For sport following their surgery, however, their incidence rate of experiencing a second ACL injury is 6 times greater athletes who have not had ACL reconstructive surgery (Paterno et. al., 2014). This high incidence rate serves as motivation for rigorous rehabilitation and return-to-sport testing.

A main focus of current rehabilitation and return-to-sport testing is quadriceps strength. Quadriceps weakness of the surgical limb, while most during the first few months following surgery (de Jong et. al., 2017; Ingersoll et. al., 20 Keays et. al., 2007) can still persist after being cleared to return to full activity (Pa exercises, especially when performed bilaterally, present their limitations. When completi example, ACL reconstruction patients may shift effort from the surgical limb to the contrala and further perpetuate quadriceps imbalances

.

As a method to combat the issue of effort being shifted away from the surgical limb during bilateral exercise, our lab has recently developed and validated a force platform that is capable of interfacing with a standard leg press machine (Figure 1), allowing feedback for patients and clinicians to evaluate force production symmetries during exercise. In addition to evaluating force production symmetry, our custom e knee flexion angle trajectories of the involved limb indicate less control of the knee joint and may demonstrate functional deficits (Lanier et. al., 2023). More recently, LyE has been used to evaluate force control in healthy individuals during a novel

Aim 1: To determine typical repetition-to-repetition variability in force production during leg press exercise in ACL reconstruction patients via the Lyapunov exponent and compare these values to those of healthy controls.

Hypothesis 1.1: Mean Lyapunov exponent values will not differ between the nonsurgical limbs of ACL reconstruction patients and either of the limbs of healthy controls. However, these values will differ between the surgical limbs of ACL reconstruction patients and both limbs of healthy controls.

Descriptive statistics (including mean, standard deviation, and 95% confidence intervals) will be calculated to describe normative values for the Lyapunov exponent during leg press exercise in ACL reconstruction patients. These values will then be compared to normative values of healthy individuals that have previously been determined by our lab using a 2x2 ANOVA with a Tukey post-hoc test as needed.

Aim 2: To determine whether force control differs between surgical and uninvolved limbs during leg press exercise in ACL reconstruction patients via the Lyapunov exponent.

Hypothesis 2.1: Lyapunov exponent values of the surgical limb will be greater than those of the nonsurgical limb.

A paired t-test will be used to compare Lyapunov exponent values of the surgical and uninvolved limb of participants. This will demonstrate if the surgical limb shows altered force control relative to the uninvolved limb and if there is a need to improve force control through rehabilitation.

Aim 3: To determine the relationship between Lyapunov exponent values from the leg press task and clinical outcomes.

Hypothesis 3.1: Lyapunov exponent values of the nonsurgical limb will not be correlated with any of the clinical outcomes measured.

Hypothesis 3.2: Lyapunov exponent values of the surgical limb will not be correlated with any of the clinical outcomes measured.

Clinical Measures

Following completion of the leg press task, participants will complete a series of clinical measures. These measures will

Budget Justification

A total budget of $5,000.00 is requested for the completion of this project. A participant stipend of $1,500.00 is requested for the purchase of gift cards to be provided to participants upon completion of the experimental protocol. This will assist in expediting recruitment of participants.

Additionally, $1,000.00 is requested to purchase a leg press machine to be permanently located in the Biomechanics Research Building. This will improve the standardization of this protocol as well as future projects investigating rehabilitation techniques for populations with lower-extremity pathology. Previous work through the Biomechanics Department as utilized the cable leg press machine in the Health and Kinesiology Building. This was inconvenient for both the researchers and gym users in H&K and also provided distractions for the participants, making it more difficult for them to complete the task at hand.

Lastly, a student stipend of $3,500.00 is requested, where the student will work on the research project for a minimum of 200 hours. This stipend will allow the student to spend more time at the Biomechanics Research Building to work on the GRACA project in addition to the time they spend working on their duties as a graduate assistant.

Item	**Price**
Participant Stipend	$1,500.00 ($50.00 per participant)
Leg Press	$1,000.00
Student Stipend	$2,500.00
Total	**$5,000.00**

References/Citations

1. Benjaminse A., Gokeleer A., van der Schans C.P. Clinical diagnosis of an anterior cruciate ligament rupture: a meta-analysis.

Letter of Mentor Support

To Whom It May Concern,

I am pleased to provide this letter of support for Lindsey Remski. Working with her as an undergraduate intern and now as a graduate student it is clear that Lindsey is driven by her desire to perform quality and meaningful research in the field of biomechanics and rehabilitation.

Lindsey's proposed project in this GRACA submission is important for moving towards improved return-to-sport assessments in ACL reconstruction patients. Her personal experience with ACL research as a patient and her thorough research background have helped Lindsey develop a project that meets her scientific aims and do so in a way that is viable and innovative. This project aligns well with the research aims of my team sc 0 Tw 14.304 0 Td52