

Rugby league injuries at state of origin level

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Injury incidence for the NSW Origin team over the period 2000-2006 was calculated as 327 injuries per 1000 player hours (based on medical presentation) or 98.9 injuries per 1000 player hours (based on missing a following game). These rates are significantly higher than the comparative rates at an NRL club (the Sydney Roosters, with rates of 247 and 34.1 respectively) over the same time period. However, there are biases which could account for the higher calculated injury rates, including greater availability of medical staff at Origin level and fewer days until the following game after an Origin match.

Rugby league is a collision-type sport played in Australia, New Zealand, England and France at the professional level. There are 13 players on the field at any given time with an interchange bench of 4 players. A maximum of 12 player movements per match are permitted, including interchanging for the blood bin and injuries¹. Matches typically last for 80 minutes. Rugby League has a high rate of injury, particularly contact mechanism injury^{2,3}, as tackles occur in the game approximately every 10-15 seconds. Players are involved in 20-40 physical confrontations per match⁴ with the percentage of injuries caused by tackling ranging between 38.2% and 77.2%⁵. In the hierarchy of matches played, international matches are officially the 'top' level of the game. However, the traditional three-match State of Origin series, played between New South Wales and Queensland during the middle of the season, is considered to have perhaps the highest intensity of all matches.

Rugby league injury incidence has been previously reported. Although a number of injury definitions have been used, a large number of studies have defined an injury as that requiring a 'missed match'^{5,6}. Studies using this definition have documented incidence rates that have varied between 34.4 and 52.3 injuries per 1000 hours⁵. While muscular injuries (haematomas and strains) are the most frequently occurring injuries in professional rugby league^{7,8}, when an injury definition requires a 'missed match', joint and ligament injuries and bone fractures become more frequent, particularly affecting the knee, ankle and shoulder⁵.



An increased risk of injury with higher intensity play has been hypothesised⁹. Thus, it was the objective of this study to present the incidence of injuries over a seven-year period from 2000-2006 inclusive (21 matches) for one State of Origin team (New South Wales) and to compare the incidence to that seen at an NRL club (the Sydney Roosters) over the same seven-year period. The first author of the study was the team doctor for the two teams over this period.

In addition to being a descriptive study, a particular hypothesis to be tested was that the intensity of State of Origin would lead to an increased incidence of injury, with the null hypothesis being that there would be no detectable difference in the

injury rate between the NRL team and the State of Origin team.

Methods

The medical officer for both the State of Origin and Sydney Roosters team prospectively recorded all injuries presenting for treatment into injury databases. Included in the databases were all occasions of players leaving the field (and being replaced) due to injury or illness and whether the player was subsequently able to return to the field or not and whether or not injuries caused players to miss subsequent games. The scope of the study was all games for the NRL (National Rugby League) matches (regular season and

Table 1 - Format of State of Origin series 2000-2006

Year	Interchange rule	Timing of matches	Time between games	Result
2000	Unlimited interchange	Wednesday nights	Two weeks	NSW 3-0
2001	12 interchanges per team	Sunday nights	Four weeks	Qld 2-1
2002	12 interchanges per team	Wednesday nights	Two then three weeks	Drawn 1-1
2003	12 interchanges per team	Wednesday nights	Two then three weeks	NSW 2-1
2004	12 interchanges per team	Wednesday nights	Three weeks	NSW 2-1
2005	12 interchanges per team	Wednesday nights	Three weeks	NSW 2-1
2006	12 interchanges per team	Wednesday nights	Three weeks	Qld 2-1

