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Declining Incidence of Catastrophic Cervical Spine Injuries in French Rugby

1996-2006

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Purpose: To investigate the incidence and the risk factors of catastrophic cervical spine injuries in French rugby.

Study Design: Descriptive epidemiology study.

Methods: The patients included had cervical spine injuries causing neurological disorder classified from the ASIA scale, grade A to D. A retrospective review of all cases that occurred between the 1996-1997 and the 2005-2006 seasons was made. Circumstances of the injuries and of the clinical outcome were collected by interview.

Results: There were 37 cases of catastrophic cervical spine injuries in French rugby for the last 10 years. The incidence of the cervical spine injuries decreased during this period. The rates of injury were 2.1 per 100 000 players per year during the 1996-1997 season and 1.4 during the 2005-2006 season ($P < .01$). The scrum was a major cause of injury, accounting for 51.3% (19/37). The forwards represented 89.2% (33/37) of the injured players. The hookers were involved in 37.8% (14/37) of the cases. The measures of prevention with the modification of the rules of scrum and the creation of a medical certificate required for players to play in the front row must have been successful.

Conclusion: The incidence of disabling cervical spine injuries in French rugby has decreased for the last 10 years, which is linked to the decreasing incidence of injuries in the scrum. This epidemiological study shows the effectiveness of the preventive measures on cervical spine injuries in French rugby players. A national register of catastrophic cervical spine injuries extends our epidemiological observations.

Keywords: cervical; injury; rugby; scrum; spine

Rugby union is a contact sport that exposes players to cervical spine injuries. Permanent disabling spinal injuries are the most relevant complication. The major emphasis on prevention of injuries in rugby union is focused on cervical spine injuries. Rugby nations have dealt with spinal cord injuries in rugby since the mid-1970s. "RugbySmart" in

New Zealand is the most important example of an educational prevention program.⁷ In France, rugby is one of the most practiced sports in terms of the number of players, 224 115 in 2007.¹ This national study is part of the prevention program including the French Rugby Union (Fédération Française de Rugby [FFR]), an association of patients (Rugby-Espoir-Solidarité), the affiliated insurance company of the FFR (CGA Colonna), and the professional Rugby Union (Ligue Nationale de Rugby [LNR]). It is the first study in France that gives an analysis and a description of the circumstances of cervical spine injuries. The evolution of the incidence of these catastrophic injuries allows us to assess and improve our program of prevention.

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TABLE 1
American Spinal Injuries Association Scale (ASIA)

A	Complete	No motor or sensory function is preserved in the sacral segments S4 to S5.
B	Incomplete	Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4 to S5.
C	Incomplete	Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade of less than 3.
D	Incomplete	Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
E	Normal	Motor or sensory function is normal.

TABLE 2
Position of the Players on the Field in Rugby

Position	Number	Name ^a
Forwards	1 and 3	Prop
	2	Hooker
	4 and 5	Lock
Backs	6, 7, and 8	Scrum-half
	9	Fly-half
	10	Wing
	11 and 14	Center
	12 and 13	Fullback
	15	

^aFront row includes 1 to 3, second row includes 4 and 5, and third row includes 6 to 8.

TABLE 3
Category of the Players in French Rugby

Category	Age (y)
Senior	Over 21
Junior	17-21
Cadet	15-17
Minime	13-15

MATERIALS AND METHODS

Definition and Database

We collected and analyzed data from the 1996-1997 season to the 2005-2006 season. We studied the incidence and the circumstances of spinal injuries in rugby in France. We included patients with permanently disabling cervical spine injuries using the American Spinal Injuries Association scale A to D (Table 1). Head trauma was excluded. Fatal injuries were excluded also. We included all rugby players of the French Rugby Union of any category by using the database of their insurance company records. We cross-checked files from the association of patients, called "Rugby-Espoir-Solidarité," which involves rugby players who are suffering from a disabling injury in rugby. We used a form constructed for this study, and we interviewed the injured players. To assess the rate of injuries per year, we chose the number of players to estimate the average incidence of spinal injuries per 100 000 players. We used records of numbers of players, available from the French Rugby Union.¹

Analyzed Data and Statistical Analysis

We focused on the following information:

- Incidence of catastrophic cervical spine injuries per season: The season opens at the beginning of August and closes at the end of June.
- Phase of play: We made a distinction between scrum and other phases of play (ruck, maul, tackle).
- Position of the player: We categorized the position of the player as forwards and backs and front-row players (Table 2).
- Category of the players: We analyzed the category of the injured players. The senior category is over 21 years of age. The junior category is between 17 and 21 years (Table 3).
- The neurological diagnosis was analyzed.
- Neurological outcome: We evaluated neurological recovery and rehabilitation status.

