Helmet Technology and Sports Safety Update from Sport Techie Pro Day

By Catherine Rinehart Mello

As part of my public policy role at the Brain Injury Association of Maryland, I attended Sport Techie Pro Day so that our organization is up to date on the latest regulations as well as emerging technologies to address the risk for damage to the brain in sports. The event brought together a panel of experts to discuss the intersection of helmet technology, helmet performance testing, chronic traumatic encephalopathy (CTE) and concussion.

With awareness of the impact of concussions and CTE on the rise in professional sports, more research and investments are going into developing better helmets to protect the skulls and brains of athletes at all levels. Football players started wearing leather helmets in the early 1900s. Later helmets were made of rigid plastic, then face masks and padding were added to reduce the risk of skull fracture and catastrophic injuries. Research does show that that modern helmets are effective in reducing the risk of these injuries[1]. Experts do not agree about whether we can conclusively say that modern helmets reduce the risk of concussion or CTE.

Chronic Traumatic Encephalopathy (CTE) is a chronic, degenerative disease of the brain that develops in some individuals who sustain repeated blows to the head. It is characterized by the buildup of tau proteins in the brain and can only be diagnosed after a person dies. Robert Stern of Boston University's CTE Center, reported that his research shows that there is a strong correlation between players developing CTE and length of time that they played football. The recent study shows that the risk of developing CTE doubled every 2.6 years that a player played football independent of the number of concussions sustained by the player[2]. Stern is not confident in the current helmet technology protecting athlete's brain from sub-concussive impacts which are associated with the risk of developing CTE.

Sterns lab currently has funding through National Institutes of Health to research methods for developing diagnostic tests that can be used to diagnose CTE during life. Having a reliable test for CTE will allow researchers to find out how common CTE is, provide a diagnosis so that people can seek treatment and identify protective risk factors that will further the understanding of CTE and inform prevention strategies. Stern and his colleagues are focusing efforts on finding biomarkers in the blood and trying to attach a tracer to Tau proteins that could be seen on a PET scan as potential diagnostic tests for CTE.

Elliot Kay, Commissioner for the Consumer Project Safety Commission (CPSC), discussed the challenges with creating industry standards as the research is still emerging. Kay reported that there is still a challenge in deciding whether helmets do reduce the likelihood of concussion in full contact sports. Exact risk of concussion for each athlete are not well understood but are generally based on the force and angle of a hit, rotational forces and individual physical factors. For these reasons, the Federal Government has not set minimum mandatory standards for helmets for most sports. There are federal standards for bicycle and motorcycle helmets.

---

[1] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2987604/

[2] https://onlinelibrary.wiley.com/doi/abs/10.1002/ana.25611?af=R

While all presenters agreed there is no way to eliminate the risk of concussion or other injury in sports. All presenters agreed that utilizing a combination of approaches would result in safer sports at all levels of play.

Kay cited three approaches to making a sport or other activity safer:

1) Design out the hazard
    a. Examples include: Having no contact practices or games
2) Guard against the hazard
    a. Examples include: Teaching techniques for tackling that reduce injury and wearing helmets
3) Warn and educate about the hazard.
    a. Examples include: Informing coaches, parents and youth about the risk for concussion and CTE and how to identify a concussion.

Mark Begonia of the Virginia Tech Helmet Rating lab described their process for determining ratings for helmets. Virginia Tech's Star rating system takes into account linear and rotational forces measured in a lab test and is weighted by how often they are likely to occur. Virginia Tech has tested and rated helmets from 8 sports and is focusing their testing on youth. Begonia reports that based on the research at Virginia Tech and review of a larger body of research, his lab is able to determine which helmets, rated highest in their tests, best reduce the risk of concussion. The National Football League (NFL) distributed information about helmet performance to players and changed rules with the aim to reduce concussions and reported a 29% decrease in concussions in 2018 over the previous season.

Dr. Jeff Bartsch discussed mouthguard based impact monitoring systems commercially available through Prevent Biometrics. Bartsch discussed the implication for gathering data about the force of any impact on athletes and what should be considered an impact or cumulative impacts that are significant enough to have implications for short-term and long-term brain health. Using a mouthguard-based sensor is the current gold standard for measuring impact to the brain. This is based on the theory that the mouthguard is in contact with the skull, making it a better placement for a sensor intended to measure the impact to the head, instead using sensors mounted on a helmet. Impact data from the sensors can be sent wirelessly to an app for real time review by sideline personnel. This technology allows sports programs to track several variables to inform decision making about impact exposure. Over time, programs will be able analyze a larger body of impact data to gain a better understanding of which variables matter the most when assessing the risk for concussion and CTE.

Jeff Crandall discussed his work at the University of Virginia and his company Biocore, which applies the same principals to testing and safety recommendations used for automobiles to testing and making recommendation for sports equipment. In one project, Crandall and his colleagues are working to develop computer based models of helmets. The computer-based models can help researchers and developers predict how the helmet and body will react to an impact. In another project, Crandall and his colleagues are using mouthguard sensors to measure the force and angles of impact to a player. They then review videos of each impact that causes a concussion to gather additional data about what happens just before and during an impact. Information and recommendations from both projects will be shared with the NFL and product developers.

Dave Marver, founder of helmet manufacturer, Vicis, described their helmets that are designed to reduce impact, much like a car bumper. The helmets yield when impacted, absorbing energy and reducing the force of the impact on the head inside. Vicis draws on the expertise of both medical and engineer professionals to collaborate on product development and testing. Marver reports that in the next 1-2 years, additional research will be released about how effective the helmets are at preventing injuries. Currently, Vicis has one of the top-rated football helmets, the Zero1, based upon testing done by the Virginia Polytechnic Institute.

During this event, it was clear that experts in the fields of helmet technology, consumer safety, and research do not agree about what we can say definitively about the protection that sports helmets provide to athletes. Funding for both research and product development is increasing options for protective equipment and what we know about its effectiveness. More data is being collected both in labs and on the field that will help both developers and researchers to better understand the impact of individual and cumulative impacts on athletes' brain health. Research is also emerging around position specific helmets, changes to shoulder pads, and changes to turf as potential engineering solutions to reduce the risk of concussions.