Disabling injuries of the cervical spine in Argentine rugby over the last 20 years

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Abstract

***Objective*—To investigate the incidence and risk factors of disabling injuries to the cervical spine in rugby in Argentina.**

***Methods*—A retrospective review of all cases reported to the Medical Committee of the Argentine Rugby Union (UAR) and Rugby Amistad Foundation was carried out including a follow up by phone. Cumulative binomial distribution, $\chi 2$ test, Fisher test, and comparison of proportions were used to analyse relative incidence and risk of injury by position and by phase of play (Epi Info 6, Version 6.04a).**

***Results*—Eighteen cases of disabling injury to the cervical spine were recorded from 1977 to 1997 (0.9 cases per year). The forwards (14 cases) were more prone to disabling injury of the cervical spine than the backs (four cases) ($p = 0.03$). Hookers (9/18) were at highest risk of injury ($p<0.01$). The most frequent cervical injuries occurred at the 4th, 5th, and 6th vertebrae. Seventeen of the injuries occurred during match play. Set scrums were responsible for most of the injuries (11/18), but this was not statistically significant ($p = 0.44$). The mean age of the injured players was 22. Tetraplegia was initially found in all cases. Physical rehabilitation has been limited to the proximal muscles of the upper limbs, except for two cases of complete recovery. One death, on the seventh day after injury, was reported.**

***Conclusions*—The forwards suffered a higher number of injuries than the backs and this difference was statistically significant. The chance of injury for hookers was statistically higher than for the rest of the players and it was particularly linked to scrummaging. However, the number of injuries incurred in scrums was not statistically different from the number incurred in other phases of play.**

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Injuries are a complication relevant to all sports, especially the so-called contact sports. In 1981, Sparks[1] reported that the rate of injury was higher in rugby than in any other sport. Disabling cervical spine injuries occur particularly in rugby. This problem has been recognised since the mid-1970s.[2–11] Unlike the rest of the spine, the cervical cord is particularly vulnerable to injury because it has[2 3 12–17]:

(1) greater mobility;
(2) smaller vertebral bodies;
(3) oblique articular facets;
(4) weaker muscle protection;
(5) relative mobility of the unsupported skull on the cervical spine.

The likelihood of injury is enhanced by the fact that, in rugby, the player leads with the head.

Cervical injury is the result of either extreme flexion with or without rotation of the neck or hyperextension of cervical vertebrae. Hyperflexion lesions are most common and occur when a force is exerted through the vertex of the head and transmitted through the skull to the cervical vertebrae. The vertebrae crush and the vertebral body and disc extrude posteriorly into the cervical cord. Dislocation may occur without fracture of the vertebrae. Forced flexion of the neck is observed most frequently during collapse of the scrum while the scrum or the opposition continue to push. Other potential injury conditions include wheeling of a scrum and when players turn their necks to look at an incoming ball. Cord injuries are predominantly at the level of C4, C5, and C6. The neck of a tight front row is estimated to brace 1–1.5 tons in each scrum.

During extreme extension of the neck, the spinal canal is narrowed and the cord may be seriously damaged. If the force of the impact is great enough, fracture of the posterior bony elements occurs as they impinge on one another. Brain damage may arise if the vertebral artery is compressed between the occipital condyles of the skull and the lamina of the first cervical vertebra.[16] This kind of damage is typically seen when the front rows "charge in" during the engagement of the scrum and the head of a player is not correctly aligned; the head is lifted out of the scrum ("pop out"). Incorrect tackling technique can also result in whiplash hyperextension neck injuries.

This study looks at the number of rugby players who have suffered this lesion in Argentina during the last 20 years and the circumstances under which the injury occurred. Age, field position, phase of play, and rule amendments are all considered.