Patients were interviewed by the authors either directly (n = 21, 56.8%) or by telephone (n = 15, 40.5%). One could not be located.

The results were analyzed by using Statview, version 5.0 (SAS Institute Inc, Cary, North Carolina), using the following:

- for the comparison of quantitative and qualitative variables, the Student-Fisher method.
- for the comparison of quantitative variable methods, the coefficient of correlation.

The level of significance was set to .05.

RESULTS

Incidences of Catastrophic Cervical Spine Injuries

Thirty-seven disabling cervical spine injuries were recorded between the 1996-1997 season and the 2005-2006 season (Figure 1). The rates of injury were 2.1 per 100 000 players per year during the 1996-1997 season and 1.4 during the 2005-2006 season (Table 4).

The incidence decreased for the last 10 years concerning the numbers of cases per year ($P < .02$, $R^2 = .52$). It is also statistically significant if the incidence is divided by the number of players in France ($P < .04$, $R^2 = .52$).

Diagnosis

The average age of the injured athletes was 25.1 years. The initial ASIA score of the patients was A in 27 cases (73%), B in 4 cases (10.8%), C in 5 cases (13.5%), and D in 1 case (2.7%). Dislocation (n = 13, 35.1%), fracture dislocation (n = 12, 32.4%), and slipped disc (n = 4, 10.8%) of the lower

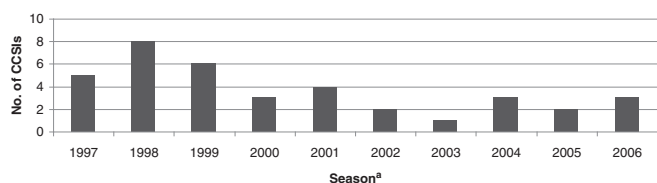


Figure 1. Incidence of catastrophic cervical spine injuries (CCSIs) per season in French rugby.

^a1997 is the 1996-1997 season.

TABLE 4
Rate of Catastrophic Cervical Spine Injuries (CCSIs) per 100 000 Players per Season in French Rugby

Season	No. of Players	No. of CCSIs	Incidence/100 000 ^a
1996-1997	239 076	5	2.1
1997-1998	241 173	8	3.3
1998-1999	231 633	6	2.6
1999-2000	227 711	3	1.3
2000-2001	230 641	4	1.7
2001-2002	222 609	2	0.9
2002-2003	189 628	1	1.9
2003-2004	201 276	3	1.5
2004-2005	201 535	2	1
2005-2006	212 059	3	1.4

^aIncidence of CCSIs per season per 100 000 players in the French Rugby Union.

cervical spine (C3-C7 level) were the most common lesions. Neurological recovery was complete, incomplete, and absent in 10.8% (n = 4), 64.9% (n = 24), and 21.6% (n = 8) of the patients, respectively. Fifty-four percent of patients (n = 20) remained wheelchair bound.

Circumstances of the Injuries

Scrum accounted for 51.3% (19/37) of spinal injuries. Forwards accounted for 89.2% (33/37) of injuries. Front-row players accounted for 56.8% (21/37) of spinal injuries. Hooker players accounted for 37.8% (14/37) of injuries (Table 5). We noticed that 4 players became injured when playing a new position. They clearly reported that the accident had occurred while they were playing in that position for the first time. All these cases concerned front-row accidents during a scrum. Three players were injured playing props instead of playing third row (2 cases) or hooker (1 case). One player had an accident playing hooker instead of playing prop. The senior category, aged over 21 years, represented 57% (21/37) of the patients. The junior category, between 17 and 21 years, is a risky category with 32.4% (12/37) of the injuries.