Table 2 – Match injuries during Origin games for NSW team

Year	Game	Match injuries	Players leaving field injured	Lacerations	Missed no games	Missed one game	Missed 2-3 games	Missed 4 of more games	Missed entire season	Total missed any games
2000	1	6	1	2	1	1		2		3
	2	3	3	1	0	1			1	2
	3	5	4	1	3		1			1
2001	1	6	0	3	3					0
	2	5	0	2	0	3				3
	3	3	0	0	3					0
2002	1	6	2	2	2	2				2
	2	7	1	3	0	3	1			4
	3	5	0	0	3	2				2
2003	1	6	2	1	4	1				1
	2	5	2	1	2	1	1			2
	3	7	2	1	4			1	1	2
2004	1	7	0	0	6			1		1
	2	5	0	0	4	1				1
	3	5	0	2	2			1		1
2005	1	6	0	1	5					0
	2	6	1	0	1	3	2			5
	3	11	1	1	7	3				3
2006	1	5	1	0	4			1		1
	2	4	0	0	4					0
	3	6	1	1	3		1		1	2
Total	21	119	21	22	61	21	6	6	3	36

finals) and New South Wales State of Origin matches.

The format of the State of Origin series each year is listed in Table 1.

A match injury recurrence (for the State of Origin team) was defined as an injury to the same body part which had been medically assessed prior to the start of the match and which caused the player to miss subsequent games for his club after the Origin match.

Comparisons between the injury incidences were done using a Taylor Series expansion and 95% confidence intervals. Compared to other methods for calculating confidence intervals, this generally leads to slightly wider ranges.

Results

Match injury incidence for Origin games is detailed in Table 2, with comparative rates for the Sydney Roosters (at NRL level) over the same time period detailed

in Tables 3 and 4. The injury rates for the two levels of play are similar although Origin injury rates are slightly higher, taking into account the various definitions of injury. The exception was injuries causing players to leave the field, which was higher at NRL level than at Origin level (although not reaching statistical significance).

Serious injuries

As seen in Table 2, there were only three injuries which occurred during the 21 Origin team matches that caused the player to miss the entire remainder of the season (approximately 3 months). One was a degenerative knee condition that appeared to have an acute onset when the player was scoring a try during an Origin match. However, the player had suffered some knee soreness for the previous month (although neither the club nor Origin medical staff had noticed an effusion). This has been recorded

both as an Origin match onset injury (although it had a gradual prodrome) and as an injury recurrence. Another injury was an acute onset shoulder instability episode which involved a moderately-severe axillary nerve palsy. Although this same player had been carrying a chronic A/C joint injury on the same side, this shoulder injury was not considered a recurrence. Subsequent to these two major injuries, the players involved missed game time in the season after the onset of injury. The third match injury which caused the player to miss the remainder of the season was a grade III knee MCL injury.

The six match injuries that caused the players involved to miss at least four weeks (but not the remainder of the season) were a fractured clavicle, a fractured thumb, a grade II hamstring strain, another knee MCL injury, an ankle syndesmosis sprain and chronic ankle posterior impingement.

Table 3 – Match injuries during Roosters NRL (first grade) games

Year	Games	Player hours	Injuries	Players leaving field injured	Lacerations	Missed one game	Missed 2-3 games	Missed 4 or more games	Missed entire season	Total missed any games
2000	30	520	184	56	21	8	6	3	2	19
2001	27	468	103	27	14	2	6	4	1	13
2002	28	485	127	37	24	8	8	3	4	23
2003	27	468	101	32	17	8	3	4	1	16
2004	27	468	87	36	10	5	2	5	0	12
2005	24	416	101	25	15	7	2	3	0	12
2006	24	416	99	29	7	3	7	2	3	15
Total	187	3241	802	242	108	41	34	24	11	110

Table 4 - Comparison of match injury incidence (NSW Origin vs. Roosters NRL)

Series	Any medical presentation	Incidence any missed games	Incidence 2 + missed games	Incidence 4 + missed games	Incidence lacerations	Incidence injuries leaving field
Origin 2000-2006	326.9	98.9	41.2	24.7	60.4	57.7
Roosters 2000	353.8	37.8	21.9	9.9	40.4	107.7
2001	220.1	28.8	24.4	11.1	29.9	57.7
2002	261.7	49.1	32.0	15.0	49.5	76.2
2003	215.8	35.5	17.8	11.1	36.3	68.4
2004	185.9	26.6	15.5	11.1	21.4	76.9
2005	242.8	30.1	12.5	7.5	36.1	60.1
2006	238.0	37.6	30.1	12.5	16.8	69.7
Roosters 2000-2006	247.4	34.1	21.4	10.9	33.3	74.7
Odds ratio (Origin: Roosters) incl. 95% CI	1.32 (1.06-1.65)	2.90 (1.96-4.29)	1.93 (1.09-3.40)	2.28 (1.09-4.78)	1.81 (1.13-2.91)	0.77 (0.47-1.27)

