Study focuses on improving facemasks to help reduce football brain injuries

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Alex Bina (right) discusses results of tests being conducted on football helmet facemasks with John Desjardins, left, and Gregory Batt, middle. Credit: Denise Attaway / Clemson University

A team of Clemson University researchers and an Upstate businessman believe they can help make football a little safer by creating a facemask that can help reduce the severity of head injuries by increasing overall

helmet protection.

The researchers are Gregory Batt, an assistant professor in the Clemson food, nutrition and packaging sciences department; John DesJardins, an associate professor of bioengineering and director of the Laboratory of Orthopaedic Design and Engineering; and Alex Bina, a doctoral student in bioengineering who also is a graduate research assistant in food, nutrition and packaging sciences. They are teaming up with Jay Elmore, owner of Green Gridiron to determine how future designs of facemasks can help improve the overall safety of football helmets. The team has received a nearly $50,000 grant from the Robert H. Brooks Sports Science Institute for their study "Quantifying the Impact Performance of Football Helmet Facemasks."

"What we're working on is trying to understand and evaluate the role a football helmet facemask plays in the overall impact performance of a football helmet system," Bina said. "We're doing this by evaluating the mechanisms by which forces are transmitted from the facemask through the rest of the helmet system upon impact."

Impact forces on face masks

The forces Bina refers to are g-forces, which result from accelerations experienced by the head during impact. Bina and the rest of the team are working to make helmets more safe by creating a facemask that can help the helmet transfer g-forces away from the head. Traditional helmet design produces protective equipment that gradually decelerates the head upon impact. Facemasks are to prevent direct contact with players' faces.

"Ideally, facemasks would deform slightly in order to produce gradual head deceleration, but not so much so as to put players at risk of injuring their faces," Bina said. "However, the deformation properties of existing facemask designs are not available, making it impossible for doctors.

trainers and parents to make informed decisions when purchasing a facemask for their helmet system. The first step in our facemask impact performance experimentation is to generate a ranking system of existing facemask designs based on their ability to deform."

According to the National Institutes of Health, head injuries can occur when there is rapid change in the movement of the head, such as when a football player is tackled. Any significant force can have a detrimental effect on brain tissue. Batt said there are many different situations on a football field that cause rapid changes in velocity, or g-forces.

"These situations can be player-to-player or player-to-turf interactions," Batt said. "These rapid changes in velocity can cause the player's brain to move around and smash against the player's skull. This trauma can result in a brain injury."

The facemask tests

The Clemson team is using a linear drop tower system for its tests. Helmets tested in this manner are placed on an anthropomorphic head model and dropped from a specific height to generate a simulated football head impact. In the lab, the researchers said the linear drop tower testing system shows fewer than three impacts of 12 mph can cause permanent damage to facemasks. Football players of all positions commonly reach maximum velocities above 12 mph, especially on kickoff returns and coverage plays in both games and practice.

Using the linear drop system introduces many variables to the overall performance of a facemask design, including the helmet's padding structure, the helmet's outer shell and the chin strap buckles. Some facemask designs only fit one helmet style, but testing the entire helmet system will not specifically determine how one facemask performs compared to another.

"Because facemasks have been overlooked by the head impact research community, it is important to start at the structural and material level to determine appropriate facemask designs, then move into studying the method with which the facemask is attached to the helmet outer shell," Bina said.

The facemask tests are being conducted in the head impact section, the Clemson Helmet Impact Performance Laboratory (CHIP LAB) of the Sonoco Packaging Science laboratory on the Clemson campus. Some variables the researchers are studying include structural stiffness, resistance to permanent deformation and energy absorption. Over the course of a season, an NFL or college team may experience a handful of permanent facemask deformations in game situations, requiring the equipment staff to replace the facemasks on the sideline. However, at the youth level, the course of a season's worth of impacts in practices and games can permanently damage facemasks beyond repair.

Facemask reconditioning service providers, such as Green Gridiron in Greenville, select permanently damaged masks from youth, high school, college and professional programs and removes them from circulation. Undeformed masks are recoated and returned to teams.

Jay Elmore, founder and chief executive officer of Green Gridiron, believes in the Clemson facemask research. Elmore donated equipment to the Clemson professors for their research.

"I have been involved in football helmet facemask testing for more than six years and have struggled with inconsistent results," Elmore said. "As a provider of football facemasks for teams across the country at various levels of play, we look forward to the testing methods developed at Clemson University and their ability to provide science-based and data-driven criteria for facemask selection and future facemask development."

"When we set out to investigate facemask performance in general, there was no literature out there," DesJardins said. "From a research university's perspective, that's the perfect thing to do: research something that is important but no one has done before."

Football is a major sport at Clemson, so it is only natural a study on how to make the sport safer would be conducted by Clemson researchers.

"Anytime someone plays a contact sport, there's a chance they will suffer a concussion," said Danny Poole, Clemson's director of sports medicine. "Football helmets were developed to help stop skull fractures, not concussions. If a helmet can be created that would stop concussions, everyone would buy it."

Statistics from the Centers for Disease Control about 75 percent of traumatic brain injuries that occur each year are concussions. Sports is second only to car crashes as the leading cause of brain injury among people aged 15 to 24 years.

Provided by Clemson University