Before and After the 2000-2001 Season

Before the 2000-2001 season, we recorded the following (Table 6):

TABLE 5
Circumstances of the Injuries From the 1996-1997 Season to the 2005-2006 Season: Position and Category of the Players^a

	No. of Players	No. of CCSIs	P Value
Total	2 197 341	37	
Category			
Under 17	1 111 309	4	.06
Junior	217 140	12	
Senior	868 892	21	
Position			
Front row	439 468	21	.18
Hooker	146 489	14	.18

^aCCSIs, catastrophic cervical spine injuries.

- From 1996 to 2000: There were 26 injuries, 16 in the phase of scrum, concerning 24 forwards, and the rate of injury was 2.2 per 100 000 players per year.

After the 2000-2001 season, we recorded the following:

- From 2001 to 2006: There were 11 injuries, 3 in the phase of scrum, concerning 8 forwards, and the rate of injury was 1.1 per 100 000 players per year.

Between these 2 periods of 5 years, the incidence of injuries during scrum decreased ($P < .01$). In the same period, forwards ($P < .01$), and among them front-row players ($P < .01$), experienced fewer injuries.

DISCUSSION

This study is the first epidemiological analysis of severe spinal cord injuries induced by rugby practice in France. Many other countries have made such studies.

One of the weaknesses of this study results from a retrospective analysis. However, we think all patients with permanently disabling spinal injuries were included in this study because patients needed to declare their accident to obtain compensation, and our database comes from the only insurance company of the French Rugby Union. We also cross-checked files with the association of injured players.

Identified Risk Factor

The incidence of such injuries is too low to show, during this period, a significant difference regarding the position of the player or the phase of play. The phase of play in which the lesion occurred varied according to the player position. Hookers and props are the most affected position on the field for such injuries in rugby. The front row is made up of 3 players (2 props and 1 hooker). With regards to the other positions in the game, the front-row players and especially the hooker are overrepresented, but there is no statistical evidence (Table 5). The risk to this group is explained by the position of their necks in the scrum under

TABLE 6
Comparison Before and After the 2000-2001 Season^a

Period	No. of Players	No. of CCSIs	Incidence/100 000 ^b	Front-Row Players	Hookers	Phase of Scrum
1996-2001	1 170 234	26	2.22	17	10	16
2001-2006	1 027 107	11	1.07	4	4	3
		<i>P</i> < .01	<i>P</i> < .01	<i>P</i> < .01	<i>P</i> < .01	<i>P</i> < .01

^aCCSIs, catastrophic cervical spine injuries.

^bIncidence per 100 000 players per season in the French Rugby Union.

the pressure of 16 players. Any wrong position can lead to collapse of the scrum and cause injuries. The cervical spine is exposed to injury because the player leads with the head. Cervical injuries are the result of hyperflexion or rotation of the neck.^{8,13} We emphasize that several cases of catastrophic injury (4 of 37) were due to a change in playing position, which means a player has been injured while playing a position that he was not used to. These cases are avoidable injuries. Coaches and players must be informed that players should be trained physically and technically to play front row. This is one of the most crucial ways of injury prevention that the French Rugby Union has been working on since this statement. The junior category must be considered as a risky category (Table 5) because the number of juniors injured is higher than the ratio of juniors during this period ($P = .06$); it has been already reported.^{9,14} In our series, 4 players in the junior category were injured while playing in the senior category. But that practice has been forbidden since the 2000-2001 season.

Decreasing Incidence After the 2000-2001 Season

The decreasing incidence of spinal injuries between 2 periods, before and after the 2000-2001 season ($P < .04$, $R^2 = .52$), is correlated to the decreasing incidence of injuries during the phase of scrum ($P < .01$). We explain this by the introduction of some changes in French rugby at the beginning of the 2000-2001 season. This may be a consequence of the application of new rules about scrums and a new license concerning front-row players.

