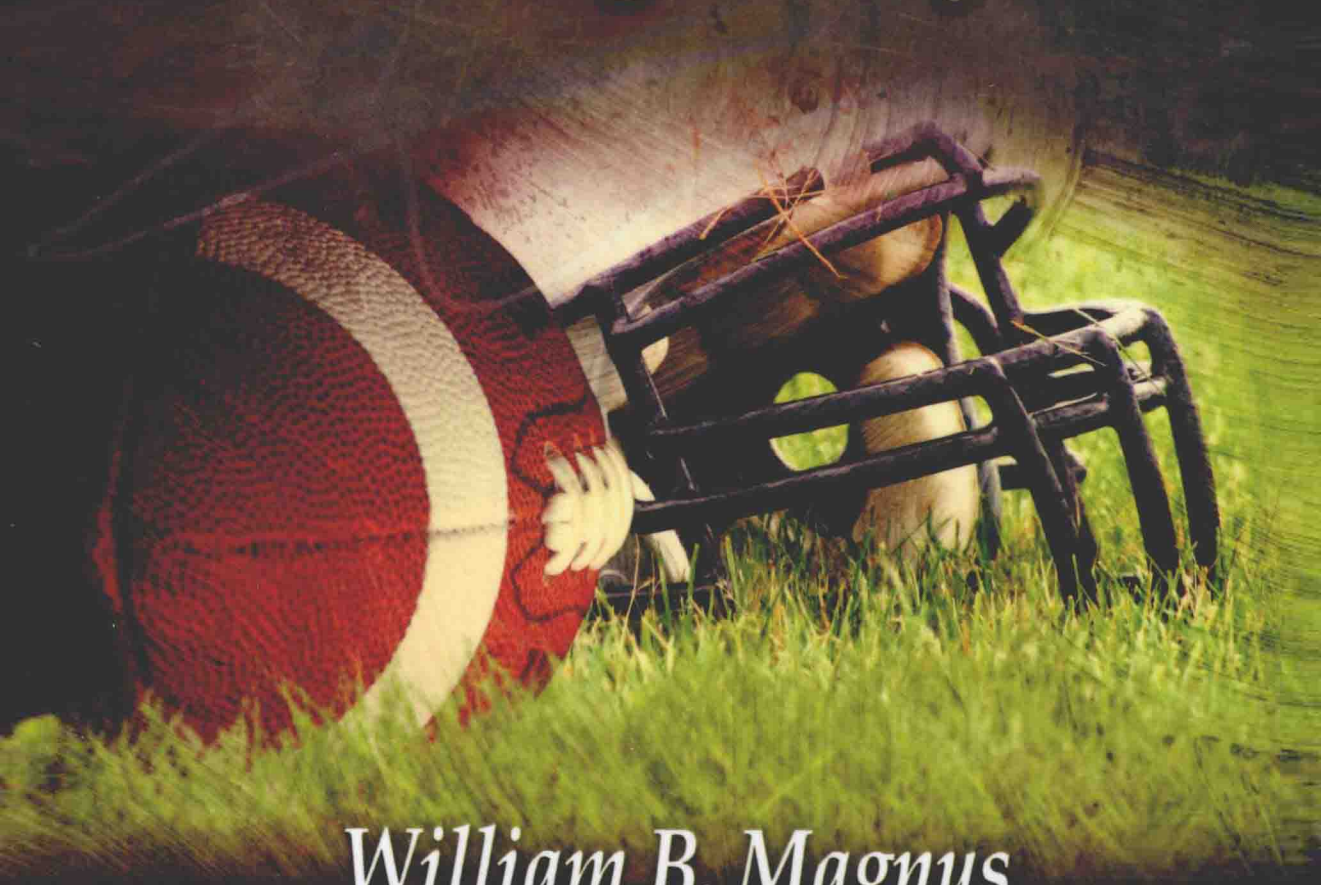


# CONCUSSIONS IN SPORTS

*Protecting the Players*



*William B. Magnus  
Linda J. Alonso  
Editors*

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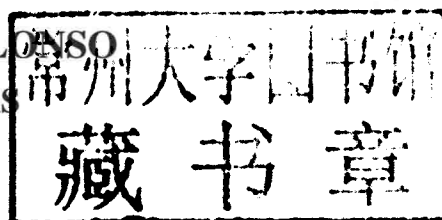
# CONCUSSIONS IN SPORTS: PROTECTING THE PLAYERS

