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Concussion and Football: Failures to Respond by the NFL and the Medical Profession

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INTRODUCTION

While medical experts have come to a better understanding of concussion in recent years, there still is much more to learn. We know that some football players develop a form of dementia (chronic traumatic encephalopathy) that appears to result from the repeated and mild head injuries that are a routine part of the sport.¹ However, we do not know the likelihood that a player will suffer from football-related dementia, nor do we know the extent to which genetic or other factors place some players at a greater risk than other players of developing dementia.

In reviewing the response of the National Football League (“NFL”) to concussion, one can easily think that the league was too slow to worry about the medical consequences of head trauma. Despite concerns being raised for many years about the risk to player health, it took until December 2009 for the NFL to advise its teams that players should not return to play or practice on the same day that they suffer a concussion.²

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¹ Steven T. DeKosky, Milos D. Ikonovic & Sam Gandy, *Traumatic Brain Injury—Football, Warfare, and Long-Term Effects*, 363 NEW ENG. J. MED. 1293, 1295 (2010).

² The guideline also states that players should not return to play or practice on a later date until cleared by the team physician and an independent neurologist. In a 2007 guideline, the NFL advised teams that players should not return to play or practice the same day as a concussion when the concussion was accompanied by a loss of consciousness. See Todd Neale, *NFL Institutes New Concussion Policy*, MEDPAGE TODAY (Dec. 3, 2009), <http://www.medpage.com/Neurology/HeadTrauma/17302>.

But the NFL was not alone in viewing concussion as a relatively mild problem; physicians also did not worry very much about the medical consequences of concussions. For some time, neurologic experts disagreed as to whether concussions could cause permanent injury, with many attributing patient symptoms to psychological issues or to the incentives created by compensation programs for people with disabling conditions. Team owners and league officials could have found articles or books that would have put them on notice about the effects of concussion, but they also could have found articles or books that would have given them a false sense of security.

Indeed for decades, concussion was viewed as a benign phenomenon without any structural damage to the brain and whose symptoms resolved fully within a short period of time.³ Moreover, people typically assumed that concussions required some kind of collision between the head and another object and that a loss of consciousness was always part of a concussion. Over time, however, it has become clear that concussions result in damage to the brain, that the damage may be permanent, and that concussions can occur without any impact to the head or without any loss of consciousness.

Accordingly, the NFL now recognizes that concussions entail some degree of brain injury and that players should not be placed at risk of further trauma to the brain until all evidence of the injury has disappeared. As long as the player experiences any signs or symptoms of the concussion, additional brain trauma may place the player at risk for even greater injury.⁴

To be sure, there are experts who believe that the brain never fully heals from a concussion, that there is always some permanent loss of brain capacity. In this view, repeated head injury increases the extent to which brain capacity is diminished with players suffering greater problems in neurologic functioning as the diminution increases.⁵ Thus, some neurologists believe that players should no

³ ROLLAND S. PARKER, CONCUSSIVE BRAIN TRAUMA: NEUROBEHAVIORAL IMPAIRMENT AND MALADAPTATION 50-51 (2001).

⁴ It is important to note that while the data on the effects of repetitive concussion are not definitive, there is growing evidence indicating that players need to fully heal after concussions to protect themselves against permanent neurologic injury.

⁵ Ultimately, repeated concussions can lead to severe neurological dysfunction and chronic traumatic encephalopathy. See Ann C. McKee, et al., *The Spectrum of Disease in Chronic Traumatic Encephalopathy*, BRAIN: A JOURNAL OF NEUROLOGY (Dec. 2, 2012), <http://brain.oxfordjournals.org/content/early/2012/12/02/brain.aws307.full>.

longer play football (or other sports) once they have had three concussions. But there is currently not a consensus on this question.⁶

While the NFL may have responded slowly to problems from concussions, the extent to which its response was unreasonable is unclear. If many medical experts did not worry about concussions, it is difficult to fault the NFL for not worrying either. Moreover, the NFL did not ignore concerns about head injuries. It imposed helmet requirements and banned types of blocking and tackling that were particularly dangerous.⁷ The NFL also convened an expert committee to study the issue.⁸ Still, one can question the NFL's failure to adopt concussion guidelines in the late 1990's, when guidelines were issued by medical experts.

