Concussions During the 1997 Canadian Football League Season

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Objective: To examine the incidence and characteristics of concussions for one season in the Canadian Football League (CFL).

Design: Retrospective survey.

Participants: 289 players reporting to CFL training camp. Of these, 154 players had played in the CFL during the 1997 season.

Main Outcome Measures: Based on self-reported symptoms, calculations were made to determine the number of concussions experienced during the previous season, the duration of symptoms, the time for return to play after concussion, and any associated risk factors for concussions.

Results: Of all the athletes who played during the 1997 season, 44.8% experienced symptoms of a concussion. Only 18.8% of these concussed players recognized they had suffered a concussion. 69.6% of all concussed players experienced more than one episode. Symptoms lasted at least 1 day in 25.8% of cases. The odds of experiencing a concussion increased 13% with each game played. A past history of a loss of consciousness while playing football and a recognized concussion while playing football were both associated with increased odds of experiencing a concussion during the 1997 season.

Conclusion: Many players experienced a concussion during the 1997 CFL season, but the majority of these players may not have recognized that fact. Players need to be better informed about the symptoms and effects of concussions.

Key Words: Concussion—Professional football—Risk factors—Symptom duration.


North American football is a very popular but often times violent game. Because of the large number of participants and the physical nature of the game, it is believed to be responsible for the majority of sports-related concussions in North America. Serious head injuries have long been a part of football’s history. The scrutiny and public outcry that result after a death due to head injury have led to rule and equipment changes in an effort to make the sport more safe for its participants. Reports of high-profile athletes experiencing serious or repeated concussions have also made the general public more aware of the incidence and effects of concussions. This increased public attention has resulted in more research into traumatic brain injury. As the study of traumatic brain injuries has grown, more people have become interested in the effects of minor head injuries and concussions in particular.

Information gathered from concussed athletes has shown that the effects of a concussion may be debilitating, cumulative, and permanent. In an effort to better categorize and standardize treatment, different grading systems and return to play guidelines have been developed. Although no prospective research has validated any of the guidelines or grading systems, they are all intended to prevent catastrophic outcomes, such as the second impact syndrome, and the more subtle cognitive and neuropsychologic impairment that may ensue after repetitive mild brain injury.

The numerous grading systems for concussions usually are based on the presence and duration of various signs or symptoms. Similarly, most return to play guidelines are based not only on the grade of the current concussion, but also on the number and severity of previous concussions. It is therefore important to better document the true incidence and severity of all concussions. Unfortunately, this can be difficult because physicians vary in their definition and assessment of concussions, and athletes can be reluctant to volunteer information about their symptoms.

Studies of concussions in football have traditionally focused on high school or college players. This study involves professional players in the Canadian Football League (CFL), and was conducted in an effort to better document the incidence, characteristics, and severity of concussions over one season.

SUBJECTS AND METHODS

The CFL is a professional football league with teams in eight Canadian cities. Individual teams are allowed to dress 37 players for each game. Each team fields 12
players, so there are 24 players on the field at any given time. For each team, the 1997 season consisted of two preseason games, 18 regular season games and as many as three playoff games, for a total of 23 possible games.

Before the 1998 football season, all players reporting to training camp were asked to complete a questionnaire based on their personal history, football history, and symptoms pertaining to the 1997 football season. The questionnaires were anonymous, voluntary, and were approved by the CFL Players Association. Once completed in each team’s home city, they were returned to a central source for statistical analysis.

The questionnaire inquired about general background information and personal football history. Data were collected about the number of years each player had participated in organized tackle football and the different positions played. Information was obtained about past recognized concussions and losses of consciousness, either associated with football or other activities. The players were then questioned more specifically about the 1997 football season, including the number of games and different positions played. Players were asked “Last season after being hit playing football, did you ever suffer a concussion?”

If players answered yes, they were asked to: 1) list the number of times they had a concussion during the season; 2) list the longest duration they experienced symptoms from a concussion during the season; 3) list the longest duration they were unable to play football (had to sit out) because of the concussion; and 4) indicate who usually decided they were unable to play football because of the concussion (e.g., trainer, team doctor, decided yourself, etc.).

The players were then asked a series of questions pertaining to the commonly recognized symptoms of a concussion. They were asked if, after being hit playing football during the 1997 season, they had been knocked unconscious; felt confused or disoriented (got “dinged” or “had your bell rung”); experienced headaches, dizziness, memory difficulties, or blurred or abnormal vision; felt nauseous or vomited; or experienced any other symptoms that affected their ability to play football (i.e., hearing problems, inability to tolerate bright lights, etc.).

If players answered yes to one of the above questions, they were asked to: 1) list the number of times they experienced this symptom after being hit during the season; 2) list the number of times they experienced a concussion when having this symptom after being hit during the season; 3) list the longest duration they experienced this symptom after being hit during the season; and 4) list the longest duration they were unable to play football because of this symptom during the season.

