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Concussion and Concussion Management in the NFL: Pathophysiology and Economics

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I. Introduction

This is a paper about concussions and the management of concussions (we'll use concussions/management) using the National Football League (NFL) as an object lesson. Because concussions/management has become such a heated policy topic, our approach is to set emotion aside and go back to the very basic issues. We begin with the clinical understanding of concussions/management. Then we overview the NFL and offer the informed opinion that the concussions/management problem in the NFL is worse than it would be if the talent market were (1) fully informed on both sides of the bargaining table, (2) absent barriers to sincere bargaining, and (3) able to effectively enforce bargains that actually do get made. We hope that rather than demonizing either concussions or the NFL, our presentation instead helps to inform the concussion policy community as it moves *forward* in dealing with this problem.

We do not mean to downplay the occurrence of concussions in any other walk of life, but our expertise lies in athletic medicine and sports economics, so sports it is. We also do not mean to downplay concussions in other sports. Indeed, based on the number of participants nationwide, other sports no doubt have a larger number of concussions with which to deal. We hope the virtues of focusing on the NFL are apparent as we go through it. For example, there is a massive set of lawsuits currently pending against the NFL for its past behavior regarding information about the long-term impacts of concussions on players and, as a result, the management of concussions by the NFL. In August 2012, University of Massachusetts sports law professor Glenn Wong documents the number of lawsuits and puts the potential total amount at $10 billion, based on a $500,000 average award and his estimate of the total number of former players that might sue at 132

cases with 3,402 litigants[1] (the number has, of course, grown since Wong's writing).

The paper goes as follows. Section II provides the state-of-the-art clinical understanding of concussions/management as a quality of life issue, essential to an informed concussion policy discussion. Section III goes through our argument that the level of concussions in the NFL is high because of information dissemination limitations, barriers to sincere bargaining, and enforcement limitations. Conclusions round out the paper in Section IV.

II. CONCUSSIONS AND CONCUSSION MANAGEMENT (BEST PRACTICES)

A. Concussion Incidence

Sport concussion has become a significant public health concern over the previous decade. Different from other injuries, concussions often do not have outwardly visible signs and symptoms, prompting the Centers for Disease Control to label the injury as a "silent epidemic."[2] Historical estimates of concussion incidence estimated 300,000 cases occurred in a given year.[3] The true injury incidence is likely higher, as 53% of concussed high school athletes are suspected of not reporting their injury to medical personnel, coaches, or parents,[4] and collegiate athletes are thought to hide their injuries at even greater rates (80%).[5] The reasons for under-reporting concussions at both levels are not entirely clear, although not wanting to let the team down, being perceived as weak, and the 'warrior' culture of the sport have all been cited.[6] With a better understanding of the substantial

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1 Glenn M. Wong, *SN Concussion Report: NFL Could Lose Billions in Player Lawsuits*, SPORTING NEWS (Aug. 22, 2012), http://aol.sportingnews.com/nfl/story/2012-08-22/nfl-concussion-lawsuits-money-bankrupt-players-sue-head-injuries.

2 MARK FAUL ET AL., U.S. CENTERS FOR DISEASE CONTROL AND PREVENTION, TRAUMATIC BRAIN INJURY IN THE UNITED STATES: EMERGENCY DEPARTMENT VISITS, HOSPITALIZATIONS, AND DEATHS 2002-2006 5 (2010), *available at* http://www.cdc.gov/traumaticbraininjury/pdf/blue_book.pdf.

3 Press Release, U.S. Centers for Disease Control and Prevention, *Sports-Associated Recurrent Brain Injuries - United States* (Mar. 1997), http://www.cdc.gov/media/pressrel/braini1.htm.

4 Michael McCrea et al., *Unreported Concussion in High School Football Players: Implications for Prevention*, 14 CLINICAL J. SPORTS MED. 13 (2004).

5 JoEllen M. Sefton et al., *An Examination of Factors That Influence Knowledge and Reporting of Mild Brain Injuries in Collegiate Football*, 39 J. ATHL. TRAIN. S52 (2004).

6 *See* McCrea, *supra* note 4.

number of injuries that go unreported and undiagnosed, more recent injury estimates approach four million each year as a result of sport and physical activity.[7]

Concussion incidence varies by activity, with contact- and collision-sport athletes at the highest risk. Among collegiate sports monitored by the National Collegiate Athletic Association (NCAA), the risk for concussion is lowest among volleyball players at 0.15 per 1000 athlete-exposures (AE) during games. Injury rates climb with more aggressive sports having higher injury rates: men's lacrosse (1.08/1000AE), men's ice hockey (1.47/1000AE), and football (2.34/1000AE). As this discussion will address concussions resulting from football participation, it is important to note that the injury incidence is consistent across all levels of play. Concussive injuries occurring during college level play are reported to range from 4.8% to 6.3% of athletes per year[8] while 7.7% of NFL athletes[9] are concussed on an annual basis. This accounts for 3,264 to 4,284 of the 38,000 collegiate players and 130 of the 1,700 NFL athletes each year. High school athletes sustain concussions at the same rate, 3.6% to 5.6% annually,[10] but among the 1.2 million players taking the field each year, 43,200 to 67,200 will be concussed.