CONCUSSION

Although concussions need not involve any impact to the head, they do involve a collision between the brain and the inside of the skull. When a person's head or body is jolted suddenly and forcefully, the brain can crash against the skull causing small tears and other damage to the brain tissue and disrupting the balance among chemicals in the brain.⁹ Both kinds of injury can cause neurological dysfunction.

The neurological dysfunction from a concussion can cause a variety of symptoms. People may temporarily lose consciousness, have headaches, feel dizzy or disoriented, and experience sensitivity to noise or light.¹⁰ Individuals may also experience nausea and vomiting, have difficulties concentrating, or fail to remember what happened just before and after the concussion.¹¹ The symptoms may resolve within minutes, hours or days; they may also persist for months or longer.¹²

Researchers believe that the disrupted chemical balance (metabolic dysfunction) leaves brain cells vulnerable to further injury. As a result, a second concussion in the next days or weeks can cause much

⁶ P. McCrory, et al., *Consensus Statement on Concussion in Sport – The 3rd Int'l Conference on Concussion in Sport, Held in Zurich, November 2008*, 16 J. CLINICAL NEUROSCIENCE 755, 760 (2009).

⁷ Richard S. Polin & Nidhi Gupta, *Athletic Head Injury*, in NEUROLOGY AND TRAUMA 506, 513 (Randolph W. Evans ed., 2nd ed. 2006).

⁸ Ira A. Casson, et al., *Concussion in the Nat'l Football League: An Overview for Neurologists*, 26 NEUROLOGIC CLINICS 217, 217-218 (2008).

⁹ ROBERT C. CANTU & MARK HYMAN, CONCUSSION AND OUR KIDS: AMERICA'S LEADING EXPERT ON HOW TO PROTECT YOUNG ATHLETES AND KEEP SPORTS SAFE 2-8 (2012).

¹⁰ Most concussions do not result in a loss of consciousness.

¹¹ CANTU & HYMAN, *supra* note 9, at 8-9.

¹² *Id.* at 71.

more damage than a single concussion alone. In some cases, the second concussion can be lethal (“second impact” injury).¹³ In addition, the repetitive brain trauma associated with football and other sports can lead to severe and permanent neurological impairment (chronic traumatic encephalopathy).¹⁴

Concussions are considered to be a relatively mild type of traumatic brain injury, with more severe types, including subdural hematoma, having the potential to cause devastating brain injury immediately. At one time, concussions were viewed as the mildest form of traumatic brain injury, but harm can also occur from blows to the brain that are not severe enough to cause a concussion (“subconcussive” trauma).¹⁵

MEDICAL UNDERSTANDING OF CONCUSSION

As mentioned, the medical profession was slow to recognize the significance of concussions. Consider, for example, what people would have learned about concussion in 1975 by consulting the fourth edition of Walton’s *Essentials of Neurology*: concussion is “a temporary and largely reversible disorder of brain function which is not apparently associated with any striking pathological change in the brain.”¹⁶ Or consider what was written in 1981 by Cartlidge and Shaw in *Head Injury*:

There are also those who believe that the postconcussional syndrome not only lacks an organic basis but is due to frank malinger. Miller . . . advanced in forthright terms the view that patients with postconcussional syndromes were simulating or at least consciously exaggerating their symptoms. In his own case studies he established a relationship between the occurrence of the syndrome and the incidence of claims for compensation . . . and he was struck by the absence of the syndrome as a sequel to sporting injuries.¹⁷

¹³ Edward M. Wojtys, et al., *Concussion in Sports*, 27 AM. J. SPORTS MED. 676, 677-78 (1999). There has never been a second impact death in the NFL. See Casson, et al., *supra* note 8, at 227.

¹⁴ Paul McCrory, *Sports Concussion and the Risk of Chronic Neurological Impairment*, 21 CLIN. J. SPORT MED. 6, 6 (2011).