The definition of concussion put forth by the Committee of Head Injury Nomenclature of the Congress of Neurological Surgeons in 1966 has gained wide acceptance. This states that a concussion is defined as a clinical syndrome characterized by immediate and transient posttraumatic impairment of neural functions, such as alteration of consciousness, disturbance of vision, equilibrium, etc. due to brain stem involvement. Although this definition is helpful, it is not always practical in helping decide whether someone has sustained a concussion. For the purposes of our study, a concussion was considered to have occurred if an athlete reported a loss of consciousness, confusion or disorientation, or any of the other most commonly recognized concussion symptoms (headaches, dizziness, memory difficulties, blurred or abnormal vision, nausea, hearing problems, or light sensitivity) after being hit playing football. The number of concussions was conservatively estimated to be the maximum number of any one sign or symptom experienced and not the cumulative number of all signs and symptoms experienced.

Descriptive analyses were created for all study variables using mean, standard deviation, median, range, or percentage where appropriate. Two by two tables correlating concussions with various potential predictors were created to investigate these relationships. Logistic regression models were created to examine the multivariate relationships between potential predictors of concussions and a wide variety of risk factors. These risk factors included the athlete’s age, the number of games played during the 1997 season, the total number of years playing football, past concussions in football, past concussions outside of football, past losses of consciousness in football, past losses of consciousness outside of football, alcohol intake, and other sports played by the athlete. In all cases, final models were selected using the Bayesian Information Criterion (BIC). The BIC improves over the conventional backward or forward model selection techniques in that models need not be nested, and the final model is selected independent of the order in which they are estimated.

RESULTS

A total of 289 completed questionnaires were returned from the eight different teams. Of these, 154 players had played in the CFL during the 1997 season. All of the questionnairees were analyzed, but only the data from athletes who had played in the CFL during the 1997 season will be discussed herein.

The average player profile is listed in Table 1. The average player had at least 4 years of professional football experience and had been playing organized tackle football for more than 14 years. The breakdown of primary positions played are listed in Table 2. Although

<table>
<thead>
<tr>
<th>TABLE 1. Average player profile</th>
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<tbody>
<tr>
<td>Age at time of the survey (yrs)</td>
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<tr>
<td>Age started organized tackle football (yrs)</td>
</tr>
<tr>
<td>Years playing organized tackle football</td>
</tr>
<tr>
<td>Years playing professional football</td>
</tr>
<tr>
<td>No. of games played in the CFL in 1997</td>
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<tr>
<td>Average no. of recognized concussions from football</td>
</tr>
<tr>
<td>Completed College/University (%)</td>
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<tr>
<td>Work during the off-season (%)</td>
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<tr>
<td>Work during the season (%)</td>
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</tbody>
</table>

* Percentage of all players.

Unless indicated, values are presented as mean ± standard deviation.
many players played several positions, they were asked to pick only one primary position. Any other positions they may have played were considered secondary positions.

Although 8.4% of all players recognized they had experienced at least one concussion during the 1997 season, 44.8% of all players reported having signs or symptoms of at least one concussion. In other words, of the 44.8% of all CFL players who likely experienced a concussion, only 18.8% of these realized they had experienced a concussion. For those who did experience at least one concussion, the conservative estimates for the number of concussions (the maximum number of any one symptom only, not all symptoms combined) are listed in Table 3.

When examining factors that increased the odds for a concussion during the 1997 season, a previous loss of consciousness, past concussions, and the amount of games played during the 1997 season were found to be significant. Players who had experienced a previous loss of consciousness after being hit playing football were nearly 6.2 times more likely to sustain a concussion than players who had never been knocked unconscious while playing football (p < 0.05). Players who had at least one recognized concussion while playing football were 5.1 times more likely to sustain a concussion than players who had never experienced a recognized concussion while playing football (p < 0.0001). For each extra game played in 1997, the odds of experiencing a concussion were increased 13% (p < 0.0001). Several other variables were examined for correlation, but most did not reach statistical significance (see Table 4).

When examining the group with the highest odds of experiencing a concussion during the 1997 season, a quarterback who had at least one previous recognized concussion while playing football in the past and who had played in all the possible games in 1997 was found to have the highest odds. The percentage of players from each position who experienced at least one concussion during the 1997 season are listed in Table 5.

Duration of symptoms for the concussion episodes are listed in Table 6, shown as the length of time that the longest symptom persisted. The duration of symptoms can be used to grade the concussion and as a guide for return to play. The data show that 25.8% of players had their longest symptoms for at least 1 day, 9.1% had them for at least 3 days, 3.0% for at least 1 week, and 1.5% of players experienced symptoms for at least 2 weeks.

All players who experienced a concussion can be classified into two groups: those who recognized they had had a concussion and those who did not recognize that they had had a concussion. The percentage of individual symptoms experienced by each group are listed in Table 7.

