Incidence of and risk factors for traumatic anterior shoulder dislocation: an epidemiologic study in high-school rugby players

Takayuki Kawasaki, MD, PhD\textsuperscript{a, *}, Chihiro Ota, AT\textsuperscript{b}, Shingo Urayama, AT\textsuperscript{c}, Nobukazu Maki, PT\textsuperscript{d}, Masataka Nagayama, MD\textsuperscript{a}, Takefumi Kaketa, MD\textsuperscript{a}, Yuji Takazawa, MD\textsuperscript{a}, Kazuo Kaneko, MD\textsuperscript{a}

\textsuperscript{a}Department of Orthopaedic Surgery, Juntendo University Faculty of Medicine, Bunkyo, Tokyo, Japan
\textsuperscript{b}Keio University Rugby Football Club, Yokohama, Kanagawa, Japan
\textsuperscript{c}Department of Sports Medicine, International Budo University, Katsura, Chiba, Japan
\textsuperscript{d}Mejiro Orthopaedic and Internal Medicine Clinic, Toshima, Tokyo, Japan

\textbf{Background}: The incidence of reinjuries due to glenohumeral instability and the major risk factors for primary anterior shoulder dislocation in youth rugby players have been unclear.

\textbf{Purpose}: The purpose of this study was to investigate the incidence, mechanisms, and intrinsic risk factors of shoulder dislocation in elite high-school rugby union teams during the 2012 season.

\textbf{Methods}: A total of 378 male rugby players from 7 high-school teams were investigated by use of self-administered preseason and postseason questionnaires.

\textbf{Results}: The prevalence of a history of shoulder dislocation was 14.8%, and there were 21 events of primary shoulder dislocation of the 74 overall shoulder injuries that were sustained during the season (3.2 events per 1000 player-hours of match exposure). During the season, 54.3% of the shoulders with at least one episode of shoulder dislocation had reinjury. This study also indicated that the persistence of glenohumeral instability might affect the player's self-assessed condition, regardless of the incidence during the current season. By a multivariate logistic regression method, a history of shoulder dislocation on the opposite side before the season was found to be a risk factor for contralateral primary shoulder dislocation (odds ratio, 3.56; 95% confidence interval, 1.27-9.97; \(P = .02\)).

\textbf{Conclusions}: High-school rugby players with a history of shoulder dislocation are not playing at full capacity and also have a significant rate of reinjury as well as a high risk of dislocating the other shoulder. These findings may be helpful in deciding on the proper treatment of primary anterior shoulder dislocation in young rugby players.

\textbf{Level of evidence}: Retrospective Survey Design, Epidemiologic Study.

\textcopyright 2014 Journal of Shoulder and Elbow Surgery Board of Trustees.

\textbf{Keywords}: Rugby; shoulder injury; glenohumeral instability; dislocation; epidemiology; high school
Rugby is a popular collision sport, and the incidence of shoulder injury is much higher than that of other sports. According to several injury reports, acromioclavicular joint injury is the most common injury, whereas traumatic anterior shoulder dislocation (and subluxation) is the most severe shoulder injury in rugby. In addition, the incidence of rugby injuries increases in players in their late teens. Although there is controversy about whether primary anterior shoulder dislocation should be treated by surgery, the incidence of reinjury (recurrence) in rugby players remains unclear. Moreover, even a single shoulder dislocation and the persistence of glenohumeral instability may affect the subsequent performance of a player who has not received surgical treatment, regardless of whether there is a recurrent injury. Better understanding of the incidence and the impact of such injuries allows us to decide on the best treatment option and its timing for these players. In addition, investigation of the intrinsic risk factors for shoulder dislocation may contribute to the development of preventive strategies.

The purpose of this epidemiologic study was to describe the incidence of and risk factors for primary anterior shoulder dislocation in male high-school rugby players and its influence on the shoulder condition. We hypothesized that some tendencies and intrinsic factors for shoulder dislocation exist in this cohort.

Materials and methods

Subjects

This study was a prospective cohort study to elucidate the incidence and characteristics of injuries among rugby players in a sample of high schools. Seven teams, 4 prefecture-representative teams and their following 3, were approached to take part in the study. A total of 413 male rugby players aged 15 to 18 years (mean, 16.2 years) were enrolled. Thirteen of the subjects had participated in international youth games. The subjects and their team staff members received a thorough explanation of the study and provided their informed consent to participate. The study was approved by the ethics committee of the university to which the authors belong.

