Spinal cord injuries in Australian footballers 1997–2002

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ABSTRACT

Objective: To review acute spinal cord injuries (ASCIs) in all Australian codes of football (rugby union [RU], rugby league [RL], Australian Rules football [ARF] and soccer) for 1997–2002 and to compare data with those of a 1986–1996 survey.

Design: Retrospective review of hospital records, and structured interviews with injured players.

Participants and setting: Patients admitted to any of the six Australian spinal cord injury units with a documented football-related ASCI over the period 1997–2002.

Outcome measures: Average annual incidence of ASCIs per 100 000 players in the different codes, final Frankel grading of injuries, and wheelchair status.

Results: Fifty-two footballers (45 adult men and seven schoolboys) suffered ASCIs between 1997 and 2002. The average annual incidence of ASCIs per 100 000 players was 3.2 for RU, 1.5 for RL, 0.5 for ARF and 0.2 for soccer. While there has been little change in incidence since the 1986–1996 survey, there has been a trend towards less severe injuries in RU and RL, but not in ARF. There have been no scrum injuries in RL since 1996, when the scrum stopped being contested. Seven injuries occurred in RU scrums, six at the moment of engagement of the opposing teams. The incidence of 2-on-1 and "gang" tackles (involving multiple tacklers) in RL is disturbing. Overall, 39% of injured players became permanently wheelchair-dependent.

Conclusions: There continues to be good reason to revise the laws of scrum engagement in RU. The laws relating to multiple tacklers in RL should be examined. The insurance cover for injured players is grossly inadequate. The longstanding need for a registry of spinal cord injuries for all football codes regrettably remains unmet.

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Recreational and sporting injuries account for 15% of admissions to Australian spinal cord injury units.[1] Acute spinal cord injury (ASCI) in body contact/collision sports is an expected consequence of the more violent games. This type of injury can have a devastating effect on the lives of the person injured, family members and other close associates. From 1960 to 2002, playing football in Australia resulted in 239 ASCIs. Data for the years 1960–1985 and 1986–1996 have been reported previously.[2,3] Here we report data for the years 1997–2002 and compare them with previous data to examine whether there have been any changes in the mechanism of injury.

METHODS

There are six specialised spinal cord injury units in Australia to which patients with ASCIs are routinely transferred. As the basis for our study, we compiled a list of all patients with a documented football-injury-related spinal cord deficit on admission to any one of the six units over the period 1997–2002. Those who sustained an injury outside Australia were excluded.

Injuries occurring in all four codes of football (rugby union [RU], rugby league [RL], Australian Rules football [ARF] and soccer) were included. Data on the registered player populations in the four codes were provided by the governing bodies.

In most cases, information was gathered by structured interviews with the players themselves (carried out by D J C).

Information concerning player demographics and relevant aspects of the injury was collected as described in earlier studies.[2,3]

Severity of injuries was measured by the Frankel grade:[4] grade A, complete loss of motor and sensory function below the level of the cord lesion; grade B, some sensation below the level of the lesion but complete motor paralysis; grade C, some motor power below the level of the lesion but insufficient for practical use; grade D, useful motor power below the level of the lesion; or grade E, no neurological symptoms, but abnormal reflexes may be present. No attempt was made to evaluate the methods of management of the injuries.

Differences in incidence rates were assessed using Poisson regression analysis, and differences in proportions were assessed using χ^2 statistics. Data were analysed using SAS statistical software.[5]

Ethics approval was obtained from the participating hospitals.

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RESULTS

Number of registered players

The registered player populations in the four codes for several different years are shown in Box 1. Between 1996 and 2002, RU and soccer increased in popularity, whereas the number of RL and ARF players remained essentially unchanged.

Injury numbers and annual incidence of injuries

There were 52 football-related ASCIs Australia-wide in the years 1997–2002. We were able to interview 46 players directly. The families of two other players, one of whom had died, supplied information. Hospital records were the source of data for the remaining four players who could not be located.

The injured players comprised 45 adults and seven schoolboys (< 18 years old). No ASCIs occurred in women or girls. Four schoolboy injuries occurred in RU and one in each of the other codes.

The number of injuries for individual codes was 23 in RU, 12 in RL, 13 in ARF

and four in soccer, with a fairly even spread over the six years.

