Knowledge of these internal loads could improve the diagnosis and treatment of neuromusculoskeletal disorders that affect walking ability (e.g., stroke, cerebral palsy, osteoarthritis). Because internal loads cannot be measured clinically, musculoskeletal models have become the primary means for developing estimates. However, if model estimates are inaccurate, clinical assessments or treatments based on these estimates could be ineffective or even harmful. We propose to evaluate musculoskeletal model estimates of muscle and joint contact forces in the knee during walking using in vivo contact force measurements obtained from patients implanted with force-measuring knee replacements. These unique internal load measurements will allow us to evaluate contact force estimates directly and muscle force estimates indirectly. For each of the five patients tested, we will collect a broad range of movement data (tibial contact force, motion capture, ground reaction force, EMG, fluoroscopic, muscle strength). We will then enhance OpenSim open-source musculoskeletal modeling software with new capabilities (e.g., “fast” contact model modeling methods, new optimization methods for predicting muscle forces based on EMG measurements) to permit construction of a high-fidelity musculoskeletal model of each patient. The ability of each patient-specific model to reproduce the patient’s tibial contact force, EMG, and other movement data will be evaluated using existing and new muscle and contact force prediction methods. We will also hold an annual competition at the ASME Summer Bioengineering Conference where researchers will use data and models we make available to predict the in vivo tibial contact forces without knowing them in advance. This musculoskeletal model validation effort will be the most extensive ever performed, and the data, models, and ideas generated will provide a foundation for further evaluation studies for years to come.

RELEVANCE (See instructions):

Musculoskeletal models could facilitate the design of effective, customized treatments for neuromusculoskeletal disorders such as stroke, cerebral palsy, and osteoarthritis. However, before they can be used for this purpose, their predictions need to be validated. This study proposes unique data and methods to perform such a validation with a focus on the knee during walking.

PROJECT/PERFORMANCE SITE(S) (if additional space is needed, use Project/Performance Site Format Page)

Project/Performance Site Primary Location		
Organizational Name:		
DUNS:		
Street 1:	Street 2:	
City:	County:	State:
Province:	Country:	Zip/Postal Code:
Project/Performance Site Congressional Districts:		

Additional Project/Performance Site Location		
Organizational Name:		
DUNS:		
Street 1:	Street 2:	
City:	County:	State:
Province:	Country:	Zip/Postal Code:
Project/Performance Site Congressional Districts:		