¹⁵ CANTU & HYMAN, *supra* note 9, at 111.

¹⁶ JOHN N. WALTON, *ESSENTIALS OF NEUROLOGY* 242 (4th ed. 1975). Seven years later, Walton’s fifth edition included the same assessment of concussion. See SIR JOHN WALTON, *ESSENTIALS OF NEUROLOGY* 258 (5th ed. 1982).

¹⁷ N. E. F. CARTLIDGE & D. A. SHAW, *HEAD INJURY* 148 (1981). Cartlidge and Shaw did not themselves subscribe to this view. Rather, they believed that individuals vary in their responses

Some discussions of concussion reflected greater concern but also did not suggest that the problems were serious. In the chapter on concussion in Cooper's 1982 *Head Injury*, the text distinguished between mild cerebral concussion, for which consciousness was maintained, and classical cerebral concussion, which involved a "transient and reversible" loss of consciousness. After a mild cerebral concussion, the athlete would recover completely except for amnesia for the time periods just before and after the concussion. After a classical cerebral concussion, the great majority of athletes would have no long-term effects other than the brief amnesia, but "some patients may have more long-lasting though, subtle neurological deficiencies. Further investigation of these sequelae must be done."¹⁸

Even experts who counseled caution sent mixed messages. In a leading text on head injuries in football that was published in 1973, the authors observed that some players should stop playing football entirely after a single severe concussion (e.g., one that involved a loss of consciousness for more than five minutes) but also described concussion as a "reversible physiologic condition" that reflected "brief neurologic dysfunction."¹⁹ And the authors advised that for mild or moderate concussions, it would be permissible for the player to return to the game once symptoms resolved.²⁰

Interestingly, the authors acknowledged that players could return to action after concussions that would trigger a twenty-four hour hospitalization for the average citizen.²¹ As one reads the literature on concussion, one cannot help notice that experts are reluctant to pre-

to concussion, with some suffering real physical injury and others having symptoms of psychological origin. *Id.* at 153.

¹⁸ Thomas A. Gennarelli, *Cerebral Concussion and Diffuse Brain Injuries*, in HEAD INJURY 83, 85-87 (Paul R. Cooper ed. 1982). While Gennarelli did not say anything about athletes suspending their play after a concussion in his HEAD INJURY chapter, he wrote a similar chapter for another book in which he advised that after a mild cerebral concussion, players "should not be permitted to participate in the remainder of the contest" and that after a classic cerebral concussion, players should abstain from play for one to two weeks. See Thomas A. Gennarelli, *Cerebral Concussion and Diffuse Brain Injuries*, in ATHLETIC INJURIES TO THE HEAD, NECK, AND FACE 93, 96-97 (Joseph S. Torg ed. 1982). However, nine years later, Gennarelli removed his recommendations about players temporarily suspending play after a concussion and said nothing on that question. See Thomas A. Gennarelli, *Cerebral Concussion and Diffuse Brain Injuries*, in ATHLETIC INJURIES TO THE HEAD, NECK, AND FACE 270, 272-74 (Joseph S. Torg ed., 2nd ed. 1991).

¹⁹ Richard C. Schneider & Frederick C. Kriss, *First Aid and Diagnosis—The Treatment of Head Injuries*, in HEAD AND NECK INJURIES IN FOOTBALL: MECHANISMS, TREATMENT, AND PREVENTION 163, 164-65 (Richard C. Schneider ed. 1973).

²⁰ *Id.* at 164-65.