WILLIAM B. MAGNUS

AND

LINDA J. ALONSO

EDITORS



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**SPORTS AND ATHLETICS PREPARATION, PERFORMANCE, AND PSYCHOLOGY**

# **CONCUSSIONS IN SPORTS: PROTECTING THE PLAYERS**

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## PREFACE

The human brain, although encased by a heavy duty cranium, isn't designed for football. Helmets do a nice job of protecting the exterior of the head and preventing deadly skull fractures, but concussions occur within the cranium when the brain bangs against the skull. Short-term effects of a head injury, which depending upon the severity of the injury, may be debilitating, include headaches, sensitivity to light and confusion. Dementia, chronic traumatic encephalopathy and depression are possible long-term consequences of repetitive head injuries. This new book examines efforts to protect football players from concussions; explores the legal issues relating to football head injuries and the impact of concussions on high school athletes.

Chapter 1- For many years, it was said that National Football League (NFL) players who had sustained concussions were “dinged,” or “had gotten their bell rung.” Out of a sense of loyalty to their teammates, a desire to win, or concern that sitting on the bench with an injury would hurt their chances to make the team, players would—and, perhaps, were expected to—play through their injuries, including concussions.

Beginning around 2006 or 2007, the NFL, the NFL Players Association (NFLPA), and others increased their efforts to safeguard active players and assist former players (although there has been no explicit, public acknowledgment by the league that repetitive brain injuries cause dementia and related illnesses in retired NFL players). It should be noted, however, that one milestone predates this time period. The NFL established its Mild Traumatic Brain Injury (MTBI) Committee in 1994; its successor, the Head, Neck and Spine Medical (HNS) Committee, was formed in 2010. As for the NFLPA, it established the Mackey-White Traumatic Brain Injury Committee in 2009.

Chapter 2- Everyone who plays football at any level knows it is a dangerous sport. There should be no surprise when a football player separates his shoulder, twists his ankle or bruises his knee. But over the last several years, an increasing number of retired players have developed long-term memory and cognitive diseases, such as dementia, Alzheimer's, depression, and Chronic Traumatic Encephalopathy, also known as “CTE.” These are not the types of risks most players or their families ordinarily associate with the game of football.

Chapter 3- Since becoming Commissioner, I can think of no single issue to which I have devoted as much time and attention. I believe we have an obligation to these men who have contributed so much to our game. I have personally travelled around the country to meet with groups of retired players and their families. I have met with many of them individually or in small groups, and have had discussions with advocates of retired players. I appointed one of

our senior executives as my Special Advisor on retired player issues shortly after I became Commissioner. Twice this year, representatives of the NFL Alumni Association and other retired player groups have met in formal league meetings with team owners. These discussions helped us as a league better understand the challenges - including health issues--facing our alumni and led to specific actions to assist them.

Chapter 4- The game of football is America's passion, as it is often discussed, analyzed and debated 24 hours a day, seven days a week and discussions focusing on the business of football are becoming increasingly popular – just ask anyone who participates in a fantasy league; however, the science of football is rarely discussed or scrutinized. Perhaps the catalysts for the current spotlight on the potential effects of traumatic brain injuries are the recent study conducted by the University of Michigan Institute for Social Research on former NFL players and an article in *GQ* entitled, “*Game Brain*”. However, during the last five years, there were other significant articles by Alan Schwarz of the New York Times and Peter Keating of ESPN.

Chapter 5- My father Hugh Culverhouse was awarded a National Football League expansion team in 1974. From that point until his death in 1994, I was intimately involved in football. I served for ten years in an administrative role first as vice president for community relations and treasurer and then as the president. I was at that time the highest-ranking woman in the NFL.

From the beginning let there be no mistake, football consists of a series of games being played to determine the ultimate Super Bowl champion. Contrary to popular opinion, this is no longer a rich man's hobby. In reality this is a cutthroat business. The goal is for the franchise to make money. The product is games on the field. The “win” is a positive financial bottom line.

