

Virginia Tech announces football helmet ratings for reducing concussion risk

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Testing the various football helmets for their ability to reduce the risk of concussions, from left to right, are: Steven Rowson, assistant professor in the Virginia Tech -- Wake Forest University School of Biomedical Engineering and Sciences, Ray Daniel, a doctoral candidate in the program, and Stefan Duma, professor and head of the school. Credit: Virginia Tech Photo

Virginia Tech released today the results of a new rating system of adult football helmets that is designed to reduce the risk of concussions. One currently manufactured helmet received the top "5 star" rating, and a total of five helmets received the very good "4-star" rating.

This biomechanical impact data study on football helmets represents the first time researchers have provided the public with comparative test

results.

The information is based on a new evaluation methodology that incorporated eight years of data and analysis, quantifying head impact exposure and risk of [concussion](#). The testing data showed that the overall best helmet currently available to the public is the Riddell Revolution Speed, which earned the only "5-star" rating. The next category includes five very good performing helmets that were all given a "4-star" rating: Schutt ION 4D, Schutt DNA Pro+, Xenith X1, Riddell Revolution, and Riddell Revolution IQ, according to Stefan Duma who directed the project.

"Our goal was to develop a thorough test matrix that would provide consumers with valuable biomechanical data in order to make educated decisions about which helmet to purchase," said Duma, a Virginia Tech professor of biomedical engineering and head of the Virginia Tech - Wake Forest University School of Biomedical Engineering and Sciences (SBES).

"The results clearly show that the newer technologies across all manufacturers are significantly better at reducing the risk of concussions compared to the older models," Duma added. The dataset for football helmets is the first installation in the National Impact Database that will cover many sports when fully implemented.

The evaluation involved performing 120 impacts on each helmet model at multiple locations and impact energies. A total of three new helmets were purchased for each model and tested to determine the STAR, an acronym for the Summation of Tests for the Analysis of Risk value. The STAR value is the calculated incidence of concussion for one season of full participation at a collegiate level.

"We utilized over one million measured head impacts to quantify the

impact exposure and concussion risk for the development of the STAR equation," said Steve Rowson, assistant professor at Virginia Tech in SBES. Rowson is responsible for the helmet testing and developed the methodology as part of his Ph.D. dissertation. "We perform the impacts using the National Operating Committee on Standards for Athletic Equipment drop test configuration because our data shows that it closely replicates on-field football head impacts."

The STAR value combines exposure with concussion risk as measured from the head acceleration results from this standards committee's style impact tests. Each helmet is tested at four impact locations (front, back, side, and top) at five different impact drop heights ranging from 12 inches to 60 inches.

"A unique aspect of the STAR system is that it weights each impact height to a corresponding number of impacts a player would see through the course of one season at that severity level. Depending on how the helmet performs, a risk is associated with each impact height," Duma said.

A manuscript detailing the methodology has been peer reviewed and [accepted for publication](#) by the *Annals of Biomedical Engineering*.

At the lower end of the ratings are several helmets that are currently in use. With a marginal rating of '1-star' the Riddell VSR4 is the second lowest rated helmet. Although it is currently being used by collegiate and NFL players, it is not currently sold to the public. The VSR4 helmets tested were in good condition but used.

"The VSR4 was included to illustrate the benefits of the new technologies from many manufacturers. For example, the Xenith X1 is a very good helmet and provides 55 percent reduction in risk of concussion compared to the VSR4, and that is statistically significant,"

noted Duma. "In other words, you can cut your risk of concussion in half by switching from the VSR4 to the Xenith X1." The reduction or increase in concussion risk between helmets can be determined by comparing the specific STAR value associated with each helmet.

Many of the 2010 Virginia Tech football team players used VSR4 helmets and had them through spring ball in April 2011. "Once we finalized the numbers, my first call was to our head team physician Gunnar Brolinson and our head team trainer Mike Goforth. We all agreed that we had to change out the helmets immediately," Duma said. "For the fall 2011 season, our players that had VSR4s will be in the Revolution Speed helmets."

To cover the cost of the new helmets, the School of [Biomedical Engineering](#) and Sciences agreed to pay for the newer and better performing helmets. "There is an appreciable cost associated with changing out approximately 40 helmets, but there is no question that we are going to do it," Duma said.

The lowest rating assigned was "NR" meaning not recommended, and that label was given to the Adams A2000 Pro Elite helmet. "The resulting STAR value of 1.7 was significantly higher than all other helmets and several of the impacts resulted in values that are close to the threshold for skull fractures," said Rowson. "For the same price that we paid, there are many other helmets that are much better," he added.

While there are large differences between the top performing helmets and the least performing helmets, the difference between 5-star and 4-star helmets is much less. "Following the earlier example, the Xenith X1 dramatically reduces concussion risk compared to the VSR4, but the improvement is much smaller going from the Xenith X1 to the Riddell Revolution Speed" said Duma. "I strongly recommend players purchase one of the 5-star or 4-star helmets as their performance is significantly

better than the others."

Overall, the cost of the helmet showed little correlation to the relative protection offered by it, Duma explained. All helmets ranged from \$159 to \$299. Interestingly, the Schutt DNA Pro + was one of the cheapest helmets at 169.95, but was one of the very good helmets given a 4-star rating. In contrast, the Adams helmet that is not recommended cost much more at \$199.

"This highlights the problems for consumers and was a key motivator for us to release the data. Performance is not directly related to cost and now consumers can make decisions based on independent data characterizing the biomechanical performance of these [helmets](#)," said Duma.

More information:

<http://www.sbes.vt.edu/people/faculty/primary/duma.html>

Provided by Virginia Tech

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