

## Investigators Identify Cleat / Natural Grass Combination May Be Less Likely To Result in ACL Injury

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Athletes put less strain on their [anterior cruciate ligament \(ACL\)](#) while making a cut on a natural grass surface while wearing a cleat. This is the conclusion from a study by investigators at Hospital for Special Surgery (HSS) that tested the strain placed on the ACL of four different shoe-surface interactions: Astroturf/turf shoe, modern playing turf/turf shoe, modern turf/cleat, and natural grass/cleat. The study appears in the January 2010 issue of the *Journal of Biomechanical Engineering*.

“It appears that a similar cut made on four different surfaces, the best strain profile is in grass/cleat combinations,” said Mark Drakos, M.D., formerly an orthopedic fellow in the [Sports Medicine and Shoulder Service](#) at HSS. “So, there is less force occurring at your ligament for the same cut on that particular surface using this model.”

He added that the study investigated noncontact injuries. “These are injuries where an athlete plants his or her foot while making a cut and blows out his or her knee,” Dr. Drakos said. “The reason that I think this is so interesting is because there are still environmental factors, which have yet to be optimized. We don’t know all the science behind why ACL injuries may be more common on turf than on grass. This study starts developing some of the science behind that, so that it can be looked at more closely because, at the end of the day, I think we need to optimize some of those environmental factors.”

Previous studies have suggested that increased traction at the shoe-surface interface may increase the risk of sustaining an ACL injury. While the majority of studies reveal that ACL injuries are more likely to occur on artificial turf, there are some studies that have shown that injuries occur more frequently on grass fields. So, investigators have concluded that confounding factors, such as weather and footwear, must play a role in injuries. Some investigators have constructed models to test how the shoe-surface interface impacts loading conditions at the level of the foot, but no studies have investigated how the interface directly impacts the knee.

To fill this knowledge gap, investigators at HSS used a cadaveric model to test various shoe-surface interactions; they used the lower extremities (knee, foot, and ankle) from eight cadavers. One at a time, each specimen was positioned in a box-like structure, rigged to be in a standing position. The knee was positioned at a 30 degree angle, the flexion angle where the anterior cruciate ligament is most sensitive to strain. Investigators constructed an apparatus that placed weight on the leg, to simulate the weight of a body. Underneath the foot was a turf box that housed whatever turf they wanted to test and underneath the turf

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box, they placed a force plate that registered how much load was being placed on the shoe-surface interface. A lazy Susan was placed underneath the force plate that allowed the force plate and turf box to rotate. In this way, researchers could simulate a cut or a person pivoting in, for example, a soccer game.

“Our model looks at how forces travel up the kinetic chain, and that is something that should be looked at more closely, meaning you can’t just look at the knee injuries by looking at the knee in isolation,” Dr. Drakos said.

The investigators found that the natural grass/cleat combination placed a statistically lower maximum strain on the leg than any of the remaining three groups. All other combinations placed a greater amount of strain compared to the natural/grass cleat combination. The Astroturf shoe was 80.2 percent greater, modern playing turf/turf shoe was 47.5 percent greater, and the modern playing turf/cleat was 45.1 percent greater.

“As a former football player. I was always curious about why I was more sore after playing on artificial surfaces than playing on grass, and I wanted to find out the reasons behind that using a biomechanical model,” Dr. Drakos said. “There are basically 200,000 ACL injuries every year in the United States alone and this [type of playing field and type of shoe] is an environmental factor which has been shown to play a role in injury, but has yet to be optimized. I think it is a scenario that deserves attention and further research.”

Astroturf can be thought of as a carpet with ½ inch fibers on a 5 millimeter foam pad. The newer, modern playing turf consists of two inched fibers with a crumb rubber infill, three pounds of infill per square foot of turf. Investigators used fresh Kentucky bluegrass sod for the natural grass samples.

Other authors of the study are Howard Hillstrom, Ph.D, James E. Voos, M.D., Anna N. Miller, M.D., Andrew P. Kraszewski, B.S.; [Thomas L. Wickiewicz, M.D.](#), [Russell F. Warren, M.D.](#), [Answorth A. Allen, M.D.](#), and [Stephen J. O’Brien, M.D.](#), MBA.

#### **About Hospital for Special Surgery**

Founded in 1863, Hospital for Special Surgery (HSS) is a world leader in orthopedics, rheumatology and rehabilitation. HSS is nationally ranked No. 2 in orthopedics, No. 3 in rheumatology and No. 24 in neurology by *U.S. News & World Report* (2009), and has received Magnet Recognition for Excellence in Nursing Service from the American Nurses Credentialing Center, and has one of the lowest infection rates in the country. In 2008 and 2007, HSS was a recipient of the HealthGrades Joint Replacement Excellence Award. A member of the NewYork-Presbyterian Healthcare System and an affiliate of Weill Cornell Medical College, HSS provides orthopedic and rheumatologic patient care at NewYork-Presbyterian Hospital at New York Weill Cornell Medical Center. All Hospital for Special Surgery medical staff are on the faculty of Weill Cornell Medical College. The hospital's research division is internationally recognized as a leader in the investigation of musculoskeletal and autoimmune diseases. Hospital for Special Surgery is located in New York City and online at [www.hss.edu](http://www.hss.edu).

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