Chapter 6- In 1994, Commissioner Paul Tagliabue requested that a committee be formed to determine what was known about concussions in sports, and study every facet of the injury as it related to the game of football. The first request revealed a stark reality—we did not have much scientific data on sports related concussions. Evaluation and treatment guidelines were well intentioned but not based on solid science. Major helmet manufacturers informed us their products had not changed substantially in many years. Their products were adequately protecting players from catastrophic brain injuries, but there was no stimulus for innovation to decrease the risk of concussion.

Chapter 7- We are here today because there is a growing awareness of the public health crisis we are facing due to the long-term consequences of football-related brain trauma. Over the past several years, there has been growing and convincing evidence that repetitive concussive and subconcussive blows to the head in NFL players lead to a progressive neurodegenerative brain disease called chronic traumatic encephalopathy or CTE.

Chapter 8- When it comes to my personal identity, I will always see myself as a former Harvard football player, and I hope this enables me to provide a unique perspective as a current brain trauma researcher, and post-concussion syndrome survivor. I began playing football in high school drawn in by the spectacle on television and the opportunity to hit people as hard as I wanted without getting in trouble. As a two-way player in high school and an All-Ivy League defensive tackle at Harvard, I probably hit my head over one thousand times a year from the ages of 13 to 21.

The concussions began happening at Harvard, and continued when I became a professional wrestler for World Wrestling Entertainment, where I played an arrogant Ivy

League snob-another story for another time. My concussions began happening so frequently, and with such severe symptoms, that I was forced to retire at age 24. I was left with an unreliable memory, daily throbbing headaches, depression, and even developed a dangerous sleepwalking habit. The first seven doctors I saw couldn't figure out why my last concussion was so devastating and why I didn't bounce back.

Chapter 9- I received my medical degree in 1979, and I am board certified in both Neurology and Neuropathology. I have extensive experience in neuropathology of neurological disease and have written extensively on the neuropathology of many neurodegenerative diseases, including Alzheimer's disease, Parkinson's disease, and Frontotemporal Dementia, as well as normal aging. For the past 23 years, I have been studying the brains of individuals after death and correlating the pathological findings to the patient's clinical symptoms during life. I have examined thousands of brains, brains from people in all walks of life including brains from individuals who have lived to be well over the age of 100. In addition, for most of my professional career, I have been focused on *tau* protein, a protein that becomes toxic when abnormally phosphorylated and builds up in the brains of patients with some neurodegenerative diseases, including Alzheimer's disease, but is found only in very limited quantities in the brains of normally functioning people.

Chapter 10- 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.

Chapter 11- I want to welcome everyone to today's hearing at the Wayne State Medical School, which has been a focal point in the research on brain injuries since 1939. It is fitting that we meet today, at the end of the regular season for professional football, and the end of the bowl season for college football, and after so much attention has been drawn to the issue of head injuries.

The American people, and especially those here in Detroit, face a litany of challenges: at the top of the list is finding stable employment and affordable health care. While I have been fighting for universal health care and full employment for all, I have also sought to highlight serious public health issues so that parents and children fully understand the ramifications of their decisions.

Chapter 12- There has been much progress in the area of concussion prevention – the NFL, in conjunction with the its concussion committee, made strides by setting return- to-play guidelines governing players that have sustained head injuries during a game or practice. The NFL is also currently running a public service announcement that encourages players to report head injuries suffered by a player or his teammates. The awareness has been heightened significantly due to these efforts by the League; however, it is unfortunate that it took Congressional pressure to force action for such a critical issue. There is simply no justification for the NFL to have previously ignored or discredited Dr. Omalu and others with relevant, valid research. For far too long, our former players were left adrift; as I emphasized



at the last hearing, we were complicit in the lack of leadership and accountability but that ends now. I am here again to make it clear that our commitment is unwavering.

Chapter 13- At your October 28 hearing in Washington, I testified on the work that has been done since 1994 by the NFL's Mild Traumatic Brain Injury (MTBI) Committee, of which I am a member. Our committee was specifically charged in 1994 with initiating and supporting independent scientific research to further the understanding of the causes, diagnosis, treatment and prevention of concussion. This work has involved research on helmet standards, injury data collection and analysis, and an ongoing study of the long-term effects of concussions on NFL players.