Despite the similarities in team concussion incidence across differing levels of play, there are distinct injury risks among different player positions. Among professional football athletes, the incidence of concussion for every 100 team games is highest among tight ends (1.45), followed by quarterbacks (1.20), wide receivers (0.91), defensive secondary (0.93), running backs (0.86), linebackers (0.61), punt returner (0.45), and the offensive and defensive linemen (0.28 and 0.26).[11]

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7 Jean A. Langlois et al., *The Epidemiology and Impact of Traumatic Brain Injury: A Brief Overview*, 21 J. HEAD TRAUMA REHABILITATION 375 (2006).

8 Kevin M. Guskiewicz, *Epidemiology of Concussion in Collegiate and High School Football Players*, 28 AM. J. SPORTS MED. 643, 646 (2000); *see* Michael McCrea et al., *Cumulative Effects Associated With Recurrent Concussion in Collegiate Football Players: The NCAA Concussion Study*, 290 J. AM. MED. ASS'N 2549 (2003).

9 *See* E.J. Pellman et al., *Concussion in Professional Football: Epidemiological Features of Game Injuries and Review of the Literature, Part 3*, 54 NEUROSURGERY 81 (2004).

10 *See* John W. Powell & Kim D. Barber-Foss, *Traumatic Brian Injury in High School Athletes*, 282 J. AM. MED. ASS'N 958 (1999); *see* Guskiewicz, *supra* note 8.

11 Ira R. Casson, *Twelve Years of National Football League Concussion Data*, 2 SPORTS HEALTH 471 (2010).

B. Concussion Pathophysiology

The term concussion comes from the Latin *concutere*, meaning to shake violently[12] and is the clinical presentation of a mild traumatic brain injury (TBI). Contrary to popular notion, during a typical sport concussion, the brain is not contused by striking the inner surface of the cranium. Indeed, there is no macroscopic physical change in brain structure resulting from this injury; rather, there is a change in brain functionality. The rapid acceleration or deceleration of the brain brought on by an external biomechanical force[13] results in the uncontrolled depolarization of neurons.[14] The ions that normally pass across the neuronal membrane to generate the electrical activity of the brain are displaced on the order of 400-500 times their normal concentration. This shift is coupled with a simultaneous decrease in cerebral blood flow[15] that inhibits the availability of energy (i.e., glucose) to the injured tissue. The brain immediately begins to restore homeostasis, but the exact duration of the process cannot be predicted.

While concussion is thought to be the clinical presentation of a mild TBI, athletes regularly sustain multiple "sub-concussive" head impacts that do not result in a clinical injury presentation. Despite the lack of clinical findings, some degree of injury has likely been sustained as preliminary evidence suggests that sub-concussive impacts are associated with cortical dysfunction that is not clinically apparent.[16] In either scenario, concussive and sub-concussive impacts are now being linked to pathophysiologic mechanisms, such as the accumulation of tau protein.[17]

C. Acute Signs and Symptoms

In the immediate aftermath of a concussion, athletes are known to report a number of symptoms to medical professionals. Headache is by far the most commonly reported with 83% of concussed athletes indicating its presence. Other symptoms are prevalent but less frequent, such as dizziness (65% of concussed athletes) and confusion

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12 John Pearce, *Observations on Concussion: A Review*, 59 EUR. NEUROLOGY 113 (2008).

13 *See* P. McCrory et al., *Consensus Statement on Concussion in Sport 3rd International Conference on Concussion in Sport Held in Zurich*, 43 BRIT. J. SPORTS MED. i76 (2009).

14 Christopher C. Giza & David A. Hovda, *The Neurometabolic Cascade of Concussion*, 36 J. ATHLETIC TRAINING 228 (2001).

15 *Id.*

16 T.M. Talvage, *Functionally-Detected Cognitive Impairment in High School Football Players Without Clinically-Diagnosed Concussion*, J. NEUROTRAUMA (forthcoming).

17 Brandon E. Gavett et al., *Chronic Traumatic Encephalopathy: A Potential Late Effect of Sport-Related Concussive and Subconcussive Head Trauma*, 30 CLINICAL J. SPORTS MED. 179 (2011).

