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Original research

Does player time-in-game affect tackle technique in elite level rugby union?

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ABSTRACT

Objectives: It has been hypothesised that fatigue may be a major factor in tackle-related injury risk in rugby union and hence more injuries occur in the later stages of a game. The aim of this study is to identify changes in ball carrier or tackler proficiency characteristics, using elite level match video data, as player time-in-game increases.
Design: Qualitative observational cohort study.
Methods: Three 2014/15 European Rugby Champions Cup games were selected for ball carrier and tackler proficiency analysis. Analysis was only conducted on players who started and remained on the field for the entire game. A separate analysis was conducted on 10 randomly selected 2014/15 European Rugby Champions Cup/Pro 12 games to assess the time distribution of tackles throughout a game. A Chi-square test and one-way way ANOVA with post-hoc testing was conducted to identify significant differences ($p < 0.05$) for proficiency characteristics and tackle counts between quarters in the game, respectively.
Results: Player time-in-game did not affect tackle proficiency for both the ball carrier and tackler. Any results that showed statistical significance did not indicate a trend of deterioration in proficiency with increased player time-in-game. The time distribution of tackles analysis indicated that more tackles occurring in the final quarter of the game than the first ($p = 0.04$) and second ($p = <0.01$).
Conclusions: It appears that player time-in-game does not affect tackler or ball carrier tackle technique proficiency at the elite level. More tackles occurring in the final quarter of a game provides an alternative explanation to more tackle-related injuries occurring at this stage.

1. Introduction

Correct tackle technique is vital for safe participation in rugby union[1,2] as the tackle is regarded as most common cause of injury in the game.[3–5] At the elite level, players must have a high physical tolerance and resistance to fatigue to repeatedly engage in tackles safely and effectively throughout the game.[2] Some players can make over 30 tackles per game.[6] It has been found previously that the number of tackles a player engages in is related to markers of muscle damage in rugby union.[7,8] In rugby league, it has been reported that tackling proficiency, based on a one-on-one tackling drill, decreases as fatigue levels increase in sub-elite players.[9]

It has been hypothesised that fatigue may be a major factor in tackle related injury risk in rugby union and hence more injuries occur in the later stages of a game.[2,10] In particular, Hendricks and Lambert[2] proposed that an upper limit exists for a player's ability to repeatedly engage in high energy impact tackles. In theory, elite players who are well-conditioned and have a high level of tackle skill may never reach the upper limit. However, players who are not conditioned and have poor technique are more likely to reach the upper limit during a match or over the course of the season. Hendricks and Lambert[2] also suggest that once this upper limit is surpassed, the risk of injury significantly increases and tackle proficiency noticeably decreases, but this theory has not been confirmed using match data. Similarly, a recent study[11] found that the majority of head impacts occurred in the final quarter of the game and it was hypothesised that fatigue may have an effect on head impact causation and hence concussion risk in rugby union but this also requires further investigation.

In rugby union, the analysis of match video footage has been previously used to identify certain performance based tackler and ball carrier injury risk factors.[11–13] Burger et al.[12] used a detailed video analysis of youth level rugby union games to detect specific ball carrier and tackler proficiency characteristics that influence injury

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Table 1
Tackler front-on and side-on tackle proficiency results based on quarter in game.