As a result, the NFL in recent years has initiated educational and preventive measures, guidelines for the management of concussions, and rule changes to eliminate unnecessary hits that can lead to concussions. Since the formation of the committee in 1994, there has been a significant positive culture change in the NFL on the issue of concussions. I have personally witnessed this culture change among NFL teams and players and I am confident that it will continue in a positive direction.

Chapter 14- As Director of Health and Safety of the NCAA, I appreciate the opportunity to respond to your request for information on a critical medical issue at the core of student-athlete well-being. The NCAA and its membership have devoted significant resources to study, educate and enforce various health and safety standards, including those in the area of football-related mild traumatic brain injury (MTBI).

Congressman Conyers, I trust you found our October 2009 response pertaining to the health and safety action of the NCAA over the years related to mild traumatic brain injuries useful and timely. We have also included our list of resources and actions as part of our written testimony for reference. You will be interested in learning that since we provided you with the response in October the NCAA has taken additional steps to further ensure student - athlete well-being, and I will expand upon that in a moment.

Chapter 15- The NFHS, based in Indianapolis, Indiana, is the national leadership organization for high school athletics and performing arts programs in speech, debate, theater and music. Since 1920, the NFHS has worked with its member state associations on the development of education-based interscholastic sports and fine arts activities. We believe these activities are an essential part of the high school experience and go a long way to improving academic performance and making better citizens. The NFHS sets direction for the future by building awareness and support, improving the participation, establishing consistent standards and rules for competition, and helping those who oversee high school sports and activities.

Chapter 16- I discovered the first case of footballer's dementia in Pittsburgh Steelers Hall of Famer Mike Webster. I performed an autopsy on Mike Webster in 2002 when he died suddenly at the age of 50. Mike Webster's life after retirement from football was marred by progressive symptoms of dementia, major depression, mood disorders, drug abuse and violent/criminal tendencies.

Surprisingly his brain at autopsy appeared normal by naked eye examination. In spite of his brain appearing normal, I performed extensive tissue analysis of his brain using sophisticated tissue technology, which revealed a unique type of dementia. This instigated my definition of a new disease, which I called Chronic Traumatic Encephalopathy [CTE].

Chapter 17- As physicians and scientists, it behooves us to critically evaluate the evidence before reaching definitive conclusions. My education, training and clinical

experience have provided me with the tools necessary to accomplish this task. In the process of researching and writing my honor's thesis at Cornell, I learned how to critically analyze scientific manuscripts and how to view science in its historical and social contexts. I studied how political pressures can subvert the scientific process. During my medical school years at NYU, I learned how to transfer information gleaned from scientific research to the clinical evaluation and treatment of patients. As resident and chief resident in neurology at NYU-Bellevue, I was fortunate to have had the unique experience for a neurologist of having primary clinical responsibility for the diagnosis and treatment of many hundreds of patients with head injuries of all severities. After completing my residency, I pursued my clinical interest in head injuries by studying boxers. Over the next few years, I exhaustively studied the neurological literature regarding brain injuries in boxers and performed numerous neurological examinations of boxers. With the assistance of many colleagues, I performed clinical neurological research studies on active and retired boxers. Our study on retired boxers that was published in JAMA was the first to report the results of clinical neurological examinations, neuropsychological testing, EEGs and CAT scans of the brain in retired boxers. The evidence collected in that study demonstrated that modern era retired boxers had signs of chronic brain damage. Many in the boxing community expressed their displeasure with the findings and criticized the paper. This did not deter me from publication. Then, as now, my allegiance was to scientific truth and I followed the scientific evidence.

Chapter 18- At the last congressional hearing, hours were spent discussing and criticizing the NFL concussion committee's research. However, we were also told that this same committee would be doing even more research, this time on helmets. The issues are many.