Demographics of the subjects

At the beginning of the 2012 season, demographic data were collected on all subjects by a self-administered questionnaire form. The data included anthropometric data, years of experience playing rugby, position (such as forward or back), side of dominance and the shoulder frequently used for collisions, and past history of shoulder injury and dislocation.

Postseason questionnaire

Just after the season, the incidence reports during the 2012 season were collected for all subjects by a self-administered questionnaire form. The injury data were collected after the attending authors’ explained the questions and were referred to the team records. In addition, the players were asked to rate the overall self-assessed condition of each shoulder throughout the season by a visual analog scale (VAS). The VAS was a 10-cm horizontal line with “0 = extreme worse” labeled on the far left and “10 = normal” labeled on the far right. The scales were measured to the nearest millimeter. The players were classified according to their status on their respective teams: grade A indicated a player who was a member of the first-team squad during the season; grade B indicated a player who was not. Information about the total number of matches and practice hours, excluding strength training sessions during the season, was also obtained from the team records. The players who had no chance to compete for more than 3 months or who retired from their athletic career during the season were excluded from the subsequent analysis.

Definition of injury

Injury

The definition of injury and the data collection procedures for studies of injuries were taken from the International Rugby Board consensus guidelines. An injury was defined as an injury occurring during rugby training or playing that resulted in a player’s being unable to take full part in future rugby training or match play for more than 24 hours.

Shoulder injury

Shoulder injuries included acromioclavicular joint injuries, shoulder contusions, clavicle fractures, and shoulder dislocation.

Shoulder dislocation

Because our study employed two questionnaires, it was difficult to determine whether shoulder dislocation was complete or partial dislocation (subluxation). Therefore, we defined an injury of shoulder dislocation in this study as a player’s subjective feeling of the humerus separating from the glenoid at the glenohumeral joint, regardless of the presence of complete dislocation or subluxation. In addition, instability was defined as a state of instability in the glenohumeral joint due to previous shoulder dislocation.

Statistical analysis

The primary analysis was performed to demonstrate the importance of epidemiologic data. The incidence rates (IR) of these injuries were calculated to represent the injury per 1000 player-hours (PH) by match or practice. To understand the aspects of shoulder dislocation in the population, the odds ratio (OR) was also calculated. The rate of reinjury (recurrence) of shoulder dislocation per season was calculated according to the following formula: the number of shoulders with recurrent dislocation in the examined season is divided by the number of the shoulders with a history of shoulder dislocation among all examined players, except for those who had received surgical treatment for glenohumeral instability. For evaluation of whether a history of shoulder dislocation negatively affected the player’s performance, the self-assessed condition of VAS score was compared between the players who had previously sustained a shoulder dislocation (group SD) and those with no such history (control group) by the
Steel-Dwass test. Group SD was also divided into two subgroups: SD1 included the players who had sustained shoulder dislocation during this season, regardless of recurrence; SD2 included the players who had not sustained reinjury during the season.

The secondary analysis focused on the relationship between the incidence of primary anterior shoulder dislocation and each of the variables described before. The data were assessed by a logistic regression analysis calculating the OR. Before proceeding with the analysis, players who had previously dislocated both shoulders were excluded. To maintain the independence of the samples for the subsequent analysis, one shoulder per player was chosen on the basis of the following priority order: the shoulders for which the contralateral side had been dislocated before the season; the shoulders that had dislocated for the first time during the season; the shoulders dislocated for the first time during the season, regardless of recurrence; SD2 included the players who had sustained shoulder dislocation during this season, regardless of recurrence; and the side with the shoulder most frequently used for collisions and the dominance of the shoulder. Before conducting the multivariate analysis, we assessed the relationships between the variables by Spearman rank correlation coefficient to prevent the effects of confounders. A value of $P < .05$ was considered to be significant, and all tests were 2 sided. The data analyses were conducted with the SPSS software program for Macintosh, version 21.0 (IBM, Chicago, IL, USA), except for the Steel-Dwass test, which was conducted with the R software program (http://www.r-project.org/).