²¹ *Id.* at 165.

vent players from participating in athletic competition.²² Of course, individuals assume risks in many occupations, and it may be the case that the risks from concussion are worth bearing in view of the potential benefits from playing football. But it also may be the case that the risks from concussion were discounted in a society that has glorified the hard hits of football.²³

Skepticism about the harms from concussion reflected a number of factors. There did not appear to be a good correlation between the apparent severity of head trauma and the extent of symptoms. Some individuals did not develop persistent symptoms, despite the loss of consciousness and other neurological abnormalities that can accompany mild head trauma, while other people developed persistent symptoms without any loss of consciousness or other evidence of significant injury.²⁴ In addition, the medical profession had not developed a good definition for post-concussion syndrome. In a 1994 article, the author reported that only twenty-four percent of neurologists agreed that the post-concussion syndrome was “a clearly defined syndrome with a solid basis for determining prognosis.”²⁵

To be sure, there were experts who sounded the alarms. In 1962, for example, *The Lancet* published “*Concussion and Its Sequelae*.” That article described the commonly held view that patients recover from concussion with no lasting deficits but then went on to observe that “[t]he concept of concussion as a transient and benign affair” is “no longer tenable.” Rather, it was actually the case that the effects of concussion “may be severe and long-continued and are not always completely reversible.”²⁶ Similarly, while the previously mentioned chapter on concussion in Cooper’s 1982 *Head Injury* seemed reassuring, a later chapter in the same book, “*Behavioral Sequelae of Head Injury*,” raised greater concerns. It discussed evidence of significant and permanent neurologic damage from concussion, especially for athletes who sustained multiple concussions.²⁷ And by 1986, a leading expert on concussion in sports, Robert Cantu, had issued guidelines on

²² LINDA CARROLL & DAVID ROSNER, THE CONCUSSION CRISIS: ANATOMY OF A SILENT EPIDEMIC 127 (2011).

²³ *Id.* at 40-41 (describing the NFL’s “Greatest Hits” videos and a “Headcracker Suite” video).

²⁴ PARKER, *supra* note 3, at 50. In fact, concussions that do not cause a loss of consciousness are just as serious as concussions that do cause a loss of consciousness; see also CANTU & HYMAN, *supra* note 9, at 106-07.

²⁵ Randolph W. Evans, *The Postconcussion Syndrome: 130 Years of Controversy*, 14 SEMINARS NEUROLOGY 32, 32 (1994).

²⁶ Sir Charles Symonds, *Concussion and Its Sequelae*, 279 LANCET 1, 1 (1962).

²⁷ Thomas J. Boll, *Behavioral Sequelae of Head Injury*, in HEAD INJURY 363, 368-69 (Paul R. Cooper ed. 1982).

the management of concussion that generally advised minimum waiting periods before resuming play after a concussion (e.g., one week), with longer waiting periods for more severe concussions (e.g., one month), and even longer waiting periods after multiple concussions (e.g., two weeks instead of one week or terminating the season instead of one month).²⁸ Still, it would have been easy for league officials and team owners to find comfort from the medical profession, particularly if they were looking for reassurance.

By the mid- to late-1990's, public and professional understandings had shifted, and concussion injuries were taken more seriously. Consider, for example, the approach of the American Academy of Neurology ("Academy"), which took a harder line than other groups. The Academy published guidelines in March 1997 for the management of concussion sustained during athletic competition. While the Academy concluded that an athlete could resume play after a concussion when symptoms lasted no more than fifteen minutes and there was no loss of consciousness, it also said that a second such concussion in the same contest should result in the athlete abstaining from play until a week passed with no symptoms at rest or with exercise. Moreover, if symptoms of concussion lasted more than fifteen minutes, the athlete should abstain from play until two weeks passed with no symptoms at rest or with exercise.²⁹

If a player lost consciousness, then greater precautions should be taken. For a loss of consciousness that lasted a matter of seconds, the Academy wrote that athletes should abstain from play until a week passed without symptoms at rest or with exercise. If athletes lost consciousness for a matter of minutes, they should abstain from play until two weeks passed without symptoms at rest or with exercise. Finally, if an athlete sustained a second concussion with loss of consciousness, the athlete should abstain from play until at least one month passed without symptoms at rest or with exercise.³⁰

While the Academy's guidelines represented important progress, they reflected some failures in the response to the problem of concussion by medical experts. For example, the Academy recommended weaker precautions for concussions without loss of consciousness than for concussions with loss of consciousness. Also, the focus was much more on management of concussion than on its prevention. Finally, there was not much consideration of the possibility that playing foot-

²⁸ Robert C. Cantu, *Guidelines for Return to Contact Sports after a Cerebral Concussion*, 14 *PHYSICIAN & SPORTSMED.* 75, 79, 82 (1986).

