G Model
JSAMS-1074; No. of Pages 5
ARTICLE IN PRESS
Journal of Science and Medicine in Sport xxx (2014) xxx–xxx
Contents lists available at ScienceDirect
Journal of Science and Medicine in Sport
journal homepage: www.elsevier.com/locate/jsams

Original research

# Shoulder injuries in elite rugby union football matches: Epidemiology and mechanisms

Juliana Usman[a], Andrew S. McIntosh[b,*], Kenneth Quarrie[c], Stephen Targett[d]

[a] Department of Biomedical Engineering, Faculty of Engineering, University of Malaya, Malaysia
[b] Australian Centre for Research into Injury in Sport and its Prevention, Federation University Australia, Australia
[c] New Zealand Rugby Union, New Zealand
[d] Aspetar Orthopaedic & Sports Medicine Hospital, Qatar

ARTICLE INFO

*Article history:*
Received 2 May 2014
Received in revised form 21 July 2014
Accepted 31 July 2014
Available online xxx

*Keywords:*
Sports injury
Video analysis
Injury surveillance

ABSTRACT

*Objectives:* Shoulder injuries in rugby union football have been the focus of few in-depth studies, despite their frequency and severity. The study's objective was to describe the incidence, patterns and mechanisms of shoulder injuries in rugby.
*Design:* Prospective cohort study of shoulder injury incidence and retrospective case-series study of shoulder injury mechanisms.
*Methods:* Data were collected from Super Rugby matches from 2005 to 2010 involving elite level adult male rugby players.
*Results:* 7920 player participation hours and 100 shoulder injuries were recorded during 397 Super Rugby matches. The shoulder injury incidence rate was 13 per 1000 player hours (95% confidence interval 10–16). The mean number of days unavailable for selection due to these injuries was 37 (95% confidence interval 25–54). Tacklers sustained shoulder injuries at a higher rate than ball carriers (Rate Ratio = 1.7 (95% confidence interval 0.5–5.3)). The most frequently reported injuries were those to the acromioclavicular joint; dislocations resulted in the greatest amount of missed play. Using video analysis, 47 of the 100 shoulder injury events were successfully identified and analyzed. The main mechanisms of shoulder injury were contact with the ground with the shoulder/arm in horizontal adduction, flexion, and internal rotation; and impact to the lateral aspect of the shoulder with the elbow flexed and arm at the side.
*Conclusions:* Direct impact to the shoulder, either through player-to-player contact or contact with the ground, is the main cause of shoulder injury. Methods to reduce injury risk, such as shoulder pads and tackle skills, require consideration.


## 1. Introduction

Injury epidemiology studies in elite rugby union football (rugby) have reported that shoulder injuries account for between 9% and 17% of all injuries.[1–3] Shoulder injuries, especially dislocations or subluxations, can lead to impairment and lengthy absences from competition. The average absence from competition due to shoulder dislocation or subluxation has been reported to be 81 days (95% CI 46–116).[4] Despite the established injury risk, little attention has been given in rugby union to preventing shoulder injuries in contrast to other established injury risks. For example, the identification and assessment of injury risks in rugby has led to the evaluation of injury prevention approaches, as well as changes in laws and policies, e.g. the effectiveness of padded headgear has been assessed, scrum laws have changed to control the risk of spinal injury, and concussion management has been progressively modified in response to emerging evidence.[5–7]

An important element in formulating strategies to prevent injuries is an understanding of the event in which the injury occurs (the 'inciting event'), as well as the global and local mechanisms of injury.[8] It is important to know not just that the injury occurred in the tackle, i.e. the inciting event, but the distribution of injury mechanisms for each injury type. A weakness of many sports injury studies is that injury mechanisms have not been sufficiently well described to identify suitable injury prevention strategies.[8] There have been developments in this area of the last decade in the use of qualitative analysis methods[9–11]; video based event reconstruction[12,13]; computer or physical modelling

* Corresponding author.
*E-mail address:* as.mcintosh@bigpond.com (A.S. McIntosh).

http://dx.doi.org/10.1016/j.jsams.2014.07.020
1440-2440/

Please cite this article in press as: Usman J, et al. Shoulder injuries in elite rugby union football matches: Epidemiology and mechanisms. *J Sci Med Sport* (2014), http://dx.doi.org/10.1016/j.jsams.2014.07.020

of injury events[14,15]; and, the use of wearable devices to measure impact events.[16,17] These methods, each with strengths and limitations, have resulted in substantial increases in knowledge on injury mechanisms. This knowledge can be, and has been, translated into injury prevention interventions and injury management through player and team management, equipment development and player preparation.

To date analysis of shoulder injury mechanisms has been limited: video-based analysis of shoulder injury mechanisms was carried out by Crichton et al. where the authors identified three mechanisms of shoulder injury taken from 24 shoulder injury cases[18]; using only four shoulder injury cases, Longo et al. reported the mechanisms of shoulder dislocation[19]; and the peak shoulder force measured during a tackle was reported to be around 2000 N.[20] The latter provides an understanding of tolerable shoulder loads in a standard tackle.

The objectives of this study were to describe the incidence, severity, and nature of shoulder injuries sustained during matches among a cohort of elite rugby players; identify the mechanisms of the shoulder injuries among the cohort over the same series of matches using a qualitative video analysis method; and consider the implications for injury prevention and management.

