

Testimony of

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Good afternoon Chairman Conyers, Ranking Member Smith, and members of the Committee.

I come to you today with the following background: a former football player-10 years including junior high school, high school, and at the collegiate level, as a sideline team physician at the NFL or NCAA Division I levels for the last 20 years, as a neurosurgeon who runs the neurological service of a busy Level I Trauma Center, a researcher both in the laboratory with models of concussion, and its effects in humans, in the expression both while living and by autopsy analysis of their brains. I am also the father of five children. I believe that football is America's greatest sport and one which I love the most. My current position is Professor and Chairman of the Department of Neurosurgery at West Virginia University School of Medicine.

To me, there are three areas of concern for concussion in contact sports, particularly football, in America today. The first is the early and accurate detection of the presence of concussion and its appropriate and *conservative* management. The second is interdiction so that the deleterious effects on brain function are not felt at that time, in that season, to the detriment of the athletes' subsequent play, their ability to learn and perform scholastically, and on their general quality of life. The third area is to do everything in our power to understand and thus ultimately prevent, the possibility of the athlete developing a chronic brain injury due to multiple, diagnosed or not, cerebral concussions. This includes the syndrome of chronic traumatic encephalopathy or CTE.

In 2000, with funding and encouragement by the NFL Players' Association, and its Executive Director, Frank Woschitz, I, along with Dr. Kevin Guskiewicz, established the Center for Study of Retired Athletes, which has been in operation since that time and is located at the University of North Carolina, Chapel Hill. I remain the Medical Director.

Using funding provided by the NFLPA, we set out to study the health of about retired NFL players. Our studies showed two major conclusions, both published as independent scientific

papers in peer-reviewed, distinguished medical journals. The findings of our first study were an amount of joint, spinal, cardiovascular and other health issues as we would expect in these age groups and with their football exposure. However, to our surprise, the most unusual finding we noted was the high incidence of cognitive or psychological problems in these retirees. Using a general health questionnaire, 2,552 retired NFL players with an average age of 54 years and average football playing career of 6.6 years, this survey research identified by statistical analysis an association between recurrent or multiple concussions and memory impairments. That is, that retired NFL players who had mild cognitive impairment (MCI) were not only a higher number than found in the general population, but the only known risk factor they had was if they had sustained 3 or more concussions during their NFL playing days. If so, they had a five times increased chance of having MCI. This impairment of mental functioning has a terrible prognosis, since the vast majority of them will go on to develop Alzheimer's Disease within a decade.

Our second published study showed a higher incidence of retirees being diagnosed as having depression, 11% which greatly exceeds the incidence in age-matched general population. The only risk factor was, once again, a history of 3 or more concussions during their career, which conferred a triple-incidence of that diagnosis of depression. Therefore, this research has shown that there appears to be a threshold number, in our findings 3 concussions, where the incidence begins to appear for future problems with mental and psychological function. Regardless if it is 3 or another number of concussions, I believe that there is a threshold exposure to documented, significant concussions whereby the risk for long term problems accrues. A current study at the CSRA under the direction of Dr. Guskiewicz is undertaking a detailed analysis using special MRI scans, neurological, and neuropsychological testing concerning the brain functioning of retired players.

I have also worked extensively with Bennet Omalu, M.D., the neuropathologist who first diagnosed in 2002 the condition of CTE in the Hall of Fame NFL player Mike Webster. We began as a West Virginia- based brain injury group, now known as the Brain Injury Research Institute

based at West Virginia University. We are now operating under a Memorandum of Understanding with the Blanchette Rockefeller Neuroscience Institute. With special brain tissue staining methods used for detecting Alzheimer's Disease, we have gone on to examine the brains of 17 modern contact sport athletes. In every case where there were similar behavioral or psychological problems, such as personality changes, memory loss, business and personal failures, depression, and suicide, we have found extensive areas of tauopathy. This is the abnormal collection of Tau protein, indicating areas of dead brain cells, neurons, and their connections.

Our research has led us to better understand and classify the types of CTE and the areas of brain which are most commonly involved. We also have conducted research into the behavioral and emotional spectrum, the areas of the brain which control these functions, and the potential effects of substances of abuse, anabolic steroids, and other potential mitigating or contributing factors. In addition, we have found important trends in the genetic profiles of individuals affected with CTE, raising the possibility that in the future prediction of risk may allow for greater prevention in those potentially exposed.

In the laboratory, I have directed research which has investigated numerous structural, cellular, and behavioral changes in the brain resultant from concussive injury. Modern models of concussion create highly quantifiable and reproducible injuries which can be used to measure the effects of potential treatment for mild traumatic brain injury. It is our hope that one day, a dietary supplement or pharmaceutical could lessen or prevent the injury to neurons and their connections, or facilitate the brain's own attempts to repair these injured areas, or perhaps block the formation of tau protein deposits.

In my opinion, the sport of football, which I love and greatly desire to see as a viable and important sport in our country, needs to consider additional ways in which the game could be made safer. Many continue to say, "we're gonna keep studying this". However, it is my scientific and medical opinion that we now have enough indisputable research-from

examination of the brains of deceased athletes and the lives of retired players-to confirm the reality of CTE.

I believe that the phenomenon of sub-concussive blows, has been previously unknown or underappreciated, has an incompletely understood role but one of increasing importance. I believe that we should focus upon the velocity of the impacts, because to me that is the single biggest change in the sport which has led to increasingly violent collisions which likely are not going to decrease, and which also, at the highest impact levels, exceed the ability of current protective equipment and human brain tolerance. I am here today to try to keep the game alive by making it safer. Thank you for allowing me to speak with you and I will be pleased to answer any questions.