The all-code average annual number of ASCIs was 8.7, a slight increase over the previous average of 7.3 for 1986–1996. Box 2 compares the average annual frequencies of ASCIs per 100 000 adult and schoolboy players in RU and RL for the periods 1986–1996 and 1997–2002. The overall injury rate for RU was virtually unchanged. There was a slight (but non-significant) fall in the overall injury rate for RL ($P = 0.18$), but not for adults as a group.

1 Number of registered players in the four football codes in various years

Code	1985	1990	1996	2002
Rugby union	83 610	71 427	68 179	148 750
Rugby league	162 220	141 481	112 092	124 949
Australian Rules football	303 100	357 586	413 450	416 734
Soccer	445 586	352 682	275 871	356 734

2 Average annual frequency of acute spinal cord injury per 100 000 players in the rugby codes, 1986–1996[3] v 1997–2002*

	Survey period	All players	Adults	Schoolboys
Rugby union	1986–1996	3.5	6.9	1.2
	1997–2002	3.2	7.2	0.9
	P	0.76	0.84	0.76
Rugby league	1986–1996	2.4	4.4	1.3
	1997–2002	1.5	5.0	0.2
	P	0.18	0.68	0.06

* Acceptable data to separate adults from schoolboys in Australian Rules football were not available for the two study periods, but the overall spinal cord injury rate rose from 0.3 to 0.5 per 100 000 players in the latest survey. The overall rate for soccer rose from 0.03 to 0.2 per 100 000 players.

Age at injury

The average age of injured players was 24.4 years in RU, 25.9 in RL, 23.4 in ARF and 26.0 in soccer.

Standard of game

Injuries occurred mainly in grade and subdistrict games for all codes, as they did in 1986–1996. There were no injuries in representative or international matches. Three injuries were sustained in RU training sessions, one in a schoolboy.

Player position

The position of the injured player was examined for the rugby codes. As in the previous studies,[2,3] forwards were more frequently injured than backs. The number of hookers injured (hookers are in the central front-row forward position) fell considerably, owing to the absence of scrum injuries in RL in the latest period (see below).[3]

Glossary of rugby terms

Breakdown

The phases of play in which the ball-carrier has just been tackled and both sides attempt to gain possession of the ball. It includes the post-tackle phase, rucks and mauls.

Contested scrum

A scrum in which the opposing teams engage in a "contest", pushing with great force towards each other to try to gain ground and get possession of the ball.

Engagement

The moment at which, on the referee's signal, the two forward packs of the opposing teams lock together to form the scrum.

Ruck and maul injuries

Injuries occurring when at least one player from each team binds around the ball-carrier. If the latter is grounded, he/she must release the ball, and this phase of play is a "ruck". If the ball-carrier remains standing, it is a "maul".

Phases of play (rugby codes)

Scrum injuries

Seven injuries occurred in RU scrummage, all but one of which were to front-row forwards (three of them hookers). Six of the seven injuries occurred at engagement and one at scrum collapse. Three injuries caused complete lesions at C5 (Frankel grade A); one schoolboy sustained an incomplete lesion in this way. In the 1986–1996 series, engagement in RU produced four injuries and scrum collapse seven. The decrease in injuries from collapse was statistically significant ($P = 0.04$).

There have been no scrum injuries in RL since 1996, when scrums stopped being contested, whereas there were nine such injuries in the period 1986–1996.

During the 1986–1996 period, 39% of the 21 players injured in RU or RL scrums were not in their regular positions, which emphasised the specialist role of front-row forwards.[3] By contrast, only one of the seven scrum injuries in 1997–2002 occurred to a forward not in his usual position.

Tackle injuries

In RU there were nine injuries from tackles, six to ball-carriers and three to tacklers. Three of the former were the result of multiple tacklers (2-on-1 tackles or "gang" tackles) — a mechanism not reported for this code in 1986–1996.

All injuries in RL were produced by a tackle, two to tacklers and 10 to ball-carriers. Of the eight injuries to ball-carriers in which the exact circumstances were known, seven were the result of multiple tacklers.