The NFL's testing protocols, implemented under the direction of Dr. Elliot Pellman and Dr. David Viano, both former chairmen of the NFL's concussion committee, are based on a very small number of "exceptionally high velocity", illegal helmet to helmet impacts, that should never have happened in the first place. I estimate these 25 hits represent only .001% of a pool of impacts that likely caused thousands of undiagnosed concussive episodes, ignored in the NFL's research, from 1996-2001. Here is one video of this testing procedure, from our lab: <http://www.xenith.com/videos/Linear-Impactor.html>

Chapter 19- For the last 25 years I have worked as a Research Scientist, testing, developing and evaluating protective systems for human beings. Most of this work has centered on head protection for athletes and military personnel. I am chairman of the American Society for Testing and Materials Subcommittee F08.53 on Helmets and Headgear. I am not here in that capacity today and wish to make that clear. I am also the Technical Advisory Consultant for the National Operating Committee on Standards in Athletic Equipment (NOCSAE). In this capacity I advise the NOCSAE board of directors, the NOCSAE committee and NOCSAE licensee manufacturers, on the science, research and test methods that NOCSAE promulgates in the interest of athlete safety. I am not here today in that capacity and wish to make clear that I do not speak for NOCSAE, do not serve on the NOCSAE board and further I am not authorized to represent NOCSAE at these meetings. I also wish to make clear that none of the testing conducted by me, my staff at SIRC or anyone involved in the recent NFL test battery was performed on behalf of, in conjunction with or for NOCSAE. In fact NOCSAE has had no involvement or input either directly or through others in the recent testing.

Chapter 20- Since my arrival at Wayne State in 2001 my research emphasis has gradually shifted to the application of "functional" MRI methods to traumatic brain injury. This was in

large part driven by cross-campus strengths in TBI at Wayne. Wayne State University has a long and illustrious history of biomechanics head trauma research beginning in the 1940's with Gurdjian and Lissner's studies utilizing cadaver brains which led to the Wayne State Concussion Tolerance Curve, which continues to be the foundation for most currently accepted head injury indices. Under Dr. Albert King's leadership for three decades, three dimensional mathematical models of the brain's response to impact and blast forces have resulted in improvements in automobile cabin safety and in football helmet design used in the NFL. On the medical side, hospitals at the Detroit Medical Center are world leaders in the acute and rehabilitation stages of TBI, respectively, and have had continued NIH research support. My clinic is comprised largely of patients with brain disorders, the majority of which are dementia evaluations and traumatic brain injury cases. In a given week I will see as many as 3-4 new patients with TBI and an equal number of memory disorder cases.

Chapter 21- My name is Jeff Kutcher. I am a neurologist at the University of Michigan where I serve as chief of inpatient neurological services as well as director of Michigan NeuroSport, a comprehensive academic program in sports neurology. NeuroSport cares for athletes at all levels, from youth sports to professional leagues, conducts research on sports concussion as well as other issues in sports neurology, and provides education to athletes, parents, coaches, schools, and health care providers.

I am the team neurologist for the University of Michigan and Eastern Michigan University athletic programs as well as a neurological consultant for several local area high schools and the USA Hockey Developmental Program. Through these roles, I conduct pre-season baseline concussion testing, diagnose and manage concussion on the sidelines, and follow patients after concussion in the training rooms and in my clinic. As a practicing general neurologist, I also have experience with the complete spectrum of neurological disease, including stroke, epilepsy, headache disorders, and dementia.

Chapter 22- My testimony from the prior hearing on October 28, 2009, provides my background with concussions in sports, beginning with my football career at Harvard University. At the prior hearing in October, I focused my testimony on two major battles in what is appropriately described as a two-front "concussion crisis." First, to define the issue today as we see it, football is currently plagued by a problem with concussions and also a problem with Chronic Traumatic Encephalopathy, or CTE, the progressive degenerative brain disease caused by repetitive brain trauma, including both concussions and subconcussive blows to the head.

Chapter 23- In late 2006, Willie Wood, NFL All Pro Green Bay Packer and Pro Football Hall of Famer, was hospitalized after an accident in his home in Washington DC. Willie is my former college teammate, close friend and sometime legal client. When I arrived at Providence Hospital to see him, he did not recognize me and could not feed himself. My initial concern was that he might have had a stroke. My own involvement with the acute medical issues that impact retired NFL players began that day.

As a result of being a "hard-hitting" defensive back for 11 years with the Packers, playing at 175 pounds, Willie had suffered many physical injuries and concussions. Willie thus had some physical problems prior to his fall at home and used a crutch and cane to get around in the house. His adult son lived downstairs in the house and had begun to notice some memory issues with his dad. For instance, he would get lost easily when driving. So, after a few incidents, he took his father's car keys away from him.

