Quantifying ACL recovery results and implications for returning to sport

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Jenna Mesisca, undergraduate in biomedical engineering, collects data in Robin Queen's lab, the Kevin P. Granata Biomechanics Lab. Credit: Spencer Roberts of Virginia Tech

According to 2021 research in the Orthopedic Journal of Sports Medicine, 35 percent of athletes who have recovered from anterior cruciate ligament (ACL) injuries will re-injure it after returning to their sport.

For Jenna Mesisca, that number is too high.

The fourth-year biomedical engineering undergraduate student has conducted research to better understand the biomechanics of returning to sport after an ACL injury, including better ways to measure landing mechanics to improve clinical recommendations for injured athletes.

In a study published in Clinical Biomechanics, Mesisca worked alongside Alex Peebles, a recent alumnus earning his Ph.D. in biomedical engineering, and Robin Queen, professor of biomedical engineering and mechanics in the College of Engineering. The team discovered the importance of factoring both weight and jump height into the tests that are used to clear athletes to resume physical activity following an ACL injury.

New insights for analysis of ACL injury recovery

The study involved collecting data from more than 20 female athletes who had recently recovered from an ACL injury and who had completed rehabilitation following an ACL reconstruction. The athletes participated in a variety of hops to measure their recovered limbs and non-injured limbs. Typically, these hop tests are analyzed using the athlete's body weight to determine when they are ready to return to their sport.

Mesisca and Peebles analyzed limb loading during the hop tests using different normalization methods to compare their results to the typical results. They analyzed their hop tests with a focus on potential energy rather than weight, and found significant differences in the results. As

they looked at the recovered limb and the load on that limb during a variety of hops, when normalizing the results solely by body weight, they found the results were different than when looking at the recovered limb and normalizing the loading results using potential energy.

Normalization using potential energy allows for the inclusion of weight and jump height, both of which can impact the load that is seen by the limb. In some cases, opposite results were found when using body weight versus potential energy to normalize the load outcomes. These results have implications for clearing athletes to return to their sport and recommending resuming activity, especially in regard to risk of re-injuring the recovered limb.

"This is an important finding," said Mesisca, who served as first author of the study. "This research shows the value in asking more questions and analyzing the results. Overall, more than a third of athletes are tearing their ACL again after recovering. If we could better understand this and give better recommendations, we could help more athletes return to their sports safely."

Undergraduate research and real-world problem-solving

Mesisca joined Queen's research group, the Kevin P. Granata Biomechanics Lab, in January 2020. She remembers receiving immediate mentorship from other graduate students and Queen. The lab's members share the goal of applying their research to clinical settings to provide actionable insights for individuals recovering from injuries.

"The lab is fortunate to be able to allow a number of undergraduate students to complete independent study and undergraduate research

projects every semester," said Queen, who is also an adjunct faculty member at the Edward Via College of Osteopathic Medicine and a faculty member of orthopedic surgery at the Virginia Tech Carilion School of Medicine. "Through their work in the lab, we hope our students can take the knowledge they have learned in class and apply it to solve real-world problems. We hope that these experiences allow our students to bridge between the classroom work they have done at Virginia Tech and their future career through hands-on, engaging projects."

Mesisca credits the hands-on work she did in the lab with enhancing her classroom knowledge and giving her the ability to apply what she has learned. The lab has also given her skills she knows will help her as she continues on her path as a biomedical engineer.

Mesisca looks forward to working alongside Queen for two more years, as a senior and in her final year as a master's student. She is participating in the department's accelerated undergraduate/graduate degree program, which will enable her to graduate with a master's degree in biomedical engineering after a fifth year of study.

Mesisca is also part of the first cohort of students in Virginia Tech's new and unique biomedical engineering degree program. "I have always had an interest in sports rehab and injury prevention, particularly as a club lacrosse player at Virginia Tech and an athlete myself," Mesisca said. "I was so excited to be part of this first cohort of biomedical engineers—a major that combines my passion for helping injured athletes, my interest in mechanics and medicine, and my knowledge and skills as a science and math student. It couldn't have worked out better."

After graduation, Mesisca wants to work in sports rehabilitation. Her dream is to conduct research and apply that to clinical settings to help athletes improve. Whether it is work with devices like knee braces or

understanding the biomechanics of movement, like landing from hops, she said she just wants to help others heal and improve.

More information: Jenna K. Mesisca et al, Including jump height when normalizing single hop impact kinetics can change the directionality of findings, *Clinical Biomechanics* (2021). DOI: 10.1016/j.clinbiomech.2021.105443

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