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Factors Associated with Prevalence and Restoration of Dental Injuries among Rugby Players

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Abstract: *This study aimed to explore the risk factors of rugby-related dental injuries and factors associated with the restorations received. Questionnaire survey and dental examination were carried out on 456 rugby players in a cross-sectional study. Experience of trauma was examined against the playing position and total playing time. To determine the factors associated with the restoration and replacement of the injured tooth, logistic regression was performed using the backward stepwise (conditional) method. Prevalence of self-reported rugby-related dental injuries was 26.5% (n=121). The injuries were associated with the total playing time (r=0.247, p<0.001), but not with the playing position (chi-square=3.246, p=0.197). A total of 172 injured teeth were found during clinical examination. The most common injury was fracture of enamel (31.4%), followed by luxation (26.2%) and tooth loss (16.9%). Most of the injured teeth (84.3%) were unrestored. Anterior teeth were found to have greater odds of being restored than posterior teeth (OR=10.0, 95% CI=2.3–42.6). Injuries involving the dentine (OR=7.8, 95% CI=1.8–32.9), pulp (p=0.009, OR=10.4, 95% CI=1.8–60.3), and tooth loss (OR=21.5, 95% CI=4.5–103) had greater odds of being restored. In conclusion, injury prevalence is positively correlated with increased playing time. Restorative decision depends on antero-posterior position of the tooth and the extent of tooth injury.*

Keywords: *athletic injuries, epidemiology, tooth injuries, tooth fracture, avulsion, rugby*

I. Introduction

Rugby is one of the most popular sports in the world [1, 2]. As a contact sport, rugby has a high incidence of injury, mainly occurring during contact with another player [2]. Most of the injuries affect the lower extremities, followed by the upper extremities, trunk, head, and neck [1, 3], but other studies found that the head and the neck are the most susceptible to injuries [4, 5]. Regardless, the incidence of oral injuries in rugby is higher than that in other sports [6, 7].

The World Dental Federation (Federation Dentaire International) considered rugby as one of the sports with a high risk for dental injuries [8]. Rugby orofacial injuries varied from 6.7% to 71.9% among 17 studies reviewed by Kumamoto and Maeda [9]. Traumatic dental injuries usually involve a single tooth, with the maxillary incisors being the most vulnerable to injuries [10]. These injuries might have a negative psychological effect [11], often required long-term care with increased expenditure [12, 13, 14, 15].

Generally, the risk factors of sports injuries can be extrinsic in nature, which includes the session (competition versus practice), playing surface, use of protective equipment, coaching education and training. In contrast, intrinsic risk factors comprise of sex, age or experience, previous injury, body size, performance measures and psychosocial variables [16]. In rugby, body injuries are also discussed by position of the player and phase of play [17, 18]. Although the prevalence of dental injuries among rugby players is widely reported in the literature, there is a lack of injury-risk research for rugby-related dental trauma. Furthermore, despite being recognized as a high risk group, follow-up data on the treatment of sports-related dental trauma is seldom reported, when compared to dental trauma cases in children. Hence, the primary aim of this study was to explore players' risk factors for dental trauma and assess the factors associated with the restorative treatment received. paper.

II. Methodology

This cross-sectional study was carried out at two national rugby tournaments organized by or affiliated with the Malaysian Rugby Union. The study protocol was approved by the Faculty of Dentistry Research Committee, Universiti Kebangsaan Malaysia. All Malaysian teams playing in these tournaments were invited to participate. The samples were obtained by convenience sampling; all players aged 16 or above were included. Informed consent was obtained from all the participants in written form. Each team was approached only once during the entire tournament to avoid duplication. Each player was instructed to submit only one copy of the completed questionnaire. No repeated participation was found during verification at the data entry stage.

Self-administered questionnaires were distributed to the players. They were required to complete and return the questionnaires on the spot. The questionnaire consisted of four parts: (a) demographic data, (b) experience of dental trauma, (c) use of mouthguard, and (d) knowledge about the management of dental trauma. This set of questionnaires was validated and pretested in a previous study [19]. The questionnaires were printed in English and Malay. This paper highlights the findings from parts (a) and (b), as well as the clinical findings.