A scrum is formed in the field of play when 8 players from each team, bound together in 3 rows for each team, close up with their opponents so that the heads of the front rows are interlocked (Figure 2). This creates a tunnel that the scrum-half throws the ball into so that front-row players can compete for possession by hooking the ball with either of their feet. The middle player in each front row is the hooker. The players on either side of the hooker are the props. The left-side props are the loose head props. The right-side props are the tight head props. The 2 players in the second row who push on the props and the hooker are the locks. The outside players who bind onto the second or third row are the flankers. Laws of the game are under the recommendations of the International Rugby Board. Front rows coming together are under the direction of the referee. He will call "crouch" then "touch." The front rows crouch and, using their outside arm, each prop touches the

point of the opposing props' outside shoulder. The props then withdraw their arms. The referee will then call "pause." After a pause, the referee will then call "engage." The front rows may then engage.

The French Rugby Union added other laws in scrum in the 2000-2001 season. The laws of the game during scrum depend on the level of the player. For nonprofessional players, instead of touching their opponent player, they link to them, make a pause, then push to compete for the ball. The 2 teams are allowed to push for the distance of 1m50 and no more. In this way, the initial position of the 2 front rows is under control of the referee; dangerous contacts and violent impacts are avoided. Uncontested scrums also exist, where the teams do not compete for the ball. The team putting in the ball must win it. None of the teams is allowed to push the other team away from the mark. This could happen in different situations: imbalance of the involved forces, repeated scrum, and default of front-row players. Before the beginning of the match, the referee checks if front-row players are able to play this position. All these laws contribute to control the initial phase of contact between the 2 opponent front rows.

The medical committee of the French Rugby Union modified the certificate that allows players to participate in rugby. From the 2000-2001 season, a special form, called the "rugby passport," specifies the capacity of the player to play in the front row. This medical examination eliminates players without skill and morphological capacity to compete in a scrum.

The relationship between these modifications and the decreasing incidence of spinal injuries is not clearly proven. We did not compare these results with a control group of rugby men who would have played without the modification of these rules in the period. But the beginning of the application of these rules is correlated with the decreasing incidence of catastrophic cervical spine injuries. The main point is that the overall incidence is correlated to the incidence of the injuries during the phase of scrum. And all the measures, explained above, about the phase of scrum seemed to have a beneficial effect on the prevention of catastrophic cervical spine injuries.

Comparison With Other Countries

Similar data, with a predominance of injuries during scrum, were reported in the United States,^{13,14} Argentina,⁹ England,^{11,12} South Africa,^{4,7,8} Australia,² and New



Figure 2. Position of the players during the phase of scrum.

Zealand.^{5,6} However, an exception was made by an Irish study¹⁰ with 8 backs out of 12 injuries and a predominance of injuries during the tackle.

It is difficult to make a comparison between the incidence of injury in different countries. The number of injuries should be compared regarding the numbers of players in each country. With the only available data, France seems to have a low incidence of catastrophic cervical spine injuries compared with others. In 2003, incidence per 100 000 players per year was 1.5, 1.7, and 6.3, respectively, in France, New Zealand,⁹ and Australia.³ The decrease in incidence seems to be similar in France and in New Zealand since 2000. The decrease of spinal cord injuries in New Zealand coincides with the introduction of a national program of prevention called "RugbySmart." From our observations, Quarrie et al⁶ reported a decrease in injuries only during the phase of scrum, and no changes occurred to the law relating to the scrum during this period in New Zealand. The only change in New Zealand during this period was this founding of RugbySmart; they concluded that such a program could prevent a lot of severe spinal injuries. We reached the same results with different patterns of prevention. It emphasizes that the most effective prevention is a public awareness campaign concerning all participants in rugby. It means that players, coaches, referees, and doctors are concerned with the risk of cervical spinal cord injuries in their sport. They take this risk into account because messages of prevention are regularly delivered.

To improve our knowledge about such catastrophic injuries, prospective studies are necessary.^{2,3} The network created with the aim of gathering files on these 37 cases will continue to run through a national register of spinal injuries in rugby. With this national database, also known

as "The National Register of Spinal Cord Injuries in Rugby," we will be able to evaluate the influence of preventive measures on the incidence and consequences of these injuries. We hope to be joined by other countries in which rugby is played to assess our program of prevention with a common form.

CONCLUSION

The incidence of catastrophic cervical spine injuries in French rugby has been decreasing for the last 10 years. It is linked to the decreasing incidence of injuries in scrum. Efforts made by the French Rugby Union through different measures of prevention, above all concerning the phase of scrum and the front-row players, seem to have been successful.

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