Methods

All rugby players of any category were included in the study if they had suffered a clinically permanent or transient disabling cervical spine injury. Head trauma and disabling injuries not affecting the cervical column were excluded. The design was descriptive. Information on all cases involving this type of injury was obtained from the Argentine Rugby Union (UAR) and the Rugby Amistad Foundation. The latter foundation involves rugby players who have suffered a disabling injury of any type in rugby and focuses on rehabilitation both physical and

Table 1 List of cases of disabling injury to the cervical spine in Argentine rugby

No	Age (years)	Date of injury	Level of injury	Tracheostomy	Surgery	Delay	Position	Mechanism	Rehabilitation
1	16	25/05/77	5	Yes	Yes	7 days	Hooker	Collapsed scrum	Shoulders and biceps
2	25	8/10/78	6, 7	No	Yes	6 hours	Prop	Scrum engagement	Upper limbs
3	17	11/03/86	6, 7	No	Yes	7 days	Flanker	Collapsed scrum	Upper limbs
4	19	7/07/86	6	—	—		Hooker	Collapsed scrum	Shoulders and biceps
5	15	26/09/87	5, 6	No	Yes	7 hours	Hooker	Collapsed maul	Upper limbs
6	15	7/07/88		—	—		Hooker	Scrum engagement	Death 7th day
7	17	29/07/89	4, 5	No	Yes		Hooker	Collapsed scrum	Biceps
8	21	7/10/90	5, 6	No	Yes	6 hours	Fly half	Tackler	Upper limbs and part of lower limbs
9	18	17/07/93	2, 3	Yes	Yes	4 days	Lock	Scrum engagement	Left body
10	23	29/08/93	6, 7	No	Yes	7 days	No 8	Collapsed maul	Upper limbs
11	19	13/03/94	4, 5	No	Yes		Centre	Tackler	Upper limbs
12	27	6/07/94	2, 3	No	No		Centre	Tackler	Complete
13	17	3/09/94	5, 6	No	Yes	2 hours	Hooker	Collapsed scrum	Upper limbs
14	22	20/06/95	4, 5	No	Yes	10 days	Wing	Tackled	Complete
15	24	12/08/95	5, 6	No	Yes	8 hours	Hooker	Scrum engagement	Upper limbs
16	17	23/06/96	5, 6	No	Yes	1 day	Hooker	Scrum engagement	Almost complete
17	26	28/07/96	2, 3	Yes	Yes	4 days	Lock	Tackled	Right hemibody
18	20	19/10/97	5, 6	No	Yes	7 days	Hooker	Scrum engagement	Left shoulder

Delay indicates the delay between injury and surgery.
Blank spaces correspond to unavailable data.

psychological. A follow up on the phone was carried out. Cumulative binomial distribution, χ^2 and Fisher tests, and comparison of proportions were used to analyse risk of injury by position and by phase of play (Epi Info 6, Version 6.04a). Table 1 gives the files describing each case and affiliated data. As far as we know, there were no cases or deaths that were not reported to the medical committee.

Results

Eighteen cases of disabling injury to the cervical spine have been recorded since 1977. The ages of the injured players ranged from 15 to 27, the mean being 22 (table 1). Fractures or dislocations between the 4th and 6th cervical vertebrae were most common. All cases were treated surgically. Three of the patients needed tracheostomy. The delay before surgery after the accident ranged from two hours to 30 days.

Statistical analysis showed that the forwards (14 cases) had a higher risk of injury than the backs (four cases). The proportion of forwards who received an injury to the cervical spine was 14/18—that is, 0.778. The proportion expected from the number of players actually playing in a game is 8/15—that is, 0.533. The cumulative binomial distribution was 0.97, which gives a p value of 0.03 for a one tailed test.

The playing position in which injury most frequently occurred was hooker (nine), then inside centre (two), third row (two), second row (two), prop (one), wing (one), and fly half (one). Hookers had a statistically higher risk of injury than the rest of the players (χ^2 test with Yates correction: $p<0.01$) As the χ^2 test was considered not valid because the expected value for Hookers was less than 5, the Fisher test proved that hookers experienced a statistically significantly increased chance of a disabling cervical spinal injury ($p<0.0004$).

Scrummaging was responsible for 11/18 cases of injury; six occurred during scrum engagement and five were the result of scrum collapse. The second most frequent cause of injury was the tackle (five). In three cases, the tackler was affected and in two the tackled player. The next most frequent cause of injury was collapse of the maul (two). Comparison of proportions between disabling cervical spine injury caused by scrums and other formations did not show any statistically significant difference ($p = 0.44$).

Almost all injuries (17/18) occurred during match play, as opposed to training sessions. Quadriplegia was the main clinical manifestation in all cases. Except for two cases of complete neurological recovery, all players experienced different degrees of neurological sequelae (table 1). Only one death, from pulmonary infection in the intensive care unit on the seventh day after injury, was registered.