²⁹ American Academy of Neurology, *Practice Parameter: The Management of Concussion in Sports (Summary Statement)*, 48 *NEUROLOGY* 581, 583 (1997).

³⁰ *Id.* at 583-84.

ball might pose risks to brain functioning that were too high. Rather, the main concern was how long an athlete should be kept out of competition after a concussion before returning to play—for fifteen minutes, the rest of the game, a week, or longer? In short, the Academy's primary concern was to ensure that athletes avoided contact that might aggravate their concussions by having the athletes refrain from play until it appeared that they had fully healed.

Indeed, when it came to recommendations for future research, the Academy said nothing about concussion prevention. Rather, it called only for the development of better ways to assess concussions in athletes on the sideline of the field immediately after the concussions occurred and for studies that would document the health consequences of concussion.³¹

Of course, concussions are an inherent risk to playing football,³² so attention must be paid to their management. Still, the Academy might have recommended that regulations be adopted to reduce the risks of concussion, as it did in a later position statement on sports such as boxing that involve intentional trauma to the brain.³³ And indeed, the NFL has taken or is considering measures to reduce the number of concussions. For example, full-contact practices may be held only about once a week during the season, and the league is contemplating the elimination of kickoffs, which have an especially high rate of concussion injuries.³⁴

Nine months after the Academy's report, in December 1997, the American Orthopaedic Society for Sports Medicine (AOSSM) convened a "Concussion Workshop Group," with representatives from major sports organizations and leading physician associations. Neurologists, neurosurgeons, orthopedic surgeons, pediatricians and emergency physicians were represented, as were the NCAA, NFL, and NHL.³⁵ Like the Academy, the workshop group focused its attention on treatment of athletes after they sustained a concussion. The group

³¹ *Id.* at 584.

³² According to Pittsburgh Steeler Troy Polamalu, "When people say they feel a little buzzed or dazed, it's considered a concussion. I wouldn't [think that]. But if that is a concussion, any football player has 50-100 concussions a year." Dan Patrick, *Just My Type*, SI VAULT (Dec. 31, 2012), <http://sportsillustrated.cnn.com/vault/article/magazine/MAG1206651/index.htm>.

³³ *Position Statement on Sports that Include Intentional Trauma to the Brain*, AMERICAN ACADEMY OF NEUROLOGY (June 21, 2008), <http://www.aan.com/globals/axon/assets/7466.pdf>.

³⁴ Judy Battista, 'Train Wreck of a Play' Collides With Consciences, N.Y. TIMES (Dec. 15 2012), http://www.nytimes.com/2012/12/16/sports/football/tradition-vs-player-safety-in-nfl-kickoff-debate.html?_r=0; Casson, et al., *supra* note 8, at 224; Collective Bargaining Agreement 143, NFL PLAYERS ASSOCIATION (Aug. 4, 2011), http://images.nflplayers.com/mediaResources/files/PDFs/General/2011_Final_CBA_Searchable_Bookmarked.pdf.

³⁵ Wojtys, et al., *supra* note 13, at 676.

published the results of its deliberations in 1999, and it identified some key areas of concern:

- Athletes should not be allowed to resume competition after a concussion while the brain was still recovering from the injury. In rare cases, a second concussion shortly after the first concussion could cause death.³⁶ In addition, repeated concussions could have a cumulative effect over time that was disabling.³⁷

- There were no objective measures that could identify whether a player actually suffered a concussion or how much harm was caused by the head trauma.³⁸

- Most athletes recovered completely after a concussion, but an “unknown number” would experience chronic symptoms, which for some players would be permanent and disabling.³⁹

After discussing the medical profession’s understanding of concussion and the ways that doctors should evaluate an athlete who may have suffered a concussion, the workshop group provided guidelines for when teams should allow players to resume competition after a suspected concussion. Surprisingly, the guidelines were not as strict as those issued by the American Academy of Neurology two years earlier:

