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Engineer helping unravel mystery of traumatic brain injury

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The American Academy of Neurology issued new guidelines last week for assessing school-aged athletes with head injuries on the field. The message: if in doubt, sit out.

With more than 3 million sports-related concussions occurring in the U.S. each year, from school children to professional athletes, the issue is a burgeoning health crisis.

While concussions may not be difficult to diagnose initially, the longer one waits, the more difficult treatment can be.

The efforts of a researcher and his colleagues at Washington University in St. Louis' School of Engineering & Applied Science are helping to unravel the many mysteries of traumatic brain injury.

"There's and urgent need to understand the problem of traumatic brain injuries, for the sake of athletes, military personnel and accident victims," says Philip Bayly, PhD, the Lilyan and E. Lisle Hughes Professor of Mechanical Engineering.

"Anyone who has met someone who's had a head injury knows how scary it is, and how frustrating it is that we know so little about the causal pathways, and thus the best therapeutic opportunities," he says.

Bayly, chair of the Department of Mechanical Engineering & Materials Science, researches the mechanics of brain injury. He recently received

a $2.25 million grant from the National Institutes of Health to better understand traumatic brain injuries.

Head injuries, concussions and the resulting trauma have been in public discussion recently as the National Football League (NFL) deals with a lawsuit regarding head injuries by about one-third of living former NFL players. The league is accused of not providing information connecting football-related head injuries to brain damage, memory loss and other long-term health issues.

Bayly's team is working on ways to measure 3-D relative motion between in the brain and skull and estimate strain during mild head acceleration. Bayly hopes computer simulation can teach researchers about the basic physics of brain injury and ways to develop new approaches to prevention and therapy.

"Our studies provide experimental data on how the brain actually responds mechanically in response to mild external loads," Bayly says. "This is especially critical to developing useful computer simulations, to make sure they reflect reality.
These simulations will in turn be used to design new equipment, evaluate rule changes in sports and determine exposure thresholds or diagnostic tests."

Computer simulation is important in creating animal models that can be used to develop diagnostic and therapeutic approaches, he says.

"Understanding mechanical deformation in traumatic brain injury is also essential to anyone studying brain trauma by exposing cultured brain cells to mechanical stress," Bayly says. "We need to understand how much stress to apply and in what directions."

How can athletes minimize their risks?

"From a mechanical standpoint, they should avoid repeated high head accelerations," Bayly says. "Head-to-head collisions and collisions with head-to-ground are clearly to be avoided."

Bayly says to truly protect athletes, new rules need to be instated.

"I would actually advocate for eliminating sports like boxing, in which injury-level accelerations are known to occur routinely. More research is needed on sports where the threshold is less clear."

There is where Bayly and his colleagues come in.

"We need to do the research to find out what kinds of repeated accelerations are responsible for producing the degeneration seen in chronic traumatic encephalopathy," he says.

Provided by Washington University School of Medicine in St. Louis