## 2. Methods

A prospective cohort study was conducted to study shoulder injury incidence and risk factors. Player participation and shoulder injury data from 2005 to 2010 were extracted from the New Zealand Rugby Union injury database (RugbyMed). The database includes all injuries from the five Super 12/14 New Zealand (NZ) professional teams as well as participation, tackle counts and demographic data. Only match shoulder injuries were included in this study. The Super 12/14 competition comprised teams from NZ, Australia and South Africa. In total there were 397 team-games during the study period. If two NZ teams played against each other, this resulted in two team-games. If an NZ team played an Australian team, for example, there was one team-game. Broadcast video recordings of the related matches were obtained. All data were collected prospectively. Players had provided consent for their injuries to be collected and this study was approved by the University of New South Wales' Human Research Ethics Committee.

The injury definition was a "medical injury" of the shoulder, where shoulder injury information had been entered into RugbyMed by the team medical staff according to agreed protocols. A "medical injury" involved medical costs related to an injury claim lodged into New Zealand's national insurance Scheme 11. Injuries were classified according to the Orchard Sports Injury Classification System (OSICS).[21] Not all "medical injury" resulted in time-loss. The injury severity (days unavailable for selection or unable to participate in activities) was classified according to the consensus statement for rugby union.[22] They are: 0–1 days (slight); 2–3 days (minimal); 4–7 days (mild); 8–28 days (moderate); and >28 days (severe). The shoulder injury incidence rate (IIR) was defined as the number of medical injuries per 1000 player participation hours; where the denominator was calculated on the minutes played in each match for each player. The denominator for the shoulder IIR by player positional group was calculated based on the minutes played in each match for each positional group. The shoulder IIR per 1000 tackles attempted (for tacklers) and per 1000 times tackled (for ball carriers) was also calculated.

A retrospective case-series study design was applied to study shoulder injury mechanisms in rugby. Video of all matches was available, but in some cases there was no video of the event associated with injury. Shoulder injury events were identified by cross-referencing the injury case details to events observed that required medical attention or players requesting to be replaced due to visible discomfort or pain to the shoulder. The video of each match was reviewed to identify the most probable inciting event and then frame by frame to code the characteristics of the event. If any specific aspect of the event was obscured or there was no video of the event, the case was excluded. The initial coding of each injury event was undertaken by author JU and then reviewed by authors JU and AMc to obtain a consensus. The inter-rater reliability associated with the basic video analysis protocol had been assessed and the median agreement was 75% for the nine fields included in the analysis.[9]

The video analysis protocol described by McIntosh et al. was revised to include characteristics related to shoulder injury mechanisms, i.e. primary contact, shoulder position at impact, elbow position, shoulder/arm direction at impact, and the loading pattern.[9] To develop and refine the coding protocol, a preliminary analysis was carried out using a sample of videos of shoulder injury cases from a previous study. The event and injury mechanism descriptors are presented in Appendix A.

Analyses of the differences in injury incidence and severity were conducted for injury type and positional grouping. The GLIMMIX procedure in SAS (Version 9.3, SAS Institute, Cary, NC, USA) was used to produce a repeated measures analysis allowing for overdispersion in the outcome variable. The Poisson distribution with a log link was used for incidence, and the geometric distribution with a log link was used for severity. The log of the time played included as an offset variable for the analyses of injury incidence. The injury risk ratio (IRR) was calculated and the 95% confidence interval (CI) obtained. Confidence intervals for injury burdens (injury incidence multiplied by severity) were estimated using log transformation to combine factor uncertainty in injury rate with factor uncertainty in days off as independent errors. Standardized differences between means were calculated to assess effect magnitudes between groups, and a qualitative scale with the following thresholds was used: 0.2 small, 0.6 moderate, 1.2 large, 2.0 very large, 4.0 extremely large. Standardization was performed with the log-transformed values of the effects and standard deviations provided by GLIMMIX. In cases where the difference between means could have been both substantially positive and negative the effect magnitude was termed unclear.

For the descriptive analysis of the injury mechanisms using video analysis methods, Chi-squared tests ($X^2$) were used to examine the significance of the association between the potential risk factors for shoulder injury (coded as mechanisms of shoulder injury) and shoulder injury. The Fisher's exact test was extracted from the options for the chi-squared test in SPSS 19.0.[23] Significance level was set at alpha = 0.05.

Cramer's *V* coefficient was derived from the same model analysis to provide the strength of association between the two variables especially if a statistically significant association was found. The Cramer's *V* coefficients are categorized as follows: strong association = >0.5, moderate association = 0.3–0.5; weak association = 0.1–0.3, and little if any association = 0–0.1.

## 3. Results

A total of 7920 player participation hours were recorded for 306 players in 397 Super 12/14 games between 2005 and 2010. During this period 100 shoulder injury claims involving 79 players were reported in RugbyMed (2005 – 14 injuries; 2006 – 19 injuries; 2007 – 21 injuries; 2008 – 14 injuries; 2009 – 14 injuries, 2010 – 18 injuries). The differences in incidence from year to year were within the range that would be expected by random variation in count variables. Seventy of the shoulder injuries caused players to miss at least 24 h of planned activity following the injury. Of the 70, 44 were