



Human Motion Lab Update

Josh Baxter, PhD

Director, Human Motion Lab

2018 was a great year in the Human Motion Lab! After developing strong collaborations with clinicians and researchers at Penn, we've had 12 research studies accepted for publication in peer-reviewed journals and 15 abstracts and have presented 9 abstracts and scientific conferences. Our lab is focused on understanding the links between musculoskeletal structure and injury with patient function and outcomes. To do this, we have integrated medical imaging, motion capture, functional testing, computational modeling, and cadaveric experiments to rigorously test clinically important questions.

The Human Motion Lab has active projects with promising young clinicians and researchers at Penn Medicine. In collaboration with the Human Motion Lab, several projects were developed into grant applications and have secured funds:

- Dr. Josh Baxter—Applying machine learning algorithms to predict tendon health using ultrasound imaging
- Dr. Kathryn O'Connor—Correlating tendon diastasis with functional outcomes in acute Achilles tendon ruptures
- Dr. Rikesh Gandhi—The development of a low-cost hand-tracking sensor to measure hand motion
- Dr. Comron Saifi—Validation of a functional screening for patients with spinal deformity

Patient movement biomechanics that were once challenging to characterize, can now be accurately quantified in the Human Motion Lab at Penn Medicine. Located within the clinics of the Department of Orthopaedic Surgery, the Human Motion Lab's mission is simple: support decision making with objective and quantitative measurements of patient biomechanics. The 1,200 square foot lab is fully instrumented with motion capture, strength testing, muscle

analysis, and ultrasonography equipment to study a wide array of musculoskeletal pathologies. These resources allow our researchers to work closely with musculoskeletal providers to identify key indicators of injury and treatment outcomes.

Thanks to the Human Motion Lab being located in the Department of Orthopaedic Surgery clinics at Penn Medicine University City, we are able to prospectively study patients as part of their routine visits to see their treating physician. We are currently studying the effects of treatment on patients following Achilles tendon ruptures. Working closely with Dr. O'Connor, we have discovered that the calf muscles change their shape after tendon rupture. Importantly, the magnitude of this change in muscle shape is strongly correlated with the amount of power deficits measured 3 months after injury. With these important findings, we are developing a follow-up study to determine the clinical treatments that minimize these changes in muscle structure. To help understand these links between muscle-tendon structure and function, we developed a computer simulation where we tested how changing the muscle and tendon affected patient function. Working with Drs. Farber and Hast, we confirmed our clinical findings that muscle changes are responsible for functional deficits, which are unique in the fact that these Achilles tendon injuries lead to changes in muscle. These computational simulation findings were published in the *Journal of Biomechanics*.

The Human Motion Lab is focused on establishing itself as a leader in the field of Achilles tendon health. Using motion capture, ultrasonography imaging, and musculoskeletal modelling we are beginning to explain the biomechanical factors that explain functional outcomes in these patient cohorts. With strong collaborations around the Department of Orthopaedic Surgery, we are excited for the future of the Human Motion Lab.