### Results

A total of 415 players were enrolled at the beginning, and 37 of them were withdrawn throughout the season. The causes for withdrawal were inadequate or incomplete responses, retirement, and an inability to participate in actual games because of injuries to areas other than the shoulder. Finally, 378 players were analyzed in this study. The characteristics of these players are summarized in Table I. At baseline, most of the players preferred to use the dominant-side shoulders for collisions (Table II). Of the players, 28.6% (95% confidence interval [CI], 24.0-33.2) had a history of shoulder injury (108 shoulders in 378 players). A history of shoulder dislocation was present in 51.9% of these cases (56 of 108; 14.8% (95% CI, 11.2-18.4) of the overall players. The direction of shoulder dislocation was anterior in all of these cases. The prevalence of a past history of shoulder injury varied according to position (Table III). The players who composed the front row had a significantly higher IR (OR, 1.8; $P < .01$) than did those in other positions. However, no such tendency was observed regarding a past history of shoulder dislocation. These data are summarized in Table III.

In the second questionnaire given at the end of the season, a total of 74 shoulder injuries were reported, which had occurred during a total of 149,090 athlete exposure hours (5730 hours in matches and 143,360 hours in practice). These constituted 17.4% of the total 425 injuries (third most common after head and ankle; data not shown) during the 2012 season (Table IV). Of these shoulder injuries, 50 events were
sustained during a match; the other 24 events occurred during a practice. The most common mechanism of shoulder injury was tackling, which constituted 67.6% (95% CI, 56.7-78.5) of all shoulder injuries. Tackling was also the most common mechanism of shoulder dislocations. The overall IR of shoulder injury was 8.5 per 1000 PH (95% CI, 5.8-11.2) in matches and 0.2 (95% CI, 0.1-0.3) in practices.
The number of players who had sustained shoulder dislocation before the season was 48 (56 shoulders), and 40 players (46 shoulders) had never received a surgical treatment. Of these 46 shoulders, 25 shoulders had at least one episode of recurrent shoulder dislocation (i.e., reinjury) during the season, indicating a recurrent rate per season of 54.3% (95% CI, 39.4-69.3).

Primary shoulder dislocation was present in 21 events, representing 45.7% of the total cases of shoulder dislocation in the season (46 events). The overall IR of the primary shoulder dislocation in matches was 3.2 per 1000 PH (95% CI, 1.7-4.7), which corresponded to 55.6 injuries per 1000 player-seasons. The incidence of overall shoulder injury varied according to the grade of the player (Table IV). The players in grade A had a significantly higher IR (OR, 1.8; \( P = .03 \)) than did those in grade B. However, no such tendency was observed regarding an incidence of shoulder dislocation. In addition, the OR of anterior shoulder dislocation varied according to the grade of the player (Table IV). The players in grade A had a significantly higher IR (OR, 1.8; \( P = .03 \)) than did those in grade B. However, no such tendency was observed regarding an incidence of shoulder dislocation.

The VAS score of each group at the end of the season is summarized in Figure 1. The mean score of the shoulders with at least one episode of shoulder dislocation (groups SD1 and SD2) was significantly lower than that of the shoulders without any episodes of shoulder dislocation (control group).

Of the 378 players who had completed the second questionnaire at the end of the season, 10 of them had sustained shoulder dislocation on both sides before the season. Therefore, the remaining 368 players were included in the second analysis (Table V). Of these, 21 players (5.7%; 95% CI, 3.3-8.1) had sustained primary shoulder dislocation during the season. From the secondary analysis by a multivariate logistic regression method, a history of shoulder dislocation on the opposite side \( (n = 48) \) before the season was found to be a risk factor for contralateral primary shoulder dislocation during the season \( (OR, 3.56; 95\% \text{ CI}, 1.27-9.97; \ P = .02) \).

**Discussion**

The IR of rugby injury has previously been reported in several populations. These epidemiologic reports of youth rugby injuries, including shoulder injury/dislocation, mentioned that subjects in their late teens had a higher incidence of injury than did younger subjects. These results appear to reflect the greater aggression and the more competitive nature of the older population and the differences in the individual maturation of physiques, skills, and experiences.26 Therefore, the present study covered the cohort aged 15 to 18 years. In Japan, there are about 120,000 registered rugby players and nearly 40,000 youth players, which ranks 10th in the world, and it is the highest number in Asia.18 Because the severity, measured as the time-loss period, is high for shoulder dislocations,7 we focused on these injuries and made several important findings. First, the overall IR of primary anterior shoulder dislocation in matches was 3.2 per 1000 PH, higher than that of mature players.4,17 Although the IR of overall shoulder injury was not apparently different between the groups, the late-teen players may be the best targets in whom to encourage strategies for preventing shoulder dislocation. Regarding the risk of shoulder injury, the front-row players are more likely to experience injury, and the IR of overall shoulder injury is higher in the grade A players, whereas these tendencies were not fully applicable for shoulder dislocation specifically. Past studies have been conflicting about the differences in position.3,21,24,26 Further study will be needed to confirm these tendencies. In contrast, tackling (67.6%) was the most frequent mechanism of all shoulder injuries, and this was consistent with previous reports.2,13,22,24 Fuller et al13 pointed out that this is probably due to a poorer tackling technique among the younger players.