(57% of concussed athletes).[18] Notably, loss of consciousness is observed in fewer than 10% of all injuries,[19] and outcomes following injury do not appear to be tied to the presence or absence of on-field loss of consciousness.[20] Other symptoms, such as post-traumatic amnesia, appear to provide greater sensitivity to injury severity with longer spans of amnesia indicative of longer recovery times.[21]

In addition to athlete reported symptoms, there are also notable changes to cognitive functioning (e.g., reaction time and memory) and motor control (e.g., balance and gait).[22] How and which deficits vary widely between athletes, but the majority of athletes (80-90%) will demonstrate a spontaneous resolution and return to pre-injury levels of functioning within seven to ten days following the injury.[23]

D. Persistent Effects of Concussion

A significant amount of research over the previous twenty years has been dedicated to elucidating concussion's acute effects and resolution. In the previous decade however, there has been an increased interest in how the injury may affect long-term cognitive health. The notion that repeated concussive and sub-concussive blows to the head lead to persistent effects is not a novel theory. In 1928, Martland first described tremors, slowed movement, confusion, and speech abnormalities in a group of boxers. The condition was labeled "Punch Drunk."[24]

At that time, the physiological underpinnings of the condition were not evident, but more recent research has reported similar clinical findings in former professional football athletes and the disease has been termed Chronic Traumatic Encephalopathy (CTE). The clinical presentation of CTE is one of disordered cognition, memory loss and executive dysfunction, depression, apathy, disinhibition, and irritability, as well as Parkinsonian signs that appear in midlife, years

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18 *See* Guskiewicz, *supra* note 8, at 647; P.R. McCrory et al, *The Nature and Duration of Acute Concussive Symptoms in Australian Football*, 10 CLINICAL J. SPORTS MED. 235 (2000); J. Scott Delaney et al., *Concussions Among University Football and Soccer Players*, 12 CLINICAL J. SPORTS MED. 331 (2002).

19 Delaney, *supra* note 18; Guskiewicz, *supra* note 8.

20 M.R. Lovell et al., *Does Loss of Consciousness Predict Neuropsychological Decrements After Concussion?*, 9 CLINICAL J. SPORTS MED. 193 (1999).

21 M.W. Collins et al., *On-Field Predictors of Neuropsychological and Symptom Deficit Following Sports-Related Concussion*, 13 CLINICAL J. SPORTS MED. 222 (2003); David Erlanger et al., *Symptom-Based Assessment of the Severity of a Concussion*, 98 J. NEUROSURGERY 477 (2003).

22 Steven Broglio et al., *The Effect of Sport Concussion on Neurocognitive Function, Self-Report Symptoms, and Postural Control: A Meta-Analysis*, 38 SPORTS MED. 53 (2008).

23 McCrory, *supra* note 13.

24 Harrison S. Martland, *Punch Drunk*, 91 J. AM. MED. ASS'N 1103, 1103 (1928).

after sports participation has ended.[25] The exact structural and chemical changes that cause the disease are not clear, but as mentioned above, both concussive and sub-concussive impacts may be associated with tau protein deposition.[26] Animal (i.e., mouse) research has also demonstrated hippocampal cell death within three days of a concussion[27] while in humans, pyramidal neuron atrophy and neuronal cell death in regions of the hippocampus are seen following traumatic brain injury.[28]

The typical aging process is also tightly linked to pyramidal cell structure declines.[29] This has led some to speculate that both normal cerebral aging combined with repeated exposure to external forces may accelerate cognitive decline in some people.[30] The exact number of concussive and/or sub-concussive impacts necessary to trigger later-life cognitive dysfunction is not known, but it is known that the average high school football athlete sustains 652 impacts across a season, while some athletes will receive over 2,200.[31] At the college level, the median number of impacts is 420 in a season, with a maximum of 2,500.[32] Research of this type has not been completed at the professional level.

The magnitude of cognitive change in later life following repeated head impacts remains in question. Anecdotal findings suggest that many athletes with a limited number of injuries have continued on to be high functioning adults while others are at risk for earlier and more severe cognitive declines. If the relationship between head impacts and later life cognitive declines proves to be true, then the disease risk is likely a dose response. That is, the high school athlete that plays two or three years will be at less risk for cognitive decline than the collegiate athlete that plays an additional two to three years or the athlete that plays two to three years at the professional level. It is important to note however, that the relationship between changes in

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25 Gavett, *supra* note 17, at 185.

26 *Id.* at 182.

27 V. Tashlykov et al., *Apoptotic Changes in the Cortex and Hippocampus Following Minimal Brain Trauma in Mice*, 1130 BRAIN RES. 197, 203 (2007).

28 W.L. Maxwell et al., *There is Differential Loss of Pyramidal Cells From the Human Hippocampus with Survival After Blunt Head Injury*, 62 J. NEUROPATHOLOGY & EXPERIMENTAL NEUROLOGY 272 (2003).

29 See A. Peters, *Structural Changes that Occur During Normal Aging of Primate Cerebral Hemispheres*, 26 NEUROSCI. BIOBEHAVIORAL REV. 733 (2002).

