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Investigating connection between ACL surgery and osteoarthritis

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Every year, about 250,000 people in the U.S. sustain injuries to the anterior cruciate ligament (ACL), and about half of these individuals end up having reconstructive surgery.

But even more disturbing is that some 30 to 60 percent of those who undergo surgery develop osteoarthritis (OA) within five years.

"ACL injury typically affects active young adults participating in sports like basketball, football, skiing and soccer, which means that this population is developing OA in their 20s and 30s," says the University of Delaware's Thomas Buchanan.

"Although they're not experiencing symptoms at this point, X-rays show evidence of early-stage OA," he adds. "And chances are that within another five to 10 years, they're going to need knee replacement surgery, which is not an option for people that young."

Buchanan, who is the George W. Laird Professor of Mechanical Engineering and director of the Delaware Rehabilitation Institute, is collaborating with Lynn Snyder-Mackler, Alumni Distinguished Professor of Physical Therapy, to shed light on the ACL-OA connection, so that therapeutic interventions can be developed to prevent it.

They recently received a grant from the National Institutes of Health to examine both the biochemical and biomechanical bases for the development of OA after ACL surgery.

The two have been working together for more than 15 years, with Buchanan bringing knowledge of biomechanical modeling and Snyder-Mackler providing expertise in clinical treatment approaches.

Data collected during their previous studies showed that some patients displayed unusual gait mechanics within the first six months after surgery.

"Biomechanical analysis from our lab showed that the injured knee undergoes unloading—that is, the joint contact force is less in the involved knee than in the uninvolved knee when the patient walks," Buchanan says. "The unloading occurs immediately after injury and is still quite pronounced at six months."

"However, even though loading typically returns to normal at about the two-year point, we found that those people who had evidenced a difference in loading right after surgery were more likely to develop OA five years out," he adds. "This finding suggests that there may be a window of opportunity for treatment if we can figure out what happens within the first two years that sets some knees up for OA."

Under the new NIH grant, the researchers plan to study people at three months, six months and two years following ACL surgery, with three aims.

The first is to explore the biomechanical basis of the observed unloading using gait analysis and electromyography, a procedure to assess the health of muscles and the nerve cells that control them.

Second, they will use quantitative magnetic resonance imaging (qMRI) to detect biochemical changes in the cartilage at the same three points in the post-surgery period. This part of the work will be carried out in UD's new Center for Biomedical and Brain Imaging, which houses a state-of-

the-art functional MRI (fMRI) scanner. The NIH funding will support the software upgrades needed to carry out the qMRI planned for the knee study.

Finally, the team will examine the effect of knee loading differences on knee cartilage stress distribution using a finite element model, which will enable them to determine precisely how the loading and biochemical changes influence the pressure in the cartilage.

"We believe this approach will allow us to understand the mechanisms governing knee unloading following ACL reconstruction and enable us to make recommendations for clinical treatment paths to avoid the development of OA in this population," Buchanan says.

The grant, "ACL Reconstructed Knee: qMRI and Biomechanical Modeling," totals $357,234 and was awarded through the Eunice Kennedy Shriver National Institute of Child Health and Human Development.

Provided by University of Delaware