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ORIGINAL RESEARCH

Abdominal Wall Injuries at the Elite Level in Australian Male Professional Cricketers

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ABSTRACT

Background: Injuries to the abdominal wall, particularly muscular injuries, are relatively common in professional cricketers. The Cricket Australia injury database holds data on these injuries over a 20 years span.

Methods: This study is a combination of (1) a descriptive outline of the parameters associated with side strains and abdominal wall injuries in elite male cricketers, based on deidentified data extraction from the Cricket Australia database from 1995 to 1996 and 2014 to 2015; (2) multivariate regression analysis of risk factors for abdominal wall strains, taking into account the risk factors of player position, player age and previous abdominal wall injury history.

Results: There were 183 injuries recorded over a 20 years period at Australian state or national player level. Significant risk factors in logistic regression analysis were: being a Pace Bowler RR 10.0 (95% CI 3.1–32.1) and being 24 years old or younger RR 3.4 (95% CI 1.7–6.8). Surprisingly, there was only minimal risk increase, not reaching statistical significance, for recent injury in the same season (p = 0.18) and no association at all with past injury in previous season (p = 0.99).

Discussion: The internal oblique muscle is reported the most commonly injured component of the abdominal wall, the injuries are overwhelmingly sustained by pace bowlers and the peak incidence of the injury is in the early part of the cricket season. Younger fast bowlers are more likely to be injured than older ones. A history of abdominal wall strain in either the recent or distant past does not increase or decrease future risk of strain, which is in contrast to other muscle strains.

Keywords: Cricket, Fast bowling, Muscle strains, Side strains.

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INTRODUCTION

The Cricket Australia injury database (CA database) tracks all injuries sustained by Australian cricketers who have professional playing contracts at state or national level. Each of the Australian states have a squad of professional players and in recent years the formation of a professional 20/20 format competition has meant that all states also have at least one 20/20 format franchise, the two most populous states have two franchises. Cricket Australia has been collecting comprehensive data on injuries sustained by contracted players since 1997 and some data sets have been maintained since 1994. The season injury statistics are published annually in the Cricket Australia Injury Report,[1] with comments as to relative frequency of each type of injury, whether the incidence appears to be increasing or decreasing and so on.

The total database provides a unique resource in cricket to gain insight into the characteristics of cricket related injury and is particularly useful for mapping the characteristics of injuries that are relatively infrequent over any given season. This paper uses deidentified data from the database to examine the nature of abdominal wall injuries in professional cricketers. Previous research has identified the characteristics of injuries to the abdominal muscles in cricket[2] and highlighted that abdominal wall injuries are common in cricket (ranked second highest incidence),[1] particularly in pace bowlers, and have high cost in regards to games missed (high prevalence).[1] These injuries have also been described in a variety of other sports but apart from cricket, the only sport in which such injuries occur relatively frequently is baseball.[3] For the purposes of this paper any injury that occurred to the abdominal wall musculature or its areas of attachment (including the lower ribs) has been categorized as an abdominal wall injury.

METHODS

Deidentified data was obtained from the CA database. The Australian Government National Health and Medical Research Council Ethical Guidelines 2014[4] do not require ethics approval when using de-identified data (negligible risk of harm), therefore, ethics approval was not sought for this project.

The CA database allows the injury data entered to range between presumed diagnosis to specific diagnosis, for example, an abdominal wall injury may be termed a 'side strain' or 'a tear of the internal oblique muscle'. Using the full breadth of entry terms in the database a total of 183 injuries over 20 Australian cricket seasons (1995–1996 to 2014–2015) were identified as fitting the description of an abdominal wall injury. The dataset was complete with respect to injuries which resulted in missed playing time, date of onset, number of matches missed, player details and category (abdominal wall strain). There was a slightly incomplete dataset with respect to specific injury diagnosis (e.g. involved muscle) and specific injury onset (e.g. during delivery, gradual onset) although for the majority of injuries these details were available. Magnetic resonance imaging (MRI) analysis of injuries was not done as although the majority of injuries occurring in recent years had MRI scans performed, the vast majority of those injuries from the early years of the study did not have MRI scans performed. The diagnosis of which muscle was involved was provided by clinicians and the database did not indicate whether this was an MRI confirmed diagnosis or purely a clinical diagnosis.

MULTIVARIATE ANALYSIS

Occasions on which players sustained a side strain during a competitive match were compared to those in which no side strain occurred, with risk factors used to predict these occurrences using a multivariate logistic regression analysis in the Statistical packages for the social sciences (SPSS) program. The risk factors analyzed were: (1) player age (2) player position (3) history of recent abdominal wall injury (earlier in the same season) (4) history of past abdominal wall injury (not in the same season) (5) recent bowling workload (6) era (year).

The results of these processes were then used to examine a number of questions. These questions were: what anatomical structures are most commonly injured, what cricket activities are associated with the onset of these injuries, which group of players are most likely to sustain such an injury, are these injuries fatigue related, is there any age group that is at greater risk of such injuries. The reasons for asking these specific questions was in part determined by what data subsets were relatively complete and in part determined by published research on a number of other cricket related injuries.