The VAS score representing the self-assessed total condition of the shoulders was significantly different in the groups (Fig. 1), indicating that glenohumeral instability may affect the players who have ever sustained shoulder dislocation, regardless of the incidence during the season. Together with our results that show a high reinjury rate of >50% in one season, we believe that surgical treatment should therefore be seriously considered for rugby players who sustain primary anterior shoulder dislocation.
The secondary analysis indicated that a history of shoulder dislocation on the opposite side was a risk for primary shoulder dislocation, which may suggest that the presence of intrinsic factors, 4,7,14,25 such as excessive shoulder laxity, 7,29 playing skill, and physical characteristics, actually affects the incidence of shoulder dislocation. These findings may be useful for the screening or prevention of shoulder dislocation in rugby players. Whereas several prevention programs were developed for sports-related lower limb injuries,10,15,28 little has been done to prevent shoulder injury. Shoulder dislocation is one of the most important sports-related injuries that lead to a long time-loss to return and occasionally affect a player’s career. Therefore, development of strategies to avoid shoulder injury is considered to be important for rugby players.

Although our study demonstrated important data as described before, there are several limitations associated with it. First, this study is based on self-administered questionnaires; thus, it remains unknown what types of anterior shoulder dislocation are likely to be sustained by reinjury. Second, this study is only a single seasonal survey, which could give rise to some bias in the resultant data. Further clinical study and a long-term observation in a larger population will be needed to confirm our findings.

Table V  Risk factor of primary shoulder dislocation (N* = 368 players)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Logistic regression analysis(^{3})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Univariate analysis OR (95% CI), P</td>
</tr>
<tr>
<td>Age (y)</td>
<td>1.27 (0.71-2.27), .43</td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>1.06 (0.94-1.20), .35</td>
</tr>
<tr>
<td>Grade (A/B)</td>
<td>0.65 (0.25-1.67), .37</td>
</tr>
<tr>
<td>Experience (y)</td>
<td>0.94 (0.82-1.08), .36</td>
</tr>
<tr>
<td>Position (forwards/backs)</td>
<td>0.51 (0.19-1.38), .18</td>
</tr>
<tr>
<td>History of dislocation in the opposite shoulder</td>
<td>3.56 (1.27-9.97), .02(^{3})</td>
</tr>
</tbody>
</table>

BMI, body mass index; OR, odds ratio; CI, confidence interval.

* Ten players who had suffered dislocation in both shoulders before evaluation are excluded from the analysis.

\(^{3}\) The model reduction by backward elimination selects one explanatory variable as significant.

The model reduction by backward elimination selects one explanatory variable as significant.

Although our study demonstrated important data as described before, there are several limitations associated with it. First, this study is based on self-administered questionnaires; thus, it remains unknown what types of anterior shoulder dislocation are likely to be sustained by reinjury. Second, this study is only a single seasonal survey, which could give rise to some bias in the resultant data. Further clinical study and a long-term observation in a larger population will be needed to confirm our findings.

Conclusions

High-school rugby players with a history of shoulder dislocation are not playing at full capacity and have a significant reinjury rate as well as a high risk of dislocating the other shoulder. This information may be useful for planning the proper treatment of primary shoulder dislocations in high-school rugby players and may help in the development of strategies to prevent shoulder injuries due to rugby.

Acknowledgments

We thank Tokuhide Doi for valuable help with data analyses and Yukimasa Toyama, Shimizu Kyoko, Shuichi Moriya, Shinnosuke Hada, Yusuke Maki, Hideo Kobayashi, Toshiyuki Wakabayashi, and Toshiharu Yamamoto for their valuable help with data collection and their cooperation in carrying out this study.

Disclaimer

The authors, their immediate families, and any research foundation with which they are affiliated did not receive any financial payments or other benefits from any commercial entity related to the subject of this article.

References