Tackler	1st quarter		2nd quarter		3rd quarter		4th quarter		p Value
	n	%	n	%	n	%	n	%	
Front-on	(n = 23)		(n = 21)		(n = 39)		(n = 39)		
Pre-contact									
Identify/track ball carrier onto shoulder	21	(91%)	20	(95%)	39	(100%)	37	(95%)	0.41
Body position—Upright to low	12	(52%)	9	(43%)	16	(41%)	19	(49%)	0.79
Straight back, centre of gravity forward of support base	8	(48%)	5	(33%)	13	(46%)	14	(54%)	0.79
Square to ball carrier	20	(87%)	20	(95%)	34	(87%)	33	(85%)	0.70
Boxer stance (elbows close, hands up)	18	(78%)	9	(43%)	23	(59%)	25	(64%)	0.10
Head up and forward/face up	21	(91%)	20	(95%)	38	(97%)	36	(92%)	0.79
Shortening steps	17	(74%)	11	(52%)	16	(41%)	25	(64%)	0.08
Approach from front/oblique	23	(100%)	20	(95%)	39	(100%)	39	(100%)	0.22
Contact									
Explosiveness on contact	5	(22%)	6	(29%)	2	(5%)	9	(23%)	***0.04**
Contact with shoulder opposite leading	13	(57%)	10	(48%)	22	(56%)	27	(69%)	0.56
Contact in centre of gravity	8	(35%)	4	(19%)	10	(26%)	11	(28%)	0.69
Head placement on correct side of ball carrier	87	(87%)	91	(91%)	97	(97%)	95	(95%)	0.20
Post-contact									
Shoulder usage (drive into contact)	7	(30%)	5	(24%)	9	(23%)	10	(26%)	0.90
Arm usage (punch forward and wrap i.e. hit-and-stick)	14	(61%)	14	(67%)	24	(62%)	24	(62%)	0.88
Leg drive on contact	1	(9%)	4	(19%)	6	(15%)	4	(10%)	0.11
Release ball carrier and compete for possession	2	(9%)	4	(19%)	6	(15%)	4	(10%)	0.75
Side-On	(n = 23)		(n = 23)		(n = 38)		(n = 27)		
Pre-contact									
Identify/track ball carrier onto shoulder	22	(96%)	23	(100%)	37	(97%)	26	(96%)	0.77
Body position—Upright to low	9	(52%)	7	(43%)	17	(41%)	6	(49%)	0.07
Straight back, centre of gravity forward of support base	4	(17%)	1	(4%)	13	(34%)	5	(19%)	***0.02**
Head up and forward/face up	22	(96%)	23	(100%)	37	(97%)	26	(96%)	0.67
Shortening steps	12	(52%)	10	(44%)	19	(50%)	12	(44%)	0.72
Contact									
Explosiveness on contact	1	(4%)	1	(4%)	4	(11%)	3	(11%)	0.68
Contact in centre of gravity	6	(26%)	8	(35%)	8	(21%)	6	(22%)	0.78
Head placement on correct side of ball carrier	22	(96%)	22	(96%)	37	(97%)	25	(93%)	0.83
Post-contact									
Shoulder usage (drive into contact)	3	(13%)	2	(9%)	6	(16%)	4	(15%)	0.63
Arm usage (punch forward and wrap i.e. hit-and-stick)	16	(70%)	18	(78%)	30	(79%)	21	(78%)	0.90
Pull ball carrier with arms to ground	18	(78%)	20	(87%)	30	(79%)	20	(74%)	0.74
Release ball carrier and compete for possession	2	(9%)	2	(9%)	4	(11%)	2	(7%)	0.98

Bold values with '*' indicate p values less than 0.05.

risk in the tackle. Therefore, using the tackle based proficiency characteristics developed by Burger et al.,[12] and match video footage of tackles in elite level European Rugby Champions Cup games, the aim of this study is to identify changes in ball carrier or tackler proficiency characteristics as player time-in-game increases. This study makes the assumption that as player time-in-game increases, so too does player fatigue. The secondary aim is to assess tackle count variation between the quarters of a game to further assess the finding that the majority of head impacts occur in the final quarter of the game.

2. Methods

A qualitative observational cohort study design was used to identify specific changes in ball carrier and tackler technique characteristics (Tables 1 and 2) as player time-in-game increased. As the data were freely available online and no medical data was obtained for this study, ethical permission was not required similar to previous rugby union video analysis studies.[11,14] The tackle definition for this study was "when the ball-carrier was contacted (hit and/or held) by an opponent without reference to whether the ball-carrier went to ground".[15] Three randomly selected 2014/15 European Rugby Champions Cup games involving a particular Irish club were selected for analysis. These games occurred about halfway through the playing season. Each game of the 2014/15 European Rugby Champions Cup was assigned a number and a random number generator (http://www.random.org/) selected 3 games. In these three games, only the tackles involving a tackler from the chosen Irish club were selected for the analysis (both ball carrier and tackler technique were analysed for each tackle). Analysis was only conducted on players who started and remained on the field for the entire game. Tackles involving ball carriers from the opposing team who were substitution players were excluded. A tackle initiated outside the peripheral vision of the ball carriers was considered a side-on tackle.[12,16] As a result, a total of 122 front-on tackles and 111 side-on tackles were analysed for tackler proficiency characteristics, whereas 113 front-on tackles and 98 side-on tackles were analysed for ball carrier proficiency characteristics.

Technical tackle based criteria developed by Burger et al.[12] for ball carrier and tackler proficiency in front-on and side-on tackles were used for the analysis, see categories in Tables 1 and 2. These criteria were developed by a group of rugby union coaches, physi-

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