Research shows promising results for a device designed to protect athletes from sports-related brain injuries

June 15 2016

Quarterback Sean Clifford for St. Xavier High School wears a collar during a game as part of a research study by Cincinnati Children's. Credit: St. Xavier High School

Two new studies involving high school football and hockey players indicate wearing a specifically designed compression collar around the

neck may prevent or reduce the devastating effects of head collisions in sports. The neck device, called a Q-Collar, is designed to press gently on the jugular vein to slow blood outflow increasing the brain's blood volume. The resulting effect of the increased blood volume helps the brain fit tighter within the skull cavity, reducing the energy absorbed by the brain during collisions.

The analysis of neurophysiological and neuroanatomical data from the brain showed athletes in the non-collar wearing group had significant functional and structural changes to white matter regions of the brain but these changes were not evident in those who did wear the Q-Collar during play.

"White matter of the brain essentially connects all the pathways including structure and function. Neuro-radiologists at Cincinnati Children's established a protocol for how the white matter in the brain is impacted after head collisions and what correlates to a brain injury," said Greg Myer, PhD, director of sports medicine research at Cincinnati Children's Hospital Medical Center. Dr. Myer is the lead author of both studies published recently.

In the preliminary study published in *Frontiers in Neurology | Neurotrauma*, 15 hockey players from St. Xavier High School took part. Half wore the collar for the hockey season and the other half did not. Each of the helmets for the athletes was outfitted with an accelerometer to measure every head impact. Results from the imaging and electrophysiological testing indicated that athletes in the non-collar wearing group had a disruption of microstructure and functional performance of the brain. Athletes wearing the collar did not show a significant difference despite similar head impacts.

In a follow-up study published today in the *British Journal of Sports Medicine*, 42 football players from two Greater Cincinnati high schools

participated. Twenty-one athletes from St. Xavier High School wore the collar during a competitive season. They were tested before play to make sure the lightweight, c-shaped neck collar fit properly. The other half of athletes participating in the study were from Moeller High School. Those 21 players did not wear the collar.

All of the athletes' helmets were outfitted with an accelerometer-a computer chip-which tracked every hit sustained during the pre-and post-season. Researchers used advanced magnetic resonance imaging (MRI) techniques, including diffusion tensor imaging (DTI), to determine the efficacy of the collar to prevent structural changes to the brain following a season of head impacts. The results of this larger study showed similar protective effects of collar wear during the football season.

"The results of the studies demonstrate a potential approach to protecting the brain from changes sustained within a competitive football and hockey season, as evidenced by brain imaging," said Dr. Myer. "We still have more data analysis and investigation to do, but this device could be a real game-changer in helping athletes."

This study follows previously published work by Dr. Myer regarding "brain slosh" and theories on how altitude influences concussions in football. Many football-related concussions are believed to occur because the brain doesn't fit tightly in the skull. Cerebral blood flow rises at higher altitudes, causing the brain to fit tighter inside the skull, thus reducing the risk of a concussion. Historical approaches to protect the brain from outside the skull such as helmets have not been effective in reducing internal injury to the brain.

David Smith, PhD, co-author in the studies, researched bighorn (head-ramming) sheep and woodpeckers because both animals routinely tolerate high-speed cranium collisions with no adverse impact. A head-on collision between two rams can be 10 times greater than that of two

football players; a woodpecker's impact against a tree is 20 times greater.

The migration patterns of head-ramming sheep show they are hitting at high altitudes. With woodpeckers, they have a long tongue that wraps around the top of their head lassoing the jugular vein, which increases blood volume creating a natural bubble wrap to keep the brain from sloshing.

Q30 Innovations designed the neck collar and provided funding for the research. Performance Sports Group has licensed the technology from Q30 for use in sports worldwide and applied for FDA approval to market the device.

Provided by Cincinnati Children's Hospital Medical Center