Demographic information included the year of birth, which was used for the computation of age as of January 1, 2009, the duration of playing rugby (in years), hours per week spent on playing rugby, the highest level of representation, and playing position in the team.

The players were asked "Have you ever experienced tooth injury when playing rugby?" This branching question directs positive respondents to explain their dental trauma experience, such as the frequency and type(s) of dental injury and number of teeth involved. An easily understood classification of fracture, luxation, and avulsion was used to assist players in recalling the injury sustained. These questions were useful in aiding the clinicians to obtain further information on trauma history and to make clinical diagnosis.

The self-reported injury experience was verified with clinical examination. The examination field was illuminated using torchlight. All teeth were dried with gauze and isolated with cotton rolls. Dental charting was done using disposable dental examination sets, and the clinical findings were recorded in standardized forms. Only relevant injuries directly related to playing rugby were recorded.

The types of injuries were charted according to clinical presentation using the classification of Ellis, modified by Holland et al., categorized as (i) fracture of enamel only; (ii) fracture of enamel and dentine, without pulp involvement; (iii) fracture of enamel and dentine, with pulp involvement; (iv) discoloration of the tooth, with or without a sinus; (v) displacement, extrusion, intrusion, and lateral displacement; and (vi) tooth loss as a result of trauma [20]. However, the seventh category defined as "tooth restored by composite or crown following fracture" was dropped since it is not comprehensive in covering all currently available treatment options. Instead, in cases where the injured tooth had been restored or replaced, the injury was categorized based on previous signs and symptoms, as revealed by detailed history taking. The type of treatment received was reported separately, determined as one of the following: untreated trauma, acid etch/composite restoration, permanent crown, denture, and other restoration. Tooth injuries and restorations unrelated to the sport were not recorded.

Prior to the actual day of study, training and calibration of the examiners were done using clinical photographs of various types of dental injuries. The interexaminer agreement for the dental trauma classification was obtained. The strength of agreement between the three examiners and the gold standard (an endodontist) was substantial with kappa coefficient values of 0.70, 0.79, and 0.77.

Statistical analysis: Data analysis was performed using SPSS Statistics 21 (IBM Corp., Armonk, NY, USA). Descriptive analysis was done for the demographic data and self-reported rugby-related dental trauma. Bivariate analysis was done using chi-square test to examine the association of player's position and dental trauma experience. Total playing time was the product of the duration of playing rugby (years), 52 weeks per year, and time spent playing rugby (hours per week). The correlation between total playing time and frequency of injury was assessed. Cross tabulation was done for the types of injuries and the treatment provided. The location of the tooth in the mouth and type of injury were used as independent variables. Then, logistic regression was performed using the backward stepwise (conditional) method. Statistical significance was set at $p<0.05$.

III. Results

A total of 456 participants returned the questionnaires on the spot. The estimated response rate was 77.8%. All the players were male. The mean age of the rugby players examined was 22.73 (SD=3.98) years old. Overall median years of active playing was 6.0 (range=1–30), and median hours of playing per week was 6.0 (range=1–40). The highest levels that the players mostly competed were at state level (35.7%) and intervarsity level (29.8%).

Risk Factors of Dental Injuries: The prevalence of self-reported rugby-related dental trauma was 26.5% (n=121). Of this, 15.8% (n=72) of the players had experienced it only once. The percentages of players who reported two and three occurrences were 6.6% (n=30) and 0.9% (n=4), respectively. The remaining 3.3% (n=15) had rugby-related dental trauma on more than three occasions. Table 1 shows the experience of injuries with respect to players' positions. The prevalence of self-reported injuries does not differ between groups (Pearson chi-square=3.246, p=0.197). However, self-reported injury experience was positively correlated with total playing time (r=0.247, $p<0.001$).

Table 1. Experience of sustaining injury to the teeth by playing positions

Position	Yes	No	Total
	Number of players (%)	Number of players (%)	Number of players
Forward	51 (29.1)	124 (70.9)	175
Back	55 (23.2)	182 (76.8)	237
Forward & Back	15 (34.1)	29 (65.9)	44
Total	121 (26.5)	335 (73.5)	456

Factors associated with restoration of injured teeth: A total of 172 injured teeth were found during clinical examination (Table 2). The most common injury was fracture of enamel (31.4%), followed by luxation (26.2%) and tooth loss (16.9%). For crown fracture, the prevalence decreased inversely to the extent of injury. Only 2.9% of the injured teeth were discolored. Most of the injured teeth (84.3%) were not restored. In a few cases, acid-etch restoration or permanent crowns were provided for the fractured teeth, while dentures were provided to replace lost teeth.