Chapter 24- Today we ll examine how concussions, experienced by high school athletes on the playing field, are impacting their academic well being and quality of life.

We ll also learn more about how schools and the medical community can provide appropriate management and support for these young student athletes.

One of our committee s key priorities has been looking at how we can keep students safe and protected in school.

But this is our first hearing looking at what happens on the athletic field, where many school injuries occur.

Last year, Congressman Andrews, Congresswoman Bono-Mack and I asked the Government Accountability Office to look into concussions in high school athletics after several professional athletes suffered debilitating and news-making head injuries diagnosed as concussions.

It was clear to us that if the NFL was paying attention to concussions at the professional level, we should be doing the same at the high school level when students bodies and minds are still growing and therefore more vulnerable.

Today, GAO will share the findings of their report.

We ll hear about the incidents of concussions in high school sports and what federal programs exist to help prevent these catastrophic injuries from sidelining students. This is the first comprehensive look at what is being done to prevent and manage these injuries.

Chapter 25- Participation in school sports can benefit children but also carries a risk of injury, including concussion. Concussion is a brain injury that can affect memory, speech, and muscle coordination and can cause permanent disability or death. Concussion can be especially serious for children, who are more likely than adults both to sustain a concussion and to take longer to recover. These factors may affect return-to-play decisions, which determine when it is safe for an athlete to participate in sports again.

GAO was asked to testify on concussion incurred in high school sports. This statement focuses on (1) what is known about the nationwide occurrence of concussion, (2) federal concussion prevention programs, (3) the components of key state laws related to the management of concussion, and (4) the recommendations of voluntary nationwide concussion management guidelines. To do this work, GAO conducted literature searches; reviewed injury databases, state laws, and documents from federal agencies and organizations that conduct work in high school athletics or sports medicine; and interviewed federal officials and experts who identified key state laws and nationwide guidelines and provided other information. GAO shared the information in this statement with the relevant federal agencies.

Chapter 26- Children's National has long been an advocate for child safety and injury prevention. Safe Kids Worldwide, the first national advocacy organization solely dedicated to pediatric injury prevention, was founded by Children's National in 1987. With respect to concussions, Children's Safe Concussion Outcome, Recovery & Education (SCORE) Program is the first and only program in the greater Baltimore-Washington region that specializes in the clinical evaluation and treatment of concussions in children, as well as conducting research and delivering public health education and advocacy nationally and internationally. The SCORE program evaluates and treats children and adolescents with concussions (also known as a mild traumatic brain injury or mTBI). In 2009-2010, the SCORE program at Children's National treated more than 1,000 children in its concussion clinics.

Chapter 27- In 2006 at an athletic director's conference, I sat in on a workshop that briefed us on the concussion management program – ImPACT. Being in the coaching business for close to 40 years and a witness to those injuries, this program and those like it had my attention. After taking this information back to our district superintendent, it was an easy sale. Any program/policy that will reduce injury risks to our student-athletes is a priority.

We were able within our school schedule to not only test our student-athletes but all our middle school and high school students. Each student is teacher every other year. Our district, Caledonia-Mumford Central School, felt that an injury, that can affect cognitive functions, can happen to any of our students – at home, to and from school, gym class, car accidents, etc.. Coverage for our total middle school and high school student population, not just athletes, is important. We tested grades 6, 8 and 10 this spring.

Chapter 28- I am here today to share with you my *traumatic* story on how much concussions have affected me and my life. I played my first basketball game when I was just seven years old and instantly fell in love with the sport. (I was even named “rookie of the year”). That following spring, I had the opportunity to fall in love with softball as well. My life revolved around sports.

In junior high school my basketball coach loved how aggressive I was. But maybe I was too aggressive. A girl from the other team and I collided while fighting for the ball. We both fell to the ground. All I thought was “ouch my head” and just got up and continued to play. Even though we both fell to the ground holding our heads, coaches, refs nor parents had thought anything of it. That was the start of my series of seven concussions over the next four years.