30 Steven Broglio et al., *Cognitive Decline and Aging: The Role of Concussive and Sub-Concussive Impacts*, 40 EXERCISE & SPORT SCI. REV. 138 (2012).

31 Steven Broglio et al., *Cumulative Head Impact Burden in High School Football*, 28 J. NEUROTRAMA 2069, 2071 (2011).

32 Joseph J. Crisco et al., *Head Impact Exposure in Collegiate Football Players*, 44 J. BIOMECHANICS. 2673, 2674-77 (2011).

metabolic and ionic function following a head impact and long term pathological changes to the cerebral tissue is not fully understood. Head impact exposure is only one determinant, as intrinsic and extrinsic factors (e.g., genetics, excessive alcohol intake, smoking, sedentary lifestyle) can also negatively influence long term brain physiology.[33]

E. Best Practices

Defining best injury-management practices for clinicians to follow when evaluating and treating concussed athletes is difficult, given the rapidly changing state of the science. In addition, concussion evaluation in the context of sport, where decisions often need to be made in a few minutes or less, places additional burden on the clinician. That being said, there are some approaches to injury management that are grounded in sound research and widely adopted.

In all instances, clinicians should evaluate their athletes at high risk for concussion prior to the competitive season. The intent of this assessment is to record pre-injury/baseline information on their athletes that can be used for post-mortem comparison. During the season, the clinical management of a concussion can be broken into two distinct but equally important sections. The first addresses the immediate evaluation and injury diagnosis while the second is directed at the recovery and return-to-play process.

When an athlete sustains an impact suspected of causing a concussion, he/she should be removed from play and evaluated by a medical professional with specific concussion training. The post-injury evaluation should include a thorough clinical exam that encompasses symptoms and is supported by objective measures of motor control and mental status.[34] In the event the athlete is diagnosed with a concussion, he/she should not be allowed to return to sport for the remainder of the day.

Following a concussion diagnosis, the athlete should be monitored on a daily basis for the presence of concussion-related symptoms. In cases where symptoms worsen within the first forty-eight hours or do not resolve in a normal time course, referral to a concussion specialist should be considered. Once symptoms associated with the injury resolve, the athlete should complete a neurocognitive and motor control examination identical to the one completed prior to the

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33 T. Etgen et al., *Mild Cognitive Impairment and Dementia: The Importance of Modifiable Risk Factors*, 108 DEUTSCHES ARZTEBLATT INT'L. 743, 747-48 (2011); Edward McAuley et al., *Cardiovascular Fitness and Neurocognitive Function in Older Adults: A Brief Review*, 18 BRAIN, BEHAVIOR, & IMMUNITY 214, 217 (2004).

34 Steven Broglio et al., *Sensitivity of the Concussion Assessment Battery*, 60 NEUROSURGERY 1050 (2007).

season. If these tests show a return to pre-injury levels of functioning, a return-to-play progression can be considered.[35] Following the progression, a medical professional should clear the athlete to return to full sport activity. As of this writing, forty-one states require the approval of a licensed medical practitioner for this final step. For example, the Zackery Lystedt Law in the state of Washington was the first after a junior high school football player suffered brain damage after returning to the game in 2006 following a concussion.[36]

Previous recommendations using firm guidelines for return to play[37] are not prudent, as each injury should be managed on an individual basis. Under most circumstances, a concussed athlete will likely miss eleven days of full sport participation: seven days injury recovery and four days during the return-to-play progression. This timeline, however, is variable based on individual injury circumstances and the clinical judgment of the medical personnel.

III. CONCUSSIONS/MANAGEMENT PROBLEMS IN THE NFL

We preface everything in this section with the obvious: this is a workplace safety issue and, as such, it is well understood in the economics literature and examples are abundant. Thus, everything that follows is distilled to the case of the NFL from a broad treatment over a long period of time. There have always been, and continue to be, dangerous workplace environments both in and out of sports.

Even this most basic observation offers something to the concussion policy community that is vital but overlooked—there is value to both sides (owners and players) in correctly handling the issue. Concussions, poorly managed, reduce player value to owners and to players themselves. That this might be true only in the "expected value" sense (not all athletes will suffer concussion for example) does not reduce the power of this initial insight.

For 2012, spotrac.com reports that top-ten quarterback salaries range from $5.5 million (Matt Hasselbeck, Tennessee Titans) to $18 million (Peyton Manning, Denver Broncos). Top-ten wide receiver pay ranges from $5 million (Larry Fitzgerald, Arizona Cardinals) to $11 million (Vincent Jackson, Tampa Bay Buccaneers). Players clearly have millions on the line with every possible concussion that may oc-

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35 McCrory, *supra* note 13.

36 *NFL Urging States to Pass Youth Football Concussion Laws*, ASSOCIATED PRESS (Feb. 23, 2011), http://www.nfl.com/news/story/09000d5d81e710d9/article/nfl-urging-states-to-pass-youth-football-concussion-laws.