Table 2. Restorations of tooth injuries (n=172)

Diagnosis	n (%)	Treatment
Fracture of enamel only	54 (31.4%)	50 (29.1%) unrestored 4 (2.3%) acid etch restoration
Fracture of enamel and dentine, without pulp involvement	23 (13.4%)	16 (9.3%) unrestored 7 (4.1%) acid etch restoration
Fracture of enamel and dentine with pulp involvement	16 (9.3%)	12 (7.0%) unrestored 1 (0.6%) acid etch restoration 3 (1.7%) permanent crown
Discolorations of the tooth, with or without a sinus	5 (2.9%)	5 (2.9%) unrestored
Displacement, extrusion, intrusion and lateral displacement	45 (26.2%)	44 (25.6%) unrestored 1 (0.6%) permanent crown
Tooth loss as a result of trauma	29 (16.9%)	18 (10.5%) unrestore 11 (6.4%) denture

To determine the factors associated with the decision to restore injured teeth, the location of the tooth (anterior vs. posterior, upper vs. lower, and left vs. right) and the types of injuries were listed as independent variables (Table 3). Logistic regression was performed using the backward stepwise (conditional) method. The parsimonious model excluded only one variable—that is, the side on which the injured tooth was located (left or right). Large confidence interval was yielded, possibly due to small proportion of restored cases. After adjusting for other variables, it was noted that anterior teeth had greater odds of being restored than posterior teeth (Wald's test p-value=0.002, Odds Ratio=10.0). When compared to enamel fracture only, injuries involving dentine (p=0.005, OR=7.8), pulp (p=0.009, OR=10.4) and tooth loss (p<0.001, OR=21.5) had greater odds of being restored. No significant differences were found for other variables. The resultant model was:

Predicted logit of (restoring injured tooth) =
-6.363 + 1.954*(upper tooth) + 2.301*(anterior tooth) + 2.048* (fracture involving enamel & dentine only) +
2.343* (fracture involving pulp) – 17.845*(discoloration) – 1.139*(luxation) + 3.068*(tooth loss)

Predictability improved from 84.3% with the null model to 88.4% with the final model. The overall test of the full model against a constant only model was statistically significant, suggestive of the predictors as a set could reliably distinguished between restored teeth and non-restored teeth (p<0.001). However, the predictors did not improve predictability of the model, as evident by the non-significant Score test (p=0.576). The non-significant Hosmer & Lemeshow goodness-of-fit test indicated that the model has adequate fit (p=0.209). Likelihood ratio test was significant (p<0.001).

Table 3. Logistic regression: Factors associated with restoration of injured teeth

	B	S.E.	Wald	df	Sig.	Odds Ratio (OR)	95% C.I. for OR	
							Lower	Upper
Upper tooth	1.954	1.090	3.215	1	0.073	7.057	0.834	59.745
Anterior tooth	2.301	0.741	9.639	1	0.002*	9.980	2.336	42.643
Injury types	-	-	23.119	5	0.000*	-	-	-
Fracture of enamel and dentine, without pulp involvement	2.048	0.738	7.710	1	0.005*	7.754	1.827	32.919
Fracture of enamel and dentine with pulp involvement	2.343	0.896	6.840	1	0.009*	10.410	1.799	60.253
Discolorations of the tooth, with or without a sinus	-17.845	17196.700	0.000	1	0.999	0.000	0.000	.
Displacement, extrusion, intrusion and lateral displacement	-1.139	1.147	0.986	1	0.321	0.320	0.034	3.033
Tooth loss as a result of trauma	3.068	0.799	14.744	1	0.000*	21.505	4.491	102.973
Constant	-6.363	1.304	23.810	1	0.000*	0.002		

* $p<0.05$

IV. Discussion

Although many sophisticated systems exist in helping to provide accurate diagnosis and management, a simpler classification was adopted for this study to allow quick categorization on the field, where it is impossible to identify intra-alveolar injuries and periapical changes without the use of radiographs. Nevertheless, comparing prevalence data across studies is challenging because of the heterogeneity of study designs and outcome measure. For example, polling a specific age-group or using orofacial trauma as the primary outcome of interest instead of dental trauma. In this study, the prevalence of self-reported rugby-related dental trauma was 26.5%, similar to the findings of a questionnaire-based study by Jolly et al in Australia, which recorded 25%–31% prevalence for four seasons [21].