Chapter 29- Clearly, the incidence and, as we are discovering through more research findings, the prevalence of sport-related concussions is a matter that we in ASEP feel compelled to address. Yard and Comstock (2009) in Brain Injury-reported an estimated 395,274 concussions sustained by high school athletes nationally in 9 sports during 2005-2008. Those sports included baseball, basketball, football, soccer, and wrestling for boys and basketball, soccer, softball, and volleyball for girls. Concussion rates were highest in football and softball.

Chapter 30- TBIs are caused by a bump, blow or jolt to the head, or a penetrating head injury that disrupts the normal function of the brain. Not all blows or jolts to the head result in a TBI. The severity of a TBI may range from “mild,” with a brief change in mental status or level of consciousness, to “severe,” with an extended period of unconsciousness or amnesia after the injury. The majority of TBIs that occur each year are concussions or other forms of mild TBI. In addition to a bump, blow or jolt to the head, concussions can also occur from a blow to the body that causes the head to move rapidly back and forth. Most concussions occur without loss of consciousness. Health care professionals may describe a concussion as a mild TBI because concussions are usually not life-threatening; however, they can cause significant and serious health consequences. This is particularly true for athletes who may be at risk for experiencing multiple concussions.

Chapter 31- Sport-related concussions pose a unique risk to the pediatric population. Children and adolescents are still undergoing a significant period of brain development and thus are even more susceptible to the damaging effects of a concussion. The young athlete's immediate job is to go to school to learn and form new memories. However, a young athlete suffering from a concussion is often not able to attend school or function normally due to the brain injury.

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The long-term effects of concussions in athletes of all ages are cause for considerable concern. Children's developing brains are exceptionally vulnerable. Three months after a concussion, children 8 to 16 years of age have been found to experience persistent deficits in processing complex visual stimuli.<sup>1</sup> Further, athletes with two or more concussions demonstrate statistically significant lower grade-point averages compared with similar students without a history of concussion.<sup>2</sup>

# CONTENTS

<b>Preface</b>		<b>ix</b>
<b>Chapter 1</b>	NFL Players and Efforts to Protect them from Concussions <i>L. Elaine Halchin</i>	<b>1</b>
<b>Chapter 2</b>	Legal Issues Relating to Football Head Injuries <i>John Conyers, Jr.</i>	<b>37</b>
<b>Chapter 3</b>	Testimony of Roger Goodell, Commissioner, National Football League, Hearing on "Legal Issues Relating to Football Head Injuries" <i>Roger Goodell</i>	<b>41</b>
<b>Chapter 4</b>	Testimony of Demaurice Smith, Executive Director, National Football League Players Association, Hearing on "Legal Issues Relating to Football Head Injuries" <i>Demaurice Smith</i>	<b>47</b>
<b>Chapter 5</b>	Testimony of Gay Culverhouse, Ed.D., Hearing on "Legal Issues Relating to Football Head Injuries" <i>Gay Culverhouse</i>	<b>53</b>
<b>Chapter 6</b>	Testimony of Andrew M. Tucker, MD, Medical Director, Sports Medicine, Union Memorial Hospital, Baltimore, MD, Member, NFL Committee on Mild Traumatic Brain Injury, Head Team Physician, Baltimore Ravens <i>Andrew M. Tucker</i>	<b>57</b>
<b>Chapter 7</b>	Testimony of Robert C. Cantu, MD, Hearing on "Legal Issues Relating to Football Head Injuries" <i>Robert C. Cantu</i>	<b>61</b>
<b>Chapter 8</b>	Written Testimony of Christopher Nowinski, Co-Director, Center for the Study of Traumatic Encephalopathy, Boston University School of Medicine, President and CEO, Sports Legacy Institute <i>Christopher Nowinski</i>	<b>63</b>
<b>Chapter 9</b>	Written Testimony of Ann C. McKee, MD, Associate Professor of Neurology and Pathology, Boston University School of Medicine <i>Ann C. McKee</i>	<b>67</b>