37 Robert C. Cantu, *Posttraumatic Retrograde and Anterograde Amnesia: Pathophysiology and Implications in Grading and Safe Return to Play*, 36 J. ATHLETIC TRAINING 244, 246-47 (2001).

cur. While the data in the last section suggest that wide receivers might be at the bottom of the relative scale of concussion incidence, they are extremely valuable economically in terms of the revenue they generate from fans.

However, it is well known among sports economists that the revenues actually generated for owners are in excess of salary payments to players, especially for younger high-performers.[38] In addition, it is the production process involving the players that contributes the rest of the value captured by owners. So, just as clear as it is to players, owners have millions in revenue on the line, over and above the part they must pay players, with every possible concussion as well.

Despite this powerful initial insight, there is every reason to believe that the number of concussions is larger than would occur, and the management of concussions is less effective than would occur, if the NFL talent market were (1) fully informed on both sides of the market, (2) absent barriers to sincere bargaining, and (3) able to effectively enforce bargains that actually do get made. We address these, seriatim.

A. Information Dissemination Limitations

How close does the talent market come to providing full and complete information of the actual state of knowledge about concussions/management *to both owners and players*? If the talent market performed perfectly on this dimension, scientific advances would be common knowledge instantly. In the case of the NFL, the answer is that the talent market has not accomplished this very well in the past. We detail that outcome not to demonize the NFL but to point out that information is key and its dissemination a matter of policy concern. While we both observed these results as observers of the sports scene, we also borrow from the exemplary overview by Joseph Hanna and Daniel Kain.[39]

Despite the growing clinical evidence, the NFL Concussion Committee denied a link between concussions and cognition starting in 2005. This is especially troubling since there was not a single neuropathologist on the committee. The evidence continued to grow. Autopsy studies claimed that Chronic Traumatic Encephalopathy (CTE) triggered by multiple concussions partially explained the

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[38] Gerald W. Scully, *Pay and Performance in Major League Baseball*, 64 AM. ECON. REV. 915 (1974).

[39] Joseph M. Hanna, *Concussions May Prove to Be A Major Headache for the NFL Players' Class Action Suit Places A Bounty on the League*, 84-OCT. N.Y. ST. B.J. 10 (2012).

deaths of former NFL players. The Concussion Committee downplayed these claims on the basis of such a small sample. When the sample grew to a survey and analysis of 2,550 former NFL athletes supporting the relationship between concussions and MCI and depression, the Concussion Committee responded that surveys of this nature were unreliable.

As the evidence continued to mount, the Concussion Committee convened a concussion summit in 2007. Crucial to our observation about the lack of information dissemination, the NFL Players Association (NFLPA) had been left out entirely to this point but was finally represented at the summit. The Concussion Committee acknowledged that concussions were an issue but still issued no policy recommendations. The body of evidence from more autopsy studies grew, but the Concussion Committee stuck to its earlier "small sample" guns.

Eventually, the evidence became overwhelming and, in 2009, the NFL finally acted. No doubt, the 2009 autopsy evidence that then current NFL player Chris Henry had CTE took the wind out of the NFL's sails. The owner members of the league replaced the leadership on the Concussion Committee and added neurologists. The league also admitted that the medical research clearly showed that concussions lead to long-term health problems and put an independent (not hired by the team owners) doctor in charge of concussion evaluation on the field. There were also changes on the field of play. For the 2009 season, blocking rules were changed to prohibit hits below the knees and in the back, additional behavior against defenseless receivers was identified that would now be penalized, and formation blocking on kickoffs was outlawed.

The league worked with the NFLPA and issued their strong warning of June 2010:

> [T]raumatic brain injury can *cause* a wide range of short- or long-term changes affecting thinking, sensation, language, or emotions. These changes may lead to problems with memory and communication, personality changes, as well as *depression* and the *early onset of dementia*. Concussions and conditions resulting from repeated brain injury can change your life and your family's life forever.[40]

Following the announcement, for the 2010 season, the league began imposing fines and playing time reductions on illegal hits, espe-

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[40] *Id.* at 17 (citing Press Release, National Football League, Concussion: A Must Read for NFL Players (July 26, 2010) (emphasis added)).

cially helmet-to-helmet and head and neck. For the 2012 season, harkening back to the data on the rate of injuries on special teams in Section II, kickoffs are now shorter by five yards. But there remained disagreement among consulting neurologists to the NFL about how widespread the problem is for *current players* (not past players) since there is only Chris Henry's autopsy to go on. But even this disagreement withered in the face of recent suicides of retired players Ray Easterling (ret. 1979) and Dave Duerson (ret. 1993).

This past behavior by NFL owners toward concussions/management information, essentially "hiding" it from scrutiny by continued non-scientific refutation and denial, clearly shows that the talent market was not allowed to perform its essential function. However, it should not be lost on the concussion policy community that eventually the information *was* forthcoming and real changes have taken place on and off the field.

