Researchers Hit Virtual Heads to Make Safer Games

Lloyd Smith, Washington State University

Two nearly identical softballs, both approved for league play, can have dramatically different effects when smacked into a player's head.

Those are the findings from a study conducted by Professor Lloyd Smith in the School of Mechanical and Materials Engineering and project engineer Derek Nevins that they will present at the Asia Pacific Congress on Sports Technology later this month in Hong Kong. Their work was published in the journal, *Procedia Engineering*.

Smith's group developed a unique model of a softball that they electronically throw at a virtual head to better understand and prevent injuries.

About a quarter of the injuries that happen on the softball field come from players getting hit with a ball, either thrown or batted at them. Most vulnerable are the pitcher, base runner, and third baseman. When they do occur, the injuries are almost always serious, oftentimes including a bone fracture, says Smith.

In many sports, balls are standardized for consistency and performance. But, researchers haven't understood specifically how the balls' different properties and materials affect player safety. They haven't been able to measure just how much or how it hurts when a ball hits a head.

While there have been human models for years, the ball is the hard part, says Smith. Models of softball collisions are especially challenging because of a low Coefficient of Restitution, or how the energy is transferred between the ball and what it hits, he says. Depending on its elasticity and its stiffness, the ball deforms and dissipates energy differently.

The researchers married the ball model they developed with Thums, or the Total Human Model for Safety. Thums sits on a computer screen – a perfect, computerized skeletal model of a head developed by Toyota for crash testing. He has a rainbow of different colored eye sockets, teeth, and detailed skull features, including the temporal and parietal bone, facial muscles, and even his cerebrospinal fluid. He looks like he's smiling, although it's not clear he's still smiling when the ball comes at the front and side of his head at between 60 and 120 miles per hour. He is called a 50th percentile male -- or an average guy.

In their study with the softball model, the researchers determined that two softballs that are commonly used for the same level of amateur play have significantly different properties and result in big differences in potential injury. The two balls differed in stiffness by 30 percent. Testing against a virtual head resulted in as much as a 64 percent difference in bone stress, or how badly he was hurt.

"For most impact conditions, bone stress exceeded the assumed bone strength,'' write the researchers.

That means that their virtual head ended up with a serious fractured skull.

The researchers hope that their ball model work can be extended to better understand more subtle but serious collision injuries, such as concussions, as well as lead to improved protective equipment and injury prevention in a number of sports.

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