- Athletes could return to play immediately if any symptoms resolved within fifteen minutes, they had a normal neurologic examination, and there was no loss of consciousness.⁴⁰

- For athletes with loss of consciousness or more than fifteen minutes of symptoms, the working group urged caution but did not provide clear guidance. For example, the group observed that:

Current medical knowledge does not adequately address this situation. While some athletes may benefit from 5 to 7 days of rest after experiencing initial symptoms in excess of 15 minutes, others may be able to safely return to play much sooner.⁴¹

- In short, “[c]urrent neuroscience knowledge in humans does not give a safe, firm timetable for return to play after concussion in most circumstances.”⁴² Hence, the working group called for more research and an individualized assessment of each athlete. Individualized assessments were to include repeated neurological assessments

³⁶ This is the “second impact” phenomenon. Richard L. Saunders & Robert E. Harbaugh, *The Second Impact in Catastrophic Contact-Sports Head Trauma*, 252 JAMA 538-39 (1984).

³⁷ Wojtys, et al., *supra* note 13, at 676-677, 681.

³⁸ *Id.* at 677.

³⁹ *Id.* at 681.

⁴⁰ *Id.* at 684.

⁴¹ *Id.*

⁴² *Id.* at 685.

during gradual increases in physical exertion to see if the exertion triggered symptoms.⁴³

Once again, the main issue was not whether athletes were placed at too great a risk of brain injury from playing football but how long they should rest after a concussion before returning to play. Notably, the working group did not suggest a different approach to the athlete who had suffered multiple concussions. Nor did it offer any suggestions by way of preventing concussions.

Indeed, the lack of recommendations for measures to reduce the frequency of concussion injuries is striking. In a 2004 article, *Unreported Concussion in High School Football Players: Implications for Prevention*, the authors concluded that prevention initiatives “should focus on education to increase athlete awareness of concussion and its risks and promotion of open lines of injury report.”⁴⁴ Robert Cantu had sounded a similar theme seven years earlier. After discussing the need to educate parents and athletes about the symptoms of concussion, he wrote that “education remains the most important preventive tool we have.”⁴⁵ In other words, prevention was viewed as a form of concussion management.

The emphasis on management rather than prevention of concussion likely reflected the fact that concussion generally did not appear to result in lasting harm. Thus, according to Goetz and Pappert’s *Textbook of Clinical Neurology* in 1999, concussions “are infrequently associated with structural brain injury and rarely lead to significant long-term sequelae.”⁴⁶ The text also advised that when “patients have unusual or persistent complaints, the possible contributions of personality disorder, psychosocial problems, or secondary gain should be considered.”⁴⁷

To be sure, the text identified two exceptions to the typical outcome. When athletes experienced a concussion in competition, they faced two significant risks: (1) the possibility of death from a second concussion shortly after the first one and (2) cognitive disability from

⁴³ *Id.* at 684-85.

⁴⁴ Michael McCrea, et al., *Unreported Concussion in High School Football Players: Implications for Prevention*, 14 CLIN. J. SPORT MED. 13, 16 (2004).

⁴⁵ Robert C. Cantu, *Reflections on Head Injury in Sport and the Concussion Controversy*, 7 CLIN. J. SPORT MED. 83, 83-84 (1997). Some experts did call for measures to prevent concussion. For example, there were recommendations for better helmet design. Jennifer M. Hootman, Randall Dick & Julie Agel, *Epidemiology of Collegiate Injuries for 15 Sports: Summary and Recommendations for Injury Prevention Initiatives*, 42 J. ATHL. TRAIN. 311, 316 (2007).

⁴⁶ Randolph W. Evans & Jack E. Wilberger, *Traumatic Disorders* in TEXTBOOK OF CLINICAL NEUROLOGY 1035, 1036 (Christopher G. Goetz & Eric J. Pappert eds. 1999).

