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# Auburn Uses Vicon Mocap to Stop ACL Tears Before They Happen

Image courtesy of Auburn University

For competitive athletes, an injury is almost a given at some point. If the athlete is lucky, the injury will be minor and the recovery time will be short. But for some, serious injuries are the beginning of a lengthy rehabilitation cycle, or even the end of a promising career.

But what if it didn't have to be like that? What if athletes were able to test themselves in order to better understand their individual risks, and prevent injuries from happening in the first place?

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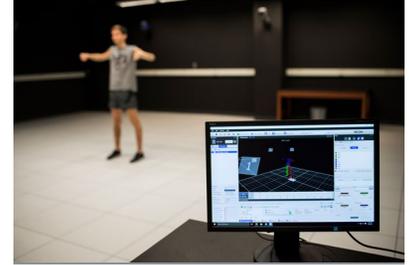
An ambitious new study at Auburn University hopes to turn this idea into reality by identifying the root causes of ACL tears, one of the most common and serious injuries that athletes face. From there, it hopes to create a training routine that will specifically act to lower those risks. By tracking current collegiate athletes throughout their college careers, Auburn is working to create a method that offers healthy, incoming athletes an ACL risk assessment before they even step on the court or field. With this information, trainers could prepare supplemental workout regimens tailored to individual athletes. This might include additional weight and flexibility training, or even retraining the athlete to avoid making certain movements. From Auburn's point of view, the more predisposed you are, the more you need to train away the risks.

Working out of the Auburn University Biomechanical Engineering Lab (AUBE), Dr. Michael Zabala, an assistant professor in mechanical engineering, started this process by looking at the root causes involved with ACL injuries, specifically in female athletes involved with soccer and basketball. Each year as many as 200,000 athletes at all levels from recreational to professional suffer ACL tears. Statistically, female athletes are far more likely to have ACL problems – in soccer, three to five times as likely; in basketball, two to seven times.

In order to create a risk assessment for athletes, Dr. Zabala and his team first need to isolate and identify the warning signs. The study currently involves 15 female soccer and basketball players, and that number is expected to grow over time. As part of the study, each athlete annually records a series of movements using high-speed optical cameras designed for motion capture. The goal is to be able to record them while healthy, to create a baseline. If they happen to suffer an ACL tear, they'll undergo a second set of motion capture recordings after they have recovered and returned to their sport.

By comparing the movements of those athletes that went through rehab alongside their baseline scans – along with the movements of those that played their entire collegiate career without an ACL injury the team hopes to be able to predict future injuries in incoming athletes based on the way they move and how their knee is naturally aligned. To do this, the team at Auburn needed cameras capable of capturing the most intricate and exacting details of athletic movement. This led Dr. Zabala to Vicon.

To gather the data, Dr. Zabala and the AUBE lab created an enclosed test area measuring 30 feet by 32 feet, lined with 10 Vantage V5 cameras surrounding the interior of the enclosure. Seven of the cameras are anchored at a height of eight feet, while the other three are positioned at waist level, giving a complete field of coverage and multiple angles for each movement. At the start of their season, athletes enter and engage in around 30 exercises that require them to run, cut, do box jumps, engage in balance tests and more, while the cameras track each knee and record the most exact details possible.

One of the reasons Dr. Zabala selected Vicon cameras was that the high-speed motion capture cameras helped to cut down any drift associated with the movement calculations, a problem familiar to most sports researchers who frequently use more portable, but less exact inertial sensors. The lab also uses two force plates as well, to record impact data along with the movements.

Although ACL tears do occur when contact is involved, the majority happen through non-contact movements, like suddenly changing speeds and coming down from a jump at just the wrong angle. These injuries can happen in a game, in practice, or even walking down the stairs. There is very little margin between an athlete cutting left to right and going on to score a goal, and someone cutting right to left and spending the next six months to a year recovering. Precision matters, which is why the lab selected Vicon.

"We're trying to do this all-inclusive analysis for multiple avenues to try and really wrap our minds around why this is happening, why someone's at risk," said Dr. Zabala. "The reality is that there are probably a lot of different factors that put someone at risk, but if we can understand as many of those as possible, and then ultimately relate those back to the actual injury, then we can start to look at determining who is at greater risk. From there we can look at how to prevent it happening in the first place."

Dr. Zabala's study will require several years' worth of data before it can begin to move on to offer a true risk assessment, but there may soon come a day when one of the most common and devastating injuries that an athlete can face becomes a minor concern.