Determinantes técnicos en el rendimiento en el placaje y ruck

UN ANÁLISIS DEL 6 NACIONES Y DEL RUGBY CHAMPIONSHIP

ACTITUDES EN EL PLACAJE

ROL	ACTITUD	BENEFICIO
PdB	Raffut	ATAQUE
	Mover al placador (placaje lateral/oblicuo)	ATAQUE
	No raffut ni mover al placador	DEFENSA
	Trabajo de piernas	ATAQUE
	No trabajo de piernas	DEFENSA
Placador	Placaje frontal	DEFENSA
	Placaje lateral	ATAQUE
	Placaje dominante	DEFENSA
	Trabajo de piernas	DEFENSA
	No trabajo de piernas	ATAQUE

ACTITUDES EN EL RUCK

La actitud más relevante de cara a conservar la posesión en el ruck es el trabajo del portador del balón en el contacto y en el suelo.

La ausencia del trabajo del portador del balón en el contacto y en el suelo dificulta la conservación de la posesión

El equipo defensor logra recuperar la posesión con bastante frecuencia en los rucks en los que involucra más jugadores que el ataque (3-5).

OTROS HALLAZGOS DE INTERÉS

También influyen en el rendimiento de los placajes (exitoso vs offload) y de los rucks factores como: posición en el campo, ubicación del campo (local vs visitante), status del partido (ganando vs perdiendo), minuto del partido y estrategias de los equipos.

Se concluye que es recomendable entrenar el ruck tras una situación de placaje, dado que en el partido la mayoría de rucks tendrán lugar tras un placaje.

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Technical determinants of tackle and ruck performance in International rugby union

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ABSTRACT

The most frequently occurring contact events in rugby