Discussion

The most distinctive characteristic of rugby in the last 25 years has been the high annual incidence of spinal cord injuries reported in many rugby playing countries such as New Zealand,[15 17] England,[3 10] Australia,[18] Ireland,[19] and France (unpublished data). Even countries that have started to participate in international rugby fairly recently, such as Canada and the United States, have reported the same increased incidence.[2]

Silver[10] observed that the average number of cervical spinal cord injuries in England each year was 2.2 between 1956 and 1982. This rose to 3.6 per annum between 1982 and 1987. The annual mean number of disabling injuries of the cervical spine in Argentina from 1977 to 1997 was 0.9—that is, less than one case a year. However, 14/18 cases occurred during the last 10 years, with an annual average of 1.4 cases since 1987. These figures are not comparable from a statistical viewpoint. Whereas the Rugby Football Union includes about 400 000 players, the Argentine Rugby Union has only 48 000. Furthermore, 25 000 players are aged under 19 in Argentina, and juveniles play an average of 15 games per year compared with 20 matches played by adults in Argentina. In other countries, such as those of the British Isles, an adult player is estimated to take part in 30 matches per annum.

As could be expected from the nature of the game, the number of injuries to forwards (77%) was significantly higher than the number of injuries to backs (23%) ($p = 0.03$). There are

Table 2 Main rule modifications concerning the scrum

Year	Rule
1978	The shoulders must be above the level of the hip. It is not allowed to hook the ball with the head.
1980	Right prop must grab the opposite prop above the shoulder. This does not apply for the left prop.
1982	Intentional collapse of the scrum is penalised.
1983	The forwards, particularly the right prop, must push in a straight line during the shove.
1985	The scrum cannot drive more than 1 m. Wheeling is limited to 45° in young divisions and to 90° in seniors.
1988	Sequential alignment is enforced (front row first, then second row and finally third row). This technique increased the number of collapses and the rule was changed.
1989	The crouch-pause-engage sequence is introduced. Scrum half should be ready to put the ball in before the engagement to reduce the time of the formation.
1991	Should a team be unable to provide competent players for the front row, the referee will not permit the game to proceed.
1994	Teams should have a complete front row on the bench. If any player of the front row is sent off, another first rower should replace any other player to cover the position.

comparable data for England[3 10] and South Africa.[2] Silver[3] reported a 65% incidence for the forwards and 35% for the backs in 57 Rugby Union players who sustained cervical spinal injuries between 1952 and 1982. The same author saw the figures change to 77 and 23% of 18 injuries between 1982 and 1987. Kew *et al*[2] retrospectively studied 117 catastrophic neck injuries in rugby players between 1963 and 1989, and reported a 57% corrected incidence for the forwards and 43% for the backs.

Hooker was the most affected position on the field. This finding agrees with reports from South Africa, New Zealand, and the United States, but, in Wales, the injury rate for props was twice as high as that for hookers. It has been reported that mismatches of skill and strength between opponents increase lesion possibilities.[2 3 9 10 14 15 20]

The most obvious risk factor for cervical spinal cord injuries was match play: 17 injuries took place during match play. Similar percentages were reported for rugby in South Africa and Australia.[2 3 21] This finding is particularly meaningful as considerably more time is spent in practice than in matches. Only one player (no 12 in table 1) was injured during a training session and developed spinal shock for 60 minutes.

It was originally believed that schoolboy rugby players were at greatest risk of spinal cord injury. The literature is full of controversy on this subject.[2 16 20 22 23] In this study, 8/18 cases involved players aged between 15 and 17. Furthermore, six of the nine injured hookers were between 15 and 17.

There were no injuries to players younger than 14. This finding may be explained by the fact that under-14 teams play the so-called "simulated scrum". In Argentina, static formations (lineouts and scrums) become more relevant in higher competition categories where the level of performance rises and the competitive nature of the game reaches higher levels.

It is arguable whether injuries to young players can be explained by the current more aggressive approach to the game, with a "win at all costs" attitude. Therefore skill does not seem to prevent injuries. This is further backed up by the fact that these injuries take place almost exclusively during match play.

The phase of play in which the lesion occurred varied according to player position. Backs suffered most of their injuries during tackles whereas props and hookers were more prone to injury while scrummaging. Ruck and maul injuries appeared to be more common in forwards. The scrum was responsible for more than half of cervical injuries in Argentina (11/18); the majority occurred during the engagement (6/11), and downward collapse of the formation accounted for 5/11 cases. No cervical cord injuries resulted from pop up of the scrum.

