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The fundamental goal of my research program is to understand muscle function and coordination during activities of daily living. We use experimental and simulation techniques to study the contributions of individual muscles to walking and recently to upper extremity function in healthy and impaired populations. Specifically, we seek to answer questions such as “How do muscles compensate for particular impairments?” and “What factors limit performance of a desired activity?” We have implemented computational tools with the hopes of expediting the time to insight for clinically relevant questions.

Consistent with the theme of muscle coordination in the presence of functional limitations which we choose to study with musculoskeletal simulations, I have outlined four recommendations to advance this field:

1. Improve validation of computational tools. A common and justified criticism of musculoskeletal simulations is the lack of formal validation techniques. Because simulations are generally used to estimate parameters which are difficult to measure directly, validation is inherently difficult. Current techniques involve instrumented implants and target a specific population (i.e., TKR). There is a potential role for animal models or novel *in vivo* instrumentation (nano-force-transducers injected in muscles) but this will require new collaborations. Funding for validation studies is typically not offered by the NIH but could be solicited separately from funding for specific applications.

2. Share data. Open source simulation tools have enabled sharing development and analysis software. Similar resources should be established with experimental databases. Why create numerous and nearly identical databases of healthy or pathological movement patterns when other experts are already acquiring and documenting this information? Access could be provided to modeling experts (via virtual collaborations, with authorship rights, potentially through NIH data sharing programs by application only) who may not be able to collect clean data (due to limited skills, patient recruitment, equipment).

3. Generate and test predictive models. Forward dynamics has the capacity to conduct hypothetical experiments that may involve parameter adjustments, neural adaptations and learning. The most robust models would not only reproduce existing experimental data but predict what happens following intervention.

4. Develop realtime simulation tools. Estimates of muscle forces or other internal parameters can be used as feedback for intervention studies (or to drive biomedical devices). With improved robustness and flexibility of optimization algorithms, task-specific cost functions can be developed, refined and tested.