Physics makes a big impact in brain-injury research

April 2 2013

From battlefields to playing fields, worries over traumatic brain injury (TBI) have intensified recently as it has become clear that heavy knocks to the head – whether from bomb detonations or crunching sports tackles – can have serious long-term consequences.

In this month's issue of *Physics World*, Sidney Perkowitz, Candler Professor of Physics Emeritus at Emory University in the US, explains how the physics of these events is being recreated to shed light on this problem.

American football is probably the most high-profile sport where the issue of TBI has become prominent – driven in no small part by the suicides of ex-players suffering from diminished memory and emotional volatility, and the nearly 4000 legal challenges brought against the NFL, the sport's governing body.

Post-mortem examinations have shown that the brains of football players, as well as military veterans, show signs of the degenerative condition chronic traumatic encephalopathy (CTE) – a disease characterized by dark clumps of abnormal tau protein among the brain's neurons that has similar outcomes to Alzheimer's.

To diagnose, treat and prevent conditions such as CTE, researchers are using physics to figure out the types of impact, as well as the intensities, that are likely to cause brain damage.

Perkowitz highlights results from a range of studies that have helped researchers start to understand the nature of impacts in football games and the actual damage the impacts cause. Studies include data from mid-game measurements on the acceleration of the heads of American football players and the effect of small explosions, undertaken in a shock tube, on the brains of mice.

This research has been complemented by computer simulations designed to recreate the impact of blast conditions on the human brain.

The findings from all of these different trials are helping to uncover the exact mechanisms that cause TBI and, potentially, how helmets can be designed to better protect soldiers and athletes.

With many questions still to be answered, Perkowitz stresses the need for physicists to continue researching this area.

He writes, "Among the reasons to continue studying TBI and CTE are the serious policy issues they raise. These include whether young people, many of whom participate as amateurs and whose brains are especially vulnerable, should play contact sports."

Provided by Institute of Physics