⁴⁷ *Id.* at 1041.

multiple concussions.⁴⁸ But even then, the risks were not taken seriously enough. With respect to the effects of multiple concussions, the Goetz and Pappert text observed that:

The cumulative effects of multiple minor [head injuries] is recognized in boxing as the *punch drunk syndrome* . . .; however, the occurrence of this syndrome in association with other sports is controversial.⁴⁹

Just as in earlier periods, there were experts in the late 1990's who expressed greater concern about the harms from concussion. As Cantu observed, some neurologists believed "that there is no such thing as a minor head injury," that intellectual functioning "may be reduced after a minor head injury," and that repeated head injuries cause more severe and more persistent impairment.⁵⁰ Hence, he republished his 1986 guidelines with its recommended waiting periods before resuming play after a concussion.⁵¹

While medical understanding of concussion had not fully caught up with reality even by the late 1990's, medical experts by then had put the NFL on notice that players needed to be assessed carefully once they had suffered a concussion and that play or practice should not be resumed as long as symptoms or signs of the concussion persisted either at rest or upon exertion. As discussed, the American Academy of Neurology and the Concussion Working Group had issued their guidelines in 1997 and 1999, respectively.⁵² An important question is why the NFL did not respond by adopting return-to-play guidelines for its players.

To be sure, the NFL did take some action. It formed its Committee on Mild Traumatic Brain Injuries in 1994, and the committee undertook a detailed study of concussion over a six-year period. But a second important question is whether the committee was correct when it concluded in 2005 that concussion management guidelines issued by other groups "may be too conservative for the NFL."⁵³ The committee reported that players did not appear to be at an increased risk of injury when they returned to a game after concussion even if it

⁴⁸ *Id.* at 1039.

⁴⁹ *Id.* Evans & Wilberger use minor head injury as an alternative term for concussion. *Id.* at 1036. The punch drunk syndrome also is known as "dementia pugilistica." DeKosky, et al., *supra* note 1, at 1295.

⁵⁰ Robert C. Cantu, *Return to Play Guidelines After a Head Injury*, 17 CLIN. SPORTS MED. 45, 51 (1998).

⁵¹ *Id.* at 53-57.

⁵² *See supra* pages 7-11.

⁵³ Elliott J. Pellman, et al., *Concussion in Professional Football: Players Returning to the Same Game—Part 7*, 56 NEUROSURGERY 79, 88 (2005).

took more than fifteen minutes for their symptoms to resolve or even if they had lost consciousness with their concussions.⁵⁴ As mentioned earlier, the American Academy of Neurology's guidelines precluded a return to the same game when symptoms lasted more than fifteen minutes or there was a loss of consciousness.⁵⁵

In the past decade, concern about concussion has generated more research studies and more consensus statements. To some extent, the guidelines have become tougher; in other ways, they have become weaker. For example, the National Athletic Trainers' Association (NATA) suggested in 2004 that players should be disqualified for the remainder of the season once they sustained three concussions during the season. NATA also observed that three concussions in a career might be grounds for permanent disqualification of the athlete.⁵⁶ On the other hand, the NATA consensus statement equivocated on the question whether athletes should refrain from play for a minimum amount of time after their first concussions. While NATA acknowledged data indicating that repeat concussions tend to occur within 7-10 days after an initial concussion, the report suggested that an earlier return to play might be appropriate if the athlete was symptom free on exertion, and activities were restricted for the first few days to avoid a repeat head injury.⁵⁷ As with other guidelines, the NATA statement focused on management rather than prevention of concussion, though it did call for the use of properly fitting helmets and mouth guards.⁵⁸

Where does medical understanding stand today? Any concussion should be taken seriously, and players should cease play or practice immediately. Moreover, play or practice should not be resumed until the brain has had a chance to heal. For some experts, that means a minimum period of rest (e.g., one week for a first concussion) plus the absence of any symptoms of head injury, either while resting or with exertion, and no evidence of injury during neurologic testing. For other experts, a minimum period of rest is not required, as long as

⁵⁴ *Id.*

⁵⁵ Although the NFL did not implement guidelines for the management of concussion, it had made some rule changes to reduce the risk of concussions or more severe brain injuries. As mentioned earlier, *supra* page 3, the league banned "spearing," or the use of the head to block or tackle another player. See Polin & Gupta, *supra* note 7, at 513, 516.