RESULTS

Of the 183 reported injuries, 140 were described as side strains, side soreness or oblique muscle injury, noting that 'side strain' is commonly used in cricket injury parlance as indicating an injury to the oblique muscles often near the anterolateral rib angle, (Fig. 1). There were 17 injuries described as rectus abdominis or abdominal muscle injury, 12 costoiliac impingements, 13 miscellaneous muscle injuries (including injuries to latissimus dorsi, the intercostals and transversus abdominis) and there was one undefined chest wall pain. The majority (77%) of abdominal wall injuries occurred during matches while the remainder occurred during training. Breaking down the available data on the level of cricket being played at the time of injury showed that 66% were related to state or national team matches and the remainder to grade or other level matches.

In 130 of these injuries, the activity leading to the onset of pain was recorded; 99 of them occurred as a specific event during the bowling delivery stride, 16 were of gradual onset while bowling, five occurred while batting, two occurred during the bowling follow through, two occurred at some undefined point in the action of bowling, two occurred while throwing, two occurred doing weight training, one occurred while warming-up for bowling, and one occurred while fielding. Regression analysis shows that the risk of abdominal wall injury while pace bowling is ten times greater than for all other cricketing roles. The low incidence of abdominal wall injury while batting is in marked contrast to the injury profile of professional baseball, where approximately half the injuries occur in the action of batting.[3]

Of the 160 injuries, specifically related to bowling, there were 154 which occurred in fast or medium pace bowlers, five occurred in spin bowlers and one was not specified. The majority (127) of the injuries occurred on the lead arm side (that is the non-bowling arm), 17 occurred on the bowling arm side and in 16 cases it was not specified which side was affected. Where a specific muscle was identified as having been injured (46 cases) 56% of the time it was identified as being internal oblique, 15%

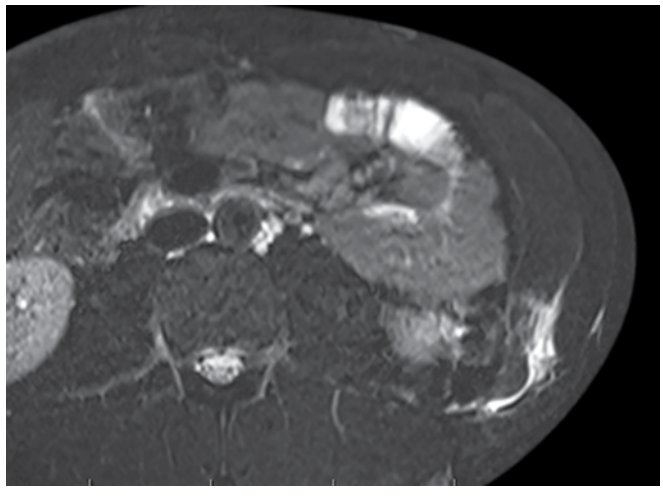
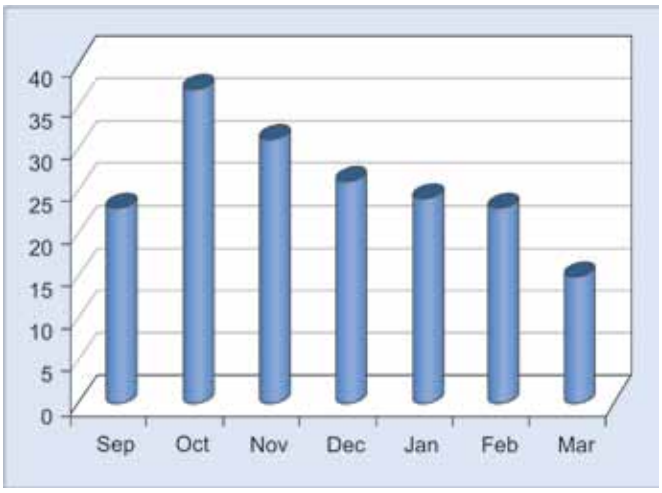


Fig. 1: Typical MRI appearance of an internal oblique strain



Graph 1: Month of occurrence (frequency) of abdominal wall injuries in bowlers

of cases involved rectus abdominis, 11% of the time it was identified as external oblique, 9% were identified as intercostals, 9% as latissimus dorsi and 2% were identified as transversus abdominis. Caution must be exercised when interpreting this data set as it is not certain that the injured muscle was determined by MRI scanning, further it is obviously easier to determine if an injury has occurred in rectus abdominis than differentiating between internal and external oblique injury on clinical signs alone.

The peak of abdominal wall injuries occurs early in the cricket season, noting that the domestic cricket season in Australia commences in September and finishes in March. Twenty percent of all injuries that occurred during the domestic season happened in October, with September and October in combination accounting for 33.5% of all injuries. Injury frequency slowly reduced in the months thereafter (Graph 1).

The mean age of occurrence of abdominal wall injury in bowlers is 25 years and 9 months.