One potentially serious match injury suffered was a pneumothorax although, in terms of missed football time, this only caused the player to miss two club matches and he played his next match in another Origin game three weeks after the initial injury. He successfully completed this game although apparently had a recurrent rib injury later that season when playing for his club (although no recurrence of the pneumothorax).

No NSW players suffered knee ACL injuries in Origin matches over this seven-year period, although one player who was selected in the squad was ruled out in camp with a knee ACL injury that had occurred playing for his club the weekend prior. It is noted incidentally that one Queensland player was known to have suffered an ACL injury in the Origin series over the same time period.

Injury risk of State of Origin matches

The raw risk of being injured during a State of Origin match (causing the player to miss a club match) is 10% (36/357). This compares to a 4% risk of being injured during a Roosters NRL match (and then missing the following match) over the same time period (110/3077). The player game exposure of 3077 for the Roosters is calculated as being 17 (number of players in a team) multiplied by the number of Roosters games per season except for the final match of the year. The final match of the year is not included in this exposure calculation as there was no match available to miss the following week.

This difference in injury risk is statistically significant, meaning that it is unlikely to be due to chance. However, the true

reason for the difference is probably mainly because the next game for Origin players is scheduled in 2-4 days time (for Origin matches other than in 2001), compared to an average of seven days for Roosters NRL games. The risk of missing more than one game was 4% for Origin players (15/357) compared to 2% for Roosters players (69/3077).

Management of lacerations

Over the 21 Origin games studied, there were 22 lacerations that required closure. Eleven of these were initially closed with staples, five were closed with sutures and six with skin glue. In the time period from 2001-2006, when limited interchange was used, only one player was forced to interchange off the field to have his laceration managed (and this was a forward who the coach elected to have leave the field anyway). Other

Table 5 - Training camp assessments NSW Origin team

Year	Game	Injuries assessed	Illnesses treated	Injuries which:				Players ruled out during camp:		
				Were new from player's last match	Caused player to miss previous match	Were ongoing but had not led to miss	Occurred during training camp	With pre-existing injury	Due to injury in camp	Due to illness in camp
2000	1	7	0	3	0	4	0	2	0	0
	2	6	2	2	2	2	0	1	0	0
	3	7	3	5	1	1	0	1	0	0
2001	1	10	1	6	1	3	0	0	0	0
	2	9	0	5	2	2	0	1	0	0
	3	10	2	6	2	2	0	3	0	0
2002	1	7	4	4	1	2	1	1	0	1
	2	11	2	6	2	3	2	1	1	0
	3	10	1	4	2	4	1	2	0	0
2003	1	11	4	7	0	4	0	0	0	0
	2	9	1	6	1	2	4	0	0	0
	3	7	4	2	1	4	2	1	0	0
2004	1	15	4	6	1	8	0	4	0	0
	2	10	3	6	2	2	1	4	1	0
	3	9	0	6	2	1	2	1	0	0
2005	1	11	6	4	0	7	2	0	0	0
	2	14	1	6	0	8	1	0	1	0
	3	15	1	4	3	8	1	5	0	0
2006	1	9	4	4	0	5	3	1	1	0
	2	8	9	2	0	6	1	0	0	0
	3	15	4	3	1	11	1	0	0	0
Total	21	210	56	97	24	89	22	28	4	1

players were initially managed by team training staff with gel, gauze and tape and then had their wound closed by the doctor at the first available opportunity. Although the process of stapling players on or near the sideline is controversial¹⁰, it has definitely allowed interchanges to be 'saved' by the NSW Origin team over this time period.