⁵⁶ Kevin M. Guskiewicz, et al., *Nat'l Athletic Trainers' Ass'n Position Statement: Mgmt. of Sport-Related Concussion*, 39 J. ATHLETIC TRAINING 280, 282, 291 (2004). While the guidelines were issued by an association of athletic trainers, leading medical experts participated in the development of the guidelines.

⁵⁷ *Id.* at 286. The report did recommend a 7-day minimum waiting period after a repeat concussion, especially if the second one occurred in the same season. *Id.*

⁵⁸ See *id.* at 292-93.

there are no symptoms of head injury, either while resting or with exertion, and sophisticated neurologic testing is normal.⁵⁹

There still is considerable uncertainty as to the long-term consequences of concussion. It appears that multiple concussions can cause permanent and severe neurologic dysfunction, but it is unclear why only a small number of players appear to be at risk for that level of injury.⁶⁰ Perhaps there are genetic or environmental factors that work in combination with concussion to cause dementia or other problems. Indeed, genetic factors affect the likelihood that a boxer will develop the punch drunk syndrome.⁶¹ Or perhaps the likelihood of severe dysfunction has been underestimated. It also may be the case that just one concussion can result in permanent and severe neurologic dysfunction, but medical understanding cannot answer that question yet either.⁶²

Part of the reason for the uncertainty is the medical profession's incomplete understanding of brain functioning and the imperfection of tests that are used to measure brain functioning. Researchers have developed more sophisticated ways to measure neurologic function, but they cannot be certain that they are measuring it fully. The other important cause of uncertainty reflects the fact that it can be difficult to distinguish between correlation and cause and effect. We know that many former athletes suffer from early dementia (a correlation), but it is impossible to conduct the kind of studies that prove cause and effect—one cannot randomize people in a study in which half of the subjects are spared concussion and half of the subjects are given one or more concussions.

CONCLUSION

Medical understanding of concussion has evolved considerably over the past few decades. While neurologists once viewed mild traumatic brain injury as a largely benign event with symptoms that were temporary, a growing body of evidence indicates that concussions can have serious consequences, especially when a person sustains multiple concussions over time. At one time, boxers were thought to be the only athletes at risk for sport-related dementia; now, medical experts understand that dementia may be a consequence of competition in football, hockey, soccer or many other sports.⁶³

⁵⁹ *Id.* at 281-82.

⁶⁰ McCrory, *supra* note 14, at 10.

⁶¹ DeKosky, et al., *supra* note 1, at 1295.

⁶² Brandon E. Gavett, et al., *Mild Traumatic Brain Injury: A Risk Factor for Neurodegeneration*, 2:18 ALZHEIMER'S RESEARCH & THERAPY 1, 1 (2010).

⁶³ CANTU & HYMAN, *supra* note 9, at 19-52.

Even with the greater understanding that has developed, there is much more to be learned about concussion. What is the actual risk to a football player of permanent brain damage from concussion? To what extent does the risk depend on the number of concussions or the severity of the concussions? Do genetic factors make some players highly susceptible to injury while leaving other players very resilient after head trauma?

As we wait for more data, the NFL and the public must grapple with other important questions. Has football become too dangerous?⁶⁴ What changes should be implemented to reduce the risk of concussion?⁶⁵ How conservative should the NFL and other football associations be in dealing with an uncertain risk? Should they err on the side of caution and take very strong precautionary measures? The answers to these questions are difficult, but they must be sorted through.

⁶⁴ A number of NFL players think so. For example, Green Bay Packer and former Indianapolis Colt Jeff Saturday won't let his son play youth football. *Id.* at 144-145. Robert Cantu believes that no child should play tackle football before age fourteen. *Id.*

⁶⁵ And for those head injuries that cannot be prevented, what steps can be taken to make athletes more comfortable reporting their symptoms? Unfortunately, there are strong pressures to remain silent in a culture in which injuries are downplayed so players can remain in the game. DeKosky, et al., *supra* note 1, at 1295.