MULTIVARIATE ANALYSIS

There were 38,781 player matches analyzed at state or national level of which 87 (0.2%) led to a side strain occurring (Table 1). The other side strains on the database either occurred at a lower level match, a training session or had a gradual or uncertain pattern of onset.

In bowlers under the age of 24, the risk of injury is three times greater than for bowlers over the age of 30 and for bowlers 25 to 29 the risk was also twice the risk than for bowlers aged 30 or over.

The risk of injury in fast bowlers was 10 times greater the risk for spin bowlers (the next highest risk category) and approximately 20 times greater risk than for batsmen and wicketkeepers.

With respect to match type, the risk was highest in Test cricket but with match units not adjusted for length of game, so this was to be expected, as these are the longest games. Because fewer overs are bowled in one day internationals (ODIs) compared to Test cricket the risk per over it at highest rate in ODI cricket, although side strains regularly occur in all forms of elite cricket.

There was a slightly higher risk of side strain in those who had previously suffered a side strain earlier in the season, although this did not reach statistical significance. This is in contrast to hamstring strain and other muscles strains where recent injury is a highly significant risk factor. Past history (in a previous season) statistically bore no relationship to risk of abdominal strain in future season (relative risk 1.00, 95% CI 0.61–1.65). Although this probably means there is no relationship, it also means that based on our analysis, if there is a relationship between past abdominal strain and current injury, it is equally likely that a past injury is protective as it is to be a risk factor.

DISCUSSION

The large data set presented here reflects similar findings in previous studies of cricket related abdominal wall injury. This larger data set gives confidence to some of the accepted wisdom regarding who is at risk, what the spread of pathology is and when these injuries occur. Two areas stand out as particularly important.

The first area is the timing of bowling related abdominal wall injuries during the season. A number of bowling injuries have been shown to relate to the volumes of bowling done in the period preceding the injury occurrence (5–8), these injuries typically peak in mid and late season. This does not appear to be the case with abdominal wall injuries, which peak early in the season and gradually become less frequent over the remainder of the season, although they can occur at any time during the season (Fig. 1). This finding does suggest that at least some of the injury risk relates to lack of specific muscle conditioning rather than cumulative load. In turn that suggests that it should be possible to mitigate some of the risk of injury with targeted pre-season preparation and a graded transition from pre-season training to early-season matches. Methods to monitor bowling intensity such as microtechnologies have the capacity to detect the relative intensity of each delivery and should be considered during the transition period from training to matches.[9]

The second area of interest is around the age of bowlers when they sustain abdominal wall injuries. Previous studies have shown a propensity for bone related injury to occur in young pace bowlers and soft tissue injuries to occur more frequently in older bowlers.[7,9] The data

Table 1: Risk factors for 87 side strains occurring in state or national level matches from 1995–96 to 2014–15 seasons

Risk factor	*Type*	*Significance*	*Relative risk*	*95% CI low*	*95% CI high*
Player position	Batsman	0.566	0.657	0.156	2.760
	Wicketkeeper	0.474	0.437	0.045	4.215
	Pace Bowler	0.000	9.983	3.105	32.098
	Spin Bowler	Ref group	0	0	0
Match type	Domestic One Day	0.209	0.522	0.189	1.439
	ODI	0.684	0.802	0.277	2.318
	Shield	0.716	1.193	0.461	3.088
	T20 cricket	0.115	0.386	0.118	1.262
	Test match	Ref group	0	0	0
Year range	2011–12 to 2013–14	0.393	1.296	0.715	2.349
	1996–97 to 2004–05	0.667	1.121	0.667	1.884
	2005–06 to 2010–11	Ref group	0	0	0
High recent bowling workload	No	0.815	1.072	0.598	1.921
	150 match overs bowled in last 3 months	Ref group	0	0	0
Age group	24 years old or younger	0	3.434	1.742	6.770
	25–29 years old	0.034	2.037	1.053	3.939
	30 years old or over	Ref group	0	0	0
Recent side strain	Not this season	0.187	0.608	0.290	1.273
	Injured this season	Ref group	0	0	0
Past side strain	No previous side strain	0.988	1.004	0.612	1.648
	Injured in past	Ref group	0	0	0

presented here suggests that the younger bowlers are more susceptible to abdominal wall injuries, which is in contrast to lower limb muscle strains where older players are typical more likely to get injured. We can only offer speculative theories for this age distribution until further study. It is possible that the nature of this injury being an insertional tear means that different mechanics are at play compared to other muscle strains (which are more commonly mid-belly or musculotendinous junction rather than insertional). A previous theory that the side strain was a 'rite of passage' injury that would only occur once (as the 'ripping of the attachment' would confer future immunity) appears to be only partially correct. That is, bowlers with a past history are no more, but no less, likely to sustain a future side strain. Compared to other muscle strains this makes side strains less likely to recur, but it is important to note that there is no actual immunity either.

CONCLUSION

Abdominal wall injuries are relatively frequent in cricket fast bowlers and relatively rare in all other cricket positions. They are not typically load related as many other bowling injuries appear to be. It may be possible to reduce the risk of injury by instigating improved specific preseason training for fast bowlers.

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