Contact rules for quarterbacks and wide receivers are the most notable to fans, but there was also the response toward on-field concussion assessment. While not all-encompassing in terms of the best practices listed in Section II, it was a move in that direction. If the doctor's opinion is that a player is exhibiting concussion symptoms, the player must leave the game and receive an immediate assessment. Failure to pass that subsequent assessment means the player cannot return to that game. While some in the concussion policy community decry the late arrival, they did at least arrive.

As for the future, the NFL is making attempts to send the message down the line. Through the Commissioner's office, the NFL owners are calling for the remaining states to follow the example of the other forty-one (with three more pending) and enact youth football concussion laws that follow the best practices in Section II. Summing it up nicely, long-time critic Congresswoman Linda Sanchez (California) offered this sideways compliment, "While it heartens me to see that the NFL's finally embraced the growing body of scientific evidence that points to major problems for people who suffer multiple concussions, it's been a long time coming."

As for the basic economic insight concerning workplace safety, there is a bit of a conundrum here. Since concussions/management information is also valuable to players, we would have predicted investment in information by the players as the owners dragged their feet through the decade of the 2000s. We can only speculate here; perhaps the players were incorporating the growing evidence and recognized that things just take time. Alternatively, since the evidence was finally making its way to usefulness, perhaps they saw no additional value to further investment in information. Finally, we cannot ignore football culture. Perhaps players were weighing the benefits of

a potentially improved concussion environment against the contribution that big hits make to their future value. Or, since contracts in the NFL are very seldom guaranteed, perhaps players were worried about how an improved concussion environment would actually reveal what owners might perceive as a performance weakness come contract renewal time.

In addition, there are other actions that some players could take in the meantime. Players understand that their employment value as well as their long-run quality of life are both at stake and have every incentive to practice their own form of concussion management. Quite simply, players can "play smarter" regarding concussion on both sides of the ball. They could purposefully choose not to put themselves into concussion-producing situations to the best of their ability. A quarterback or wide receiver about to take a serious hit knows that out of bounds is their best friend. At this writing, sports writers were heaping criticism at Washington Redskins quarterback Robert Griffin III for attempting to gain just a couple of extra yards rather than going out of bounds and receiving a mild concussion as his reward. In addition, quarterbacks and wide receivers can take the slide route.

Also, as the old saying goes, the proof is in the eating of the pudding, and it just does not look like these changes have yet generated any noticeable improvement in coarsely measured injury. We preface with our caution that there is no consistent reporting source for injury in the NFL and that most official injury lists, like the league's Injured Reserve (IR) list, are actually subject to strategic choice by General Managers and coaches. Of course, we also know that reports are reports and, as just noted above, repression of especially neurological and psychological reports by players is to be expected.

All that said, we summarize the following results from the well-known Edgeworth Economics studies of NFL injury.[41] From NFLPA data, disability claims increase steadily from 1975 through 2007, but jump dramatically in 2008 and 2009. There was also a marked jump in the number of players placed on IR from 2007 to 2009. Of the total 2,423 claims, 91% were orthopedic, 2% were neurological, and less than 1% were psychological. From other data collected for the report, of the 16,552 injuries reported from 2004-2009, 57% involved the lower body and 10% involved the category "head/neck/spine." Special teams have the highest injury incidence, quarterbacks the lowest, and other positions suffer pretty much equally. However, the incidence of

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[41] Edgeworth Economics, *Dangers of The game: Injuries in the NFL, Analysis for The NFLPA* (2010), *available at* http://www.esquire.com/cm/esquire/data/Dangers-of-the-Game-Draft-Esquire.pdf; Edgeworth Economics, *Dangers of the Game: NFL Injury Report* (2011), *available at* http://www.esquire.com/cm/esquire/data/Dangers-of-the-Game-Report-Esquire.pdf.

concussion is nearly equal between quarterbacks and special teams when the category is refined to mild TBI. It also is the case, from the charted data in the reports, that the number of players suffering at least one concussion jumped after 2007. Prior, it was about 2%, increasing from 2.5% in 2007 to almost 6% by 2010. The later update showed an increase in mild TBI from between 150-200 in 2004 to over 250 by 2010 and 2011. Mild TBI during kickoffs was at its lowest in 2011. Interestingly, while the percentage of players suffering a season-long injury was highest in 2010, there is no discernable pattern over the entire time period, 2002-2010 (the average is about 3.5 percent).