---

<b>Chapter 10</b>	Testimony of Julian Bailes, MD, Chairman of the Department of Neurosurgery at West Virginia University School of Medicine <i>Julian Bailes</i>	<b>75</b>
<b>Chapter 11</b>	Hearing on Legal Issues Relating to Football Head Injuries, Part II <i>John Conyers, Jr.</i>	<b>79</b>
<b>Chapter 12</b>	Testimony of DeMaurice Smith, Executive Director, National Football League Players Association <i>DeMaurice Smith</i>	<b>83</b>
<b>Chapter 13</b>	Statement of Joseph C. Maroon, MD, Professor and Vice-Chairman, Department of Neurosurgery, Heindl Scholar in Neuroscience, University of Pittsburgh Medical Center, Team Neurosurgeon, The Pittsburgh Steelers <i>Joseph C. Maroon</i>	<b>87</b>
<b>Chapter 14</b>	Statement of David Klossner, NCAA Director of Health and Safety <i>David Klossner</i>	<b>91</b>
<b>Chapter 15</b>	Testimony of Bob Colgate, Assistant Director, National Federation of State High School Associations <i>Bob Colgate</i>	<b>95</b>
<b>Chapter 16</b>	Statement of Bennet I. Omalu, MD, MBD, MPH, Forensic Pathologist/ Neuropathologist/Anatomic Pathologist, Co-Director, Brain Injury Research Institute, West Virginia University, Morgantown, West Virginia, and others <i>Bennet I. Omalu</i>	<b>99</b>
<b>Chapter 17</b>	Written Statement of Ira R. Casson <i>Ira R. Casson</i>	<b>105</b>
<b>Chapter 18</b>	Testimony of Vincent R. Ferrara, MD, MBA, Founder and CEO, Xenith LLC <i>Vincent R. Ferrara</i>	<b>113</b>
<b>Chapter 19</b>	Testimony of P. David Halstead <i>P. David Halstead</i>	<b>117</b>
<b>Chapter 20</b>	Written Testimony of Randall R. Benson, MD, Assistant Professor of Neurology, Wayne State University School of Medicine <i>Randall R. Benson</i>	<b>121</b>
<b>Chapter 21</b>	Testimony of Jeffrey Kutcher, MD, University of Michigan, Department of Neurology, Director, Michigan NeuroSport <i>Jeffrey Kutcher</i>	<b>131</b>
<b>Chapter 22</b>	Written Testimony of Christopher Nowinski, Co-Director, Center for the Study of Traumatic Encephalopathy, Boston University School of Medicine <i>Christopher Nowinski</i>	<b>135</b>



<b>Chapter 23</b>	Testimony of Robert L. Schmidt, Chairman/ Co-Founder, Vincent T. Lombardi Foundation <i>Robert L. Schmidt</i>	<b>143</b>
<b>Chapter 24</b>	Chairman Miller Statement at Committee Hearing on “The Impact of Concussions on High School Athletes” <i>George Miller</i>	<b>149</b>
<b>Chapter 25</b>	Concussion in High School Sports: Overall Estimate of Occurrence is not Available, but Key State Laws and Nationwide Guidelines Address Injury Management <i>Linda T. Kohn</i>	<b>151</b>
<b>Chapter 26</b>	Testimony of Gerard A. Gioia, PhD, Chief, Division of Pediatric Neuropsychology, Children’s National Medical Center, Washington, DC <i>Gerard A. Gioia</i>	<b>167</b>
<b>Chapter 27</b>	Testimony of Michael T. Monacelli, Director of Athletics, Football Coach, Caledonia-Mumford Central School District <i>Michael T. Monacelli</i>	<b>173</b>
<b>Chapter 28</b>	Testimony of Michelle Pelton, Former Student Athlete, Age 19 <i>Michelle Pelton</i>	<b>175</b>
<b>Chapter 29</b>	Testimony of James Schmutz, Executive Director, American Sport Education Program, A Division of Human Kinetics <i>James Schmutz</i>	<b>179</b>
<b>Chapter 30</b>	Statement of Vikas Kapil, D.O., M.P.H., FACOEM, Associate Director for Science, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, U.S. Dept. of Health and Human Services <i>Vikas Kapil</i>	<b>195</b>
<b>Chapter 31</b>	Testimony of Joel S. Brenner, MD, MPH, FAAP, American Academy of Pediatrics <i>Joel S. Brenner</i>	<b>201</b>
<b>Chapter Sources</b>		<b>207</b>
<b>Index</b>		<b>211</b>