It was noted that 10.7% of the players had repeated trauma, with 15 players reporting more than three occurrences. Possible explanations include oral predisposing factors such as increased overjet, incompetent lips and risk-taking behaviors as well as emotional stress [14]. However, these factors were not assessed in this study. Similarly, we could not establish the role of a mouthguard in the risk for dental trauma [22]. Tooth fractures occurred most commonly, followed by luxation and avulsion. This trend is consistently shown among rugby players [21, 23].

The association of the rugby players' positions in the field and the risk for dental trauma was not evident in this study. A similar observation was made among Swiss rugby players [23]. However, a greater proportion of dental injuries occurred among French and northern Swedish forwards [24, 25]. Muller-Bolla et al. further explained that more than half of the injuries actually occurred during physical brawls compared with during contact in the games (e.g., scrum and tackle), and those in back-row positions were injured more frequently than those in props positions [24]. Despite that, the measure of association could be diluted with the presence of a third group of players, who played both forward and back positions in this study. In contrast, the total playing time remained a significant risk factor in the occurrences of dental trauma. This should not come as a surprise since the frequency of self-reported rugby-related dental trauma is a cumulative measure over time. It could also be argued that the older players are more muscular and aggressive than their younger counterparts [24].

Crown fracture made up slightly more than half of the total cases, a domination that was also observed by Borssén and Holm [25]. The prevalence of crown fracture corresponds inversely to the extent of the damage. Nevertheless, we acknowledged that misclassification could happen since diagnoses were done based on history and clinical findings only, hence limiting our ability to diagnose pulpal and periapical lesions. Accuracy can be improved by using a periapical radiograph and cone-beam computed tomogram in future studies, but this was impossible in field research. Luxation was encountered by 26.2% of the players, approximating the 23.7% of the players noted by Schildknecht et al. [23]. Yet again, this could be due to recall bias and misclassification bias. The periodontal tissue often heals uneventfully with a mild dislocation of the tooth [26KY]. This, coupled with physiologic tooth movement and tooth drifting secondary to periodontal disease, may result in erroneous findings. Hence, this information needs to be retrieved primarily through history taking.

Most of the injured teeth (84.3%) were not restored. Even tooth loss, which could potentially affect appearance and function, was largely left untreated. In cases of crown fracture, bonding of tooth fragment, contouring, or restoration with composite resin can be done depending on the extent and location of the fracture; calcium hydroxide may be used as a base, while root canal treatment may be indicated if the injury involved the pulp [27]. Regardless of the extent, most of the tooth fractures in this study remained untreated. Such findings were comparable to the studies involving children population in this country, in which most of the fractured incisors were not treated [28], thus further emphasizing the need for resources and manpower in treating dental trauma.

When adjusted for injury types and the location of jaws, anterior teeth had greater odds of being restored compared with posterior teeth. This could be due to the readily visible defects. In addition, the restorations may be indicated for aesthetical reasons. When compared with enamel fracture, injuries involving the dentine, the pulp, and tooth loss had greater odds of being restored. It is postulated that when the injuries cause pain, players are more likely to seek immediate treatment. Exposure of dentinal tubules to a cold or hot stimulus may trigger sensitivity, whereas pulpal exposure often leads to pain. On the other hand, the restoration of lost teeth is predominantly done to restore function and aesthetics. Nevertheless, our results displayed large confidence intervals for the odds ratio, suggesting high variability, possibly because of the small sample size of players with injured teeth and the high proportion of unrestored cases.

V. Conclusion

In conclusion, the prevalence of rugby-related dental trauma was 26.5%. Injury prevalence does not differ among players with different positions in the team but is positively correlated with increased playing time. Most of the injured teeth (84.3%) were not restored, although anterior teeth and injuries involving the dentine, the pulp, and tooth loss were more likely to be restored.

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