As can be seen from Table 4, the match incidence of lacerations in Origin of 60.4 injuries per 1000 player hours is significantly higher than the rate at the Roosters over the same time period of 33.3 lacerations per 1000 player hours.

Use of cortisone and local anaesthetic

Origin players were injected 39 times with local anaesthetic to play over the time of the study, representing 10.9% of players taking the field. This is a very

similar rate of injection (and for a similar profile of body parts) to that used by the same first author for regular season NRL matches¹¹. Of these, approximately half (17) were for injuries previously being injected by their club doctors in NRL games. Six of the 39 injuries were not injected pre-game by prior arrangement but were performed during the match for an injury that occurred in the match itself. In addition, six extra players (on top of the 39) used an EMLA patch (topical local anaesthetic) to play.

Over the same time period, 12 cortisone injections were used on Origin players (in 21 training camps). Exact comparative figures for the Roosters for cortisone injections are not available, but the Origin rate is likely to be higher. The 9-10 day period of an Origin camp gives a more desirable 'rest period' after a cortisone injection, if completed early in

the camp, so that some chronic injuries (eg, bursitis) could be managed this way in camp. It is problematic avoiding contact training in the days after a cortisone injection in the regular season, given the average of seven days only between matches.

Injury recurrence

There were few recurrences from the 210 injuries assessed during Origin camps that worsened during Origin matches. Incidents which were or may have been considered recurrences included:

1. A player who took a chronic ankle posterior impingement condition into an Origin game, which worsened during the game. He elected to have mid-season surgery after this game (mentioned above under serious injuries) and returned later in the season.

2. A player who took a rib cartilage injury into an Origin game and, in a new incident, was accidentally kicked in the chest and suffered a pneumothorax (also mentioned above). While technically the rib cartilage and lung are separate body parts, the overlap between a rib injury and a traumatic pneumothorax is such that this injury was considered to be a recurrence.
3. A player who took a quadriceps strain into the game and suffered a minor re-strain in the final minutes of the match. Although he actually played very well, vindicating the selection, because he was unable to back up for his club this technically was a recurrence. He only missed the one match for his club.
4. The player also mentioned previously under serious injuries who had been suffering what appeared to be minor knee soreness coming into an Origin match and then had an acute episode during the match to the same knee.

Although episode number 3 was 'unlucky' to be considered an injury recurrence (as the selection to play was probably correct), there was one player who re-sprained an ankle during an Origin match and also didn't play for his club the following weekend. However, he was suspended for one match from an incident in the same Origin match, so technically he did not miss a match after the Origin with a recurrence from the injury.

This list of injury recurrences makes the percentage of injuries which were assessed that recurred 2% (4/210). Expressed as a percentage of team matches, there were 0.19 injury recurrences per team match.

By comparison, the Roosters had 26 injury recurrences over the time period 2000-2006 (187 NRL matches), from a total of 494 injuries that were considered prior to the match to be 'at risk' of recurrence. This reflects an injury recurrence rate of 5% (26/494) and a rate of 0.14 recurrences per team match. It is difficult to draw any conclusions between the recurrence rate at NRL level and Origin level because these rates vary in an inconsistent fashion. The recurrence rates at both levels are fairly low but obviously not zero.

Discussion

Previous literature has demonstrated that severe injuries are more common at higher levels of play at the professional level^{12, 13}. This has been suggested to be the result of factors such as an increased intensity of play, increased player fatigue and pressure on players to participate with minor injuries which are susceptible to exacerbation and more severe injury¹⁴. At the professional level an increasing number of players will miss a match each week with injury as the season progresses¹⁵. However, during the finals series this number decreases. This has been hypothesised to be a result of more aggressive medical management and players being more willing to take risks and carry injuries into important games¹⁵. A similar situation may exist with State of Origin rugby league, with it being a highly sought-after selection, so players may be more likely to want to carry an injury into the game. On the other hand, at Origin level there is often pressure from a player's NRL club on the Origin medical staff to rule out players who are carrying injuries that have any significant risk of recurrence, as the cost of any recurrence would be carried by the club more so than the Origin team.