These rather discouraging data raise the possibility that, ultimately, the player response could be whether or not, and for how long, they participate. The *Sporting News* surveyed 125 players for a five-part concussion report.[42] Only nine, including two hall of fame members, answered "no" to the following question: "Knowing what you know now, would [you] play in the NFL again?"[43] However, of the ninety-six (77%) that answered "yes", fifteen had caveats including that they would reconsider the length of their stay in the NFL, alter how they would hit, and pay attention to doctors rather than hiding from and ignoring them.[44]

These are quite startling admissions given the culture of football values "playing hurt" and "shaking it off" for the good of the team. Both prove anathema to concussions/management best practices in the previous section. Players are so physically gifted that high-impact contact is guaranteed, as are the rates of concussion that follow. In addition, the fierce loyalty to teammates and coaches toughens this nut that must be cracked. There is clearly a cultural dimension with which the concussion policy community must deal.

B. Barriers to Sincere Bargaining

How close do the contracts struck between owners and players come to including what economists call a "compensating differential" to cover the presence of physical risk in the workplace? If the talent market performs well on this dimension, then the risk costs would be worked completely into salary and benefits packages. Clearly this did not happen in the past. Despite the fact that there has been a retirement and disability plan in place since 1959, redress of previous physi-

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42 *SN Concussion Report: Five-part Series Overview*, SPORTING NEWS (Aug. 20, 2012), http://aol.sportingnews.com/nfl/story/2012-08-20/nfl-concussion-report-series-statistics-study-brain-trauma-retired-players.

43 *Id.*

44 *See id.*

cal incapacitation was a bone of contention between retired players and the NFL years before attention turned to the long-term effects of concussions. The focal point has always been the retirement and disability package for past players, and there is good reason to believe that it is not large enough for current and future players either. For example, only recently has the NFL Collective Bargaining Agreement (CBA) contained the "88 Benefits" section (dementia, amyotrophic lateral sclerosis or Lou Gehrig's disease, and Parkinson's), a long-term care section, and a neuro-cognitive benefits section.

In addition, after its establishment in 1959, the retirement and benefits program was owner-controlled until after the great NFL labor rift of 1993-94. A joint player/owner board with an independent director was a long time coming. The board manages the retirement and benefits fund. However, the fund is paid for by owner contributions to the level required to cover the bargained benefits.

Just why it should be expected that the benefits package be underfunded is a complicated mix of factors that all return to the fact that owners and players interact with each other through collective bargaining.[45] That same body of law governs how players must behave toward each other when acting collectively through their chosen collective bargaining agent. Thus law, not economic competition, binds players and owners under the rules of collective bargaining and a host of complications arise from this fact.

First, there is the issue of strategic information dissemination because information is not cost free. The player strategy is to portray the problem as more expensive than it really is; they receive compensation without facing any actual higher risk. The owner strategy is to portray the problem as less expensive than it really is; they reduce the compensation to players and keep the rest. Owners would find it in their best interest to know about the playing consequences of concussions. If the consequences are long-term, so that they happen by-and-large after a player's career is over, then one can see an incentive to withhold the information from general consumption.

On top of the incentive to obtain and hold on to asymmetric information advantages, we need to add the additional bargaining issues that are the grist of the collective bargaining mill. Even though both sides might genuinely wish to convey all of their information about workplace safety issues like concussions, there is inherent disbelief built into the bargaining process since each knows that the other side has a bargaining incentive to misrepresent their side.

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[45] *See* National Labor Relations Act, 29 U.S.C. §§ 151-169 (1935); Labor-Management Relations Act, 29 U.S.C. §§ 185-188 (1947).

With the threat of work stoppage by either side, based on other elements on the table, safety might be bargained away for something else of importance. Risk becomes a bargaining chip when costs of information are such that there is asymmetric information between owners and players. This may result from nothing more sinister than the cruel whims of general economic situation (recessions, for example, or how the industry fares at some collective bargaining juncture). However, at any collective bargaining juncture, the relative positions of owners and players may actually make some elements on the table more highly prized than safety.

C. Enforcement Limitations

Enforcement complications happen because of the nature of joint production and because of the nature of what happens after agreements are struck. The first complication arises from the truly fascinating "peculiar economics" of sports for pay.[46] Sports are a "joint production" activity where opponents and economic competitors are all required to make play happen. Thus, the very definition of NFL football requires cooperation among franchise owners in order to brand and identify this version of football relative to others, e.g., college football. In addition, acting together as their league, franchise owners also engage in a variety of other agreements that enhance the value of their league production. The best example is granting the league the ability to negotiate part or all of the value of broadcast/broadband contracts.

It is quite well known that *individually* owners may be better off breaking agreements with each other. Thus, leagues have a multitude of enforcement issues. Leagues have to make sure that owners play the schedule that defines their version of NFL football and also that players and managers follow the rules on the field. Owners have to make sure that their fellows obey the business rules and agreements as well. One famous example is NFL owners having to monitor each other so they do not violate the league payroll cap.