**DISCUSSION**

The results of this study revealed that 44.8% of players experienced at least one concussion during the 1997 season. The study used what may be considered a liberal definition of inclusion, in that a concussion was considered all players recognized they had experienced at least one concussion during the 1997 season, 44.8% of all players reported having signs or symptoms of at least one concussion.
tered to have occurred if an athlete reported a loss of consciousness, confusion or disorientation, or any of the other most commonly accepted symptoms of a concussion (headaches, dizziness, memory difficulties, blurred or abnormal vision, nausea, hearing problems, or light sensitivity) after being hit playing football. Although the players were asked to include only those common concussion symptoms that occurred immediately after being hit playing football, it is possible that the inclusion criteria overestimated the number and severity of concussions. In particular, the symptom of headaches may be difficult to attribute solely to concussions. Even if a more limited definition of a concussion was used to include only those players who experienced a loss of consciousness or confusion, 31.2% of the players would still be considered to have experienced a concussion. This compares with an incidence of 19 per every 100 players per year in a previous high school study and 5.9 per every 100 athletes in a previous collegiate study that used similar definitions of concussion.

When examining the occurrence of different symptoms, confusion (getting “dinged”) was the most common for both those who recognized they had experienced a concussion and those who did not recognize that they had experienced a concussion. Headache was the second most common symptom in all groups. The incidence of headaches is similar to that in previous reports of concussions. Other symptoms 0/13 (0.0) 4/55 (7.3) 4/69 (5.8)

### TABLE 6. Maximum duration of symptoms among concussed players (N = 66)

<table>
<thead>
<tr>
<th>Symptom duration</th>
<th>No. (%) of concussed players</th>
</tr>
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<tbody>
<tr>
<td>≤5 sec</td>
<td>4 (6.1)</td>
</tr>
<tr>
<td>≤30 sec</td>
<td>8 (12.1)</td>
</tr>
<tr>
<td>≤5 min</td>
<td>13 (19.7)</td>
</tr>
<tr>
<td>≤30 min</td>
<td>26 (39.4)</td>
</tr>
<tr>
<td>≤60 min</td>
<td>37 (56.1)</td>
</tr>
<tr>
<td>≤2 hrs</td>
<td>44 (66.7)</td>
</tr>
<tr>
<td>≤1 day</td>
<td>59 (89.4)</td>
</tr>
<tr>
<td>≤3 days</td>
<td>63 (95.5)</td>
</tr>
<tr>
<td>≤1 week</td>
<td>65 (98.5)</td>
</tr>
<tr>
<td>≤2 weeks</td>
<td>66 (100.0)</td>
</tr>
</tbody>
</table>

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Tables and figures are not provided in the text.
opportunity for a professional football player to have a concussion compared with collegiate or high school athletes. Traditionally, concussion rates have been reported as the rate per 1,000 athletic exposures (i.e., one athlete playing in one practice or game equals one athletic exposure). Because of the retrospective nature of the study, it is impossible to determine the true amount of athletic exposures, because the practice schedule of each team and player would need to be determined. Studies have shown, however, that most concussions in football occur during game situations. In the CFL, most teams do not hold full contact practices once training camp has ended because of the limited roster size and fear of injuring players. Knowing the total number of concussions, the number of games played for the whole league, and the average number of plays per game over that time allowed us to calculate a theoretical risk of concussion per play. If one were to assume that all concussions during the 1997 season occurred solely during games, this would yield a concussion rate of 3.1 per 1,000 athlete plays in a game situation. This translates into a risk of 0.3% that an athlete will experience a concussion on each play of the game.

Our study was retrospective in nature, and thus not ideal in that athletes can forget symptoms and are often less accurate with respect to duration and frequency of symptoms. However, it does allow an athlete the opportunity to reveal symptoms that may not have been identified prospectively. This may occur if the athlete is unaware that his symptoms are secondary to a concussion or if the athlete is afraid to mention his symptoms to a trainer or physician for fear of being prevented from returning to play.

The questionnaires were answered anonymously. Although this makes it impossible to confirm or gather further data from a player, it was decided that players would be less inhibited in answering an anonymous questionnaire. In a similar study performed a year earlier, players remarked on their reluctance to answer truthfully about concussions for fear it would jeopardize their chances of making or remaining with a team (personal observation). Anonymity allowed them to answer truthfully without fear of negative repercussions.

Finally, this study does not account for possible confounding variables, such as the different equipment worn by individual players. The use of different helmets, proper inflation of these helmets, and use of mouth guards or soft cervical collars (cowboy collars) were not addressed in the questionnaire.

The results of this study show that, despite an increased public awareness about head injuries, many professional football players may not recognize the symptoms of a concussion. The players need to be better informed about the symptoms, incidence, and dangers of concussions. With increased knowledge and awareness, the players will be more likely to recognize and communicate information about their own concussive episodes. Our hope is that increased education will allow for a more accurate reflection of the reality of head injuries in football. In turn, we hope that this will lead to a safer, more informed assessment and management of concussions by the team physicians.

Acknowledgment: The authors thank the Canadian Football League Players Association, particularly Dan Ferrone and Kathy McMullan, who were instrumental in coordinating and collecting the questionnaires; Tracy Troutman Delaney for her work in entering the data and proof reading the article; and Dr. David Mulder and Dr. Eric Lenczner, two team physicians, whose interest and ideas helped this study come to fruition.

REFERENCES