A similar dilemma occurs in other sports, most notoriously in soccer, where a player's club side (eg, an English Premier League team) may argue that a player should rest an injury whereas his national team may argue that he should play in an international game. This arises because soccer internationals (like rugby league State of Origin) are often held mid-season. In sports or competitions where the international or representative games are held at the end of the club season, there is relatively less pressure from the club to have players rest minor injuries. It is also worth noting that the concept of a State of Origin match was originally used in Australia in the sport of Australian Football for interstate matches between Victoria, South Australia and Western Australia. However, the AFL has ceased holding mid-season State of Origin matches in recent years, partially because too many selected players were prevented from playing in them by their clubs when carrying minor injuries.

Lacerations are a very frequent injury in rugby league⁷, with the findings of this study suggesting they are more



frequent in the State of Origin series. Despite this high incidence, most of these injuries are dealt with on the field of play rather than utilising one of the 12 limited interchanges available. In rugby league there is 'limited' rather than 'zero' tolerance for player bleeding. If a player is seen to be bleeding, the referee allows him to remain on the field and have the wound attended to before re-joining the play. If he is seen to be bleeding a second time, the referee can then force him to leave the field. This ruling is now preferred to the use of a 'blood bin' with a free interchange, as competitions which have trialled this have considered that too much advantage was given to teams which received free interchanges from 'blood bins'. A number of procedures are used to close wounds such as bandaging, suturing and stapling¹⁰ and generally lacerations do not cause the player to miss any subsequent matches.

A lack of literature documenting injury recurrence exists in the sport of rugby league (as it does for many other sports). At the professional level, recurrence rates have been measured at approximately 10% of all injuries occurring¹², with the most common injury types to be prone to recurrence being back injuries, rib injuries, hamstring and quadriceps strains¹⁵. However, defining an injury recurrence and an 'at risk' injury remains difficult.

Further injury surveillance is required at the NRL level to assess the impact that participation in State of Origin matches has on players for the duration of the season. This has received anecdotal attention in recent seasons as it has been suggested that teams with more representative players often suffer a slump in performance for 1-2



months after the Origin series due to a combination of player fatigue and injury. It would be interesting to compare injury rates in NRL games for the remainder of the season between Origin representatives and non-Origin players to see whether there was a major difference.

Recognised limitations exist in the study conducted. The number of players participating in State of Origin and the number of total matches is far less than that of even a single NRL club, lowering the power of the study. The definition of an injury, which is subject to debate in the rugby league literature¹⁶, is hard to apply consistently between Origin and NRL levels. Although the team doctor was the same for both teams in this study, at Origin level all training sessions and even team functions were attended by the doctor whereas for the Sydney Roosters only matches, injury clinics and occasional training sessions were attended by the doctor. This gives a bias towards medical presentation at Origin level, compared to NRL level.

If a 'missed game' definition of injury is used, there is again a bias towards Origin games appearing to have a higher injury rate. This is because players must generally 'back up' within 2-4 days after their Origin game for their club side, as opposed to the usual 5-9 day

recovery period they would receive after a standard NRL match. Certain minor injuries that would recover within seven days may not have recovered within the 2-4 day period. Notwithstanding this bias, if a player does miss an extra match for his club, it has the same impact on team performance as if he had missed a match from an injury playing in an NRL game, so it is not misleading to conclude from this study that State of Origin games are more likely to lead to players missing further matches through injury than regular NRL games.

Conclusion

As the rates of injury are higher for State of Origin matches than NRL games under most categories examined (including lacerations) it suggests that there is a consistently slightly higher injury incidence which may be due to the increased pace and intensity of the game. However, because of the biases present in the study, further research is required to confirm the hypothesis that the higher intensity of State of Origin leads to a higher injury rate.

Authorship and acknowledgement

John Orchard is the Sydney Roosters medical officer, a position he has held from 1998-present. He was NSW Origin

doctor from 2000-2006 and has a PhD and MD in sports injury epidemiology.

Wayne Hoskins is a medical student at the University of Melbourne who has previously published papers on rugby league injury epidemiology.

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