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CONTACT: John Iwanski
(847) 378-0517 or jai@aans.org

Study Shows Modern Football Helmets May Provide No Better Protection than Vintage Leather Helmets in Tests of Near- and Subconcussive Impacts

Charlottesville, Va. – A new study, published online on Nov. 4, 2011, in the *Journal of Neurosurgery*, took a clinical approach to the question of whether early 20th-century leather helmets could offer the same level of protection as the modern, current versions used on the gridiron today — and supplied researchers with some surprising findings. Researchers in Ohio at the Cleveland Clinic and Case Western Reserve University, and in West Virginia at United Hospital Center, subjected the helmets to biomechanical loads that simulated near-concussive and subconcussive head impacts from a variety of directions. The study authors found that the protection afforded by vintage leather helmets often was comparable to or better than that provided by 21st-century varsity helmets currently in use. The study can be found online by going to http://thejns.org/doi/pdf/10.3171/2011.9.JNS111059. In addition, the November 2011 issue of *Neurosurgical Focus* is focused on both adult and pediatric sports injuries, and offers additional related information about the importance of safety and injury-prevention on the playing field — including a look at sports-related neurosurgical injuries, mechanisms and consequences of head injuries in soccer, and the development of an iPhone application for sideline concussion testing. The articles are posted online at http://thejns.org/toc/foc/current.

"Impact test comparisons of 20th and 21st century American football helmets. Laboratory investigation," is authored by Adam Bartsch, PhD, Spine Research Laboratory and the Cleveland Traumatic Neuromechanics Consortium. Co-authors are Edward Benzel, MD (Spine Research Laboratory; and department of neurosurgery, Neurological Institute, Cleveland Clinic); Vincent Miele, MD (Cleveland Traumatic Neuromechanics Consortium; and United Hospital Center Neuro-Spine Center, Bridgeport, W.Va.); and Vikas Prakash, PhD (Cleveland Traumatic Neuromechanics Consortium; and department of mechanical engineering, Case Western Reserve University, Cleveland). With concussion being one of the most important "signature" injuries in American football in the 21st century, modern varsity helmets are believed to universally improve protection by reducing head-impact doses and head injury for the three million young football players participating in the game in the United States. The object of the study was to compare those head-impact doses and injury risks with 11 widely used modern varsity helmets and two early 20th-century "leatherhead" helmets, and to hypothesize what the results might mean for children wearing similar varsity helmets.

The first author, Adam Bartsch, Ph.D., says the authors were "very surprised. We thought that the lighter leatherhead might reduce force and torque on the neck, but never suspected the head injury metrics would be comparable. We did not appreciate how stiff the modern helmets would be in common, everyday hits. Hence, the stiff modern helmet was often comparable to the minimalistic leatherhead."

The authors tested 11 commonly used 21st-century varsity helmets and two early 20th-century leather helmets (leatherheads) to compare doses of head impact and risks of injury. Placed on a head form (to simulate the head of the athlete), each helmet was struck by a large adult-size varsity helmet affixed to another head form on a pendulum. Front, oblique front, lateral, oblique rear, and rear head impact tests were conducted. The contact points were selected to approximate the same ones used in tests conducted by the National Operating Committee on Standards for Athletic Equipment (NOCSAE). The simulated injuries were designed to mimic

impacts of near-concussive and subconcussive head injuries sustained in football games. Studies have shown that “routine on-field head impact doses in high school and college were in the subconcussive range.”

American football is the leading cause of sports-related concussion in the United States. Today’s football helmets must meet standards set by the NOCSAE. These standards are based on avoidance of severe skull fracture and brain injury, and helmets currently in use have been optimized to protect the athlete’s head from these high-severity impact injuries. However, Bartsch and colleagues found that these helmets do not do as well in providing superior protection from lower-severity near-concussive and subconcussive head impacts. Although not so dramatic, these injuries may cause anatomical and functional changes in the athlete’s brain, and repeated injuries can lead to impact dose accumulations, which may produce a variety of disorders such as depression, memory problems, Parkinson disease and chronic traumatic encephalopathy.

Rather than suggest that football players return to leatherheads, Bartsch and colleagues strongly recommend the development of new safety designs and testing standards for helmets that will minimize doses of both high-severity and low-severity impacts and injury risks. This would be particularly important for helmets worn by children and adolescents.

Disclosure: The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper. The opinions contained herein are those of the authors.