The front row is usually more prone to collapse of the scrum when[14]:

(1) the two front rows charge in during the engagement;
(2) the two front rows stand too close to each other;
(3) the second row and third row forwards apply the push before the front row is properly formed;
(4) the second shove is not made straight forward;
(5) the crotch binding technique is exercised (second row binds on to the prop's jersey by reaching between his legs) adding to the downward force at engagement;
(6) the formation of the scrum takes a long time;
(7) there is incorrect body alignment—that is, shoulders are below the level of the hip;
(8) there is downward push in the second shove;
(9) the playing surface is wet or soft.

Tight forwards often have premature cervical osteoarthrosis and are thus at greater risk of hyperextension injuries to the cervical spinal cord.[24 25]

The second most common mechanism of injury in the study was the tackle (5/18). It has been noted that the percentage of disabling cervical injuries sustained through tackling has increased recently in South Africa[14 15 20] and New Zealand.[2] Injuries to the tackler are often the result of incorrect tackling technique, particularly in the dive tackle. Injuries to the tackled player are caused by a high tackle around the neck, a late or early tackle, and a stiff arm tackle.[20]

We recorded five cases of injury that were due to the tackle, four of which occurred when the ensuing pile up collapsed on the neck of either the tackling player or the player being tackled. The other case of injury caused by the tackle occurred when the neck of the tackled player hyperextended after the chin had hit the ground.

Examination of the time of the season at which the injuries occurred disclosed that 6/18 occurred in July (before the mid-season interval). In contrast, other reports state that most cervical injuries occur at the start of the season or after the mid-season break.[2 16] It is hard to find a clear explanation for our finding, which was not statistically significant.

There have been nine amendments to the rules of rugby with respect to the scrum since 1978 (table 2). Half of the injuries in this study took place between 1992 and 1997. Unlike in New Zealand, Australia, and England, these changes to the laws of rugby do not appear to have reduced the number of critical injuries of the cervical spine in Argentina.

The treatment of cervical fracture-dislocation is well established on arrival of the patient at hospital: skull traction, reduction of dislocation, and, sometimes, spinal fusion. However, there is major concern about the immediate management of the critically injured rugby player at the ground.[16] A severely injured player may be extremely breathless for two reasons: firstly, he/she has just been exerting great physical effort; secondly, if the intercostal muscles are paralysed, he/she immediately becomes completely dependent on the diaphragm to meet respiratory requirements. Shortness of breath may be mistaken for airway obstruction by inexperienced personnel, and the player may be placed in the "recovery position" with neck flexed and rotated, which could lead to a total transection of a previously partly damaged cervical cord.

Once quadriplegia is established the prognosis is very poor, as recovery is usually limited to the proximal muscles of the upper limbs (table 1). In this study, there were only two cases of full recovery. In the first, the patient improved over the hours immediately after the spinal shock, and, in the second, the patient recuperated after about six months of physiotherapy.

Many measures can be taken to decrease the chances of injuring the cervical spine. All players, coaches, referees, parents, doctors, and supporters should be made aware of the dangers related to neck injury, particularly those associated with the scrum and tackle. Individual skills in tackling technique should be reviewed and rule amendments should be constantly updated.

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Take home message

The paper tries to emphasise, and warn at the same time, that disabling injuries to the cervical spine are still an intractable problem in Argentina. The highest incidence is in hookers, and its association with scrums calls for further investigation in order to find a pragmatic solution.

Commentary

This paper is valuable in pointing out that injuries to the spine are still occurring in rugby and they are occurring in the Argentine.

Theoretically, the easiest problem to tackle is the problem of the scrum, and efforts have been made throughout the world to depower the scrum and make it safer. Despite this, these injuries are still occurring and it is noteworthy that they are predominantly in the front row.

Other studies[1 2] have found a larger number of forwards injured than backs because forwards today run about and can injure their necks in a tackle, in the same way as the backs, but, in addition, they have the risk of being injured in the scrum.

It has to be recognised that the Argentine forwards are particularly powerful in the scrummage and use different techniques to achieve their domination over the unfortunate forwards of the opposing team. This may well account for the large number of injuries in the front row.

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