Ruck and maul injuries

Six RU injuries took place in rucks or mauls, which are a relatively unstructured phase of play. We found no evidence that the change of laws for breakdown, introduced in 1994,[3] have resulted in an increased risk of ASCI.

Phases of play (other codes)

In ARF, two players were injured in tackles and 11 in open play, usually in a contest for the ball in a variety of situations. Six injured players were onballers (ie, players not in a set position [eg, rovers and ruckmen]). Seven of the 13 injuries in this code were reported as having been illegally sustained when a player was bent over the ball in a "pack" or "ruck" and was struck by some part of an opponent's lower limb.

In soccer, three players were injured in falls during open play, sustaining spinal cord injury without radiological abnormality (SCIWORA). All made a complete recovery. One other, in a fall after a head collision with another player, developed a complete lesion at C4 that ascended to C2, leaving

3 Final Frankel grades of acute spinal cord injuries in football players, 1986–1996[3] v 1997–2002*

	Survey period	Frankel grade A	B	C	D	E	Proportion of injuries of final Frankel grade A, B or C
Rugby union	1986–1996 ($n = 30$)	12	4	0	14	0	53%
	1997–2002 ($n = 23$)	6	0	2	10	5	35%
Rugby league	1986–1996 ($n = 33$)	15	2	0	16	0	51%
	1997–2002 ($n = 10$)	2	0	0	8	0	25%
ARF	1986–1996 ($n = 12$)	3	1	0	7	1	33%
	1997–2002 ($n = 13$)	3	1	0	6	3	30%
Soccer	1986–1996 ($n = 1$)	0	0	0	0	1	0
	1997–2002 ($n = 4$)	1	0	0	0	3	25%

ARF = Australian Rules football. * Data were not available for three rugby league players and one rugby union player for the period 1986–1996, and two rugby league players for the period 1997–2002.

him ventilator dependent. Between 1960 and 1996 there were only two ASCIs in soccer.[2,3] Because of the rarity of these injuries in the code, they will not be considered further here.

Injury type, neurological level and long-term function

Damage to the cervical spine (dislocation, fracture-dislocation and fracture) occurred most often at the C4/5 and C5/6 levels, as was the case in previous studies. Similarly, the lowest normal neurological level was at C4 (22 injuries) and at C5 (19 injuries). Two injuries occurred in the thoracolumbar spine.

A comparison of the final Frankel grades for 1997–2002 and 1986–1996 is shown in Box 3. More relevant, however, is the proportion of injuries of grade A, B or C in the three codes for the two study periods. There has been a decrease in the severity of the residual neurological deficit in RU and RL players, though neither change was statistically significant. In ARF, the severity of residual deficit was essentially the same in both periods.

Overall, the proportion of patients remaining wheelchair dependent fell from 53% in 1986–1996 to 39% in 1997–2002.

Spinal cord injury without radiological abnormality occurred in three RU and three ARF players. One RU player recovered to Frankel grade D and the rest recovered fully (grade E).

Other factors potentially contributing to injury

Analysis of other possible contributory factors for injury that had been examined in the previous studies (stage of match, stage of season, pre-game alcohol intake, and neck-strengthening exercise programs) did not provide new pertinent information, and the results are not reported here.

Player insurance

As in previous studies, not all injured players were willing to divulge the amounts they had received in insurance payouts via compulsory club registration schemes and other sources. In 1998, the maximum payment that could be awarded for injury rose from $250 000 to the present level of $300 000. At review, four of the Frankel grade D players had not yet received a payment, which is scaled according to the degree of residual disability. In addition, public generosity provided a variable degree of financial support to 29 players. Private medical insurance was held by 30% of the footballers.

DISCUSSION

The ASCI rates in all football codes have changed little since 1986–1996. However, there are measures that could be introduced for certain phases of play in RU and RL to reduce the incidence of ASCI.

ASCI in RL resulted exclusively from tackles, those involving multiple defenders being particularly dangerous. A player so brought down is at a disadvantage in his ability to protect himself. The laws relating to the tackle in RL should be amended. There were no injuries in which the recently-appeared "grapple tackle" (a variant of a high tackle in which a rival player locks his arm around the ball-carrier's neck) could be implicated. The reduced rate of injuries to schoolboys in this game compared with the 1986–1996 rate is encouraging.