Turning directly to workplace safety, if star players on one team are hurt, then there is a reduction in quality of play in all games where those stars play at reduced capacity. This is detrimental to fan enjoyment and reduces the value of games to all team owners. Thus, there is an externality on all owners and players if players on one team violate the safety rules while the rest of the players do not. There are various reasons why players would do this, from coaching imperatives

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[46] Walter C. Neale, *The Peculiar Economics of Professional Sports: A Contribution to the Theory of the Firm in Sporting Competition and in Market Competition*, 78 Q. J. ECON. 1 (1964).

to their own desire to show the owner of their own team their value on the field, and it will require league-level decisions; unilateral decisions will put any given owner at a disadvantage so do not expect any individual team leadership here.

As with performance enhancing drugs, where there is a clear policy, enforcement will eventually become the issue. Information dissemination will have to be enforced. The rules on the field will have to be enforced. The rules on best practices will have to be enforced. Finally, benefit package financing will have to be monitored as there have been past episodes where owners have not lived up to their plan contribution requirements.

IV. CONCLUSIONS

First and fundamentally, there is a world of understanding about the occurrence, incidence, and immediate and long-term impacts of concussions. There are also best practices to be considered. This is the essential information needed by the concussion policy community, and disseminating advances is job one. Right now, that knowledge is less impactful than it could be. Best practices have only recently begun to be applied in the NFL, but there are encouraging signs in state law. However, in addition to protecting quarterbacks and wide receivers, an unscientific extrapolation of the college football incidence data to the NFL, by position, suggests that linebackers and offensive linemen are in need of more protection as well. Their play-by-play contains the less observable "sub-concussive" impact problem detailed in Section II. A focus away from unconsciousness, admittedly gut wrenching, toward sub-concussive impact is long overdue.

The NFL's past barriers to information dissemination also have a lesson for the concussion policy community. While there are potent economic forces at work, in specific situations there may need to be some way to make information dissemination happen that is independent of owners and players. While the NFL's response is economically predictable, so is a prediction that owners may return to their previous treatment of concussions/management information should the economic margins governing information dissemination so dictate. In addition, just why is it that players were not also entering into the information dissemination fray needs investigating. Finally, eventually, if there is no change in injury rates, especially concussion occurrences, something has surely gone awry in terms of turning information into action.

Anything that can smooth the bargaining process so that the wishes of owners and players actually make it to the table and are bargained sincerely, rather than strategically, will put concussions/management more in line with what is best for both sides. The

result will be rules on the field, concussion management on the field, and compensation and long-term benefits packages that overcome the tension between injury and profit inherent in play-for-pay sports.

We suspect that this will require time to develop. Lest we forget, player safety and financial issues including retirement and disability pay have always been an important part of negotiations and will become even more so over time. So, it remains possible that collective bargaining will get the job done. If not, the NLRB and the courts under appeal must understand this relationship between bargaining limitation and concussions/management. Of course, the particular issue of workplace safety might be taken out of collective bargaining altogether by the Occupational Safety and Health Administration (OSHA). However, to date, there has been no pressure by elected officials on OSHA's "hands off" approach to pro sports league workplace safety. To date, the NFL has only drawn OSHA scrutiny in the case of death during training.

Finally, and in our opinion possibly the thorniest issue, is enforcement. In a version of the famous Prisoners' Dilemma, there is value to owners who cheat both in the form of play they encourage on their team and in terms of eventual payment of compensation. There is also value to players who cheat because winning still involves incapacitation of opposing players. Unless suitable enforcement is also imposed, then the rules and compensation approach may be undone by the pursuit of individual welfare to the detriment of the overall good of both owners and players. The current system of oversight by the Commissioner's office is a "fox and henhouse" issue since the Commissioner serves at the discretion of owners.

In closing, we offer a caution. It is easy to demonize the concussions and the games that cause them rather than the mismanagement of brain injury itself. Anyone can get a concussion, but it is more likely to occur during participation in contact sports. If sports are to continue, it is not just about reducing contact. It might be more about how the resulting injury is handled. Relative to best practices, in many documented instances, additional contact is not precluded and nobody intervenes to make the athlete take the prescribed period of rest after contact.

In addition, remember, the lawsuits pending against the NFL are not about the risk of injury. They are about whether or not the NFL withheld their knowledge of that risk. In a sense, it is not really a concussion issue *per se* but a question about liability. It is easier to demonize the concussion and the game that causes it than to condemn how some people handled the problem in the past.

Ultimately, concussions/management is a source of *business management* conflict. The fans simply love the game, violence and all.

And as the revenue that players generate has risen to millions more than they are paid, owners have worked to retard violence compared to the level of just ten years ago. But it cannot be forgotten that owners are conflicted. They want to preserve their very valuable talent, but they also want to give the fans what they are willing to pay the most to see. With player quality of life in the balance, and with all of the other impediments to information dissemination, bargaining, and monitoring, that conflict can be expected to lead to an unacceptably high level of safety risk. The level of safety that maximizes the value of talent is not necessarily the level that is best for the long-term health of players unless the full cost of concussions/management is accounted for.