There has been a total of 70 scrum injuries in RU and RL since 1960, and the details are known for 63 of these. The considerable force created at scrum engagement accounted for 65% of the ASCIs at scrummage in 1960–1985,[2] 47% in 1986–1996[3] and six out of seven (86%) in RU in 1997–2002. The absence of scrum injuries in RL since 1996, when scrums stopped being contested, speaks for itself.

In the 1960–1985 series, there were 12 schoolboy scrum injuries, half of which took place at engagement. We proposed a variation to the laws of scrummage to reduce impact force at engagement — namely, that the two opposing front rows engage separately, with the second and back rows being added sequentially.[2] Although this specific recommendation was not adopted, the Australian Rugby Union had, in 1985, introduced a separate set of laws for players under 19 years of age, one of which was designed to depower engagement. There have been 15 adult engagement injuries since 1986. In 1988, the laws relating to scrum engagement changed to a sequence called by the referee: "crouch — touch — pause — engage". This evolved, in the early 1990s, to "crouch and hold — engage". The "touch" instruction was eliminated for adult footballers, as it was felt that its purpose (to ensure proximity of the opposing front rows before engagement) could be achieved by allowing the referee to prearrange the distance between teams.

In our opinion, there has been a gradual return to a forceful scrum engagement. While this may allow a tactical advantage for a team, it increases the risk of engagement injury. In our present study, six of the seven scrum injuries occurred at engagement. We recall the 1988 warning of Burry and Calcinai:[6] "Failing to alter the procedures of a game despite the knowledge that existing practices were hazardous and a safe alternative existed could well be held by a court to constitute culpable negligence".

The front-row forwards, and particularly the hooker, are the players most at risk of ASCI in scrummage. Only three of the 70 scrum injuries in both rugby codes since 1960 have occurred to forwards other than those in the front row. There is some evidence of positive change in RU scrummage, with a decrease in injuries from scrum col-

lapse and to players not in their regular positions. The latter emphasises the specialist role of front-rowers in RU and the absolute need for equally-prepared replacements.

The real costs of life-time care of a quadriplegic young male are enormous and are based on a life expectancy approaching 80% of that for an otherwise normal person of the same age.[1] These costs are well reflected in settlements for third-party insurance in motor vehicle accidents, in which awards are directly linked with neurological level (disability) and the age at injury. For example, a 19-year-old with C5 quadriplegia resulting from a road traffic accident in 2002 would receive a payment in the range $7–9 million (P Tait, Claims Manager, NRMA Insurance, personal communication). The range reflects the heads of damage, which vary with individual circumstances.

In the present series, there were eight RU players with injuries of Frankel grade A, B or C, two being ventilator dependent. We have calculated that the total for the range of settlements for these quadriplegic players would be $70.5–88.4 million (in 2004 dollar terms) had they been injured in road accidents. In regrettable contrast, under existing player insurance cover, the maximum award for quadriplegia is $300 000.

If the present laws of RU and RL remain unchanged, other things being equal, the current injury rates will not change. Thus we could well ask: if injury rates are predictable, why not use the predicted rates to institute adequate insurance schemes for injury in each code? The incidence of ASCI is highest in RU, and the resulting neurological deficits are more severe.

One unexpected finding in the present series is the reduced severity of final Frankel grades in RU and RL players compared with their counterparts in 1986–1996,[3] particularly in light of the minimally altered incidence rates for the two study periods. One possible contributory factor is the much-improved handling of suspected spinal injuries on the field of play and in the safety protocols for transport to hospital. In a 1988 Victorian study on deterioration of neurological function in spinal injuries before admission to hospital, it was found that pre-admission deterioration occurred in 26% of cervical injuries of diverse causation.[7]

Review of the 42 ARF injuries since 1960 does not identify any particular phase of play in which specific preventive measures could be introduced. However, in all codes, strict enforcement of the laws of the games and heavy penalties for deliberately illegal and foul play must be rigorously pursued.

We first made a strong case for an independent registry of football-related ASCIs in 1987,[2] a case which is strongly supported by another recent study.[8] Simply, the games must be made safer than they presently are, and a national registry is the first step in this direction.

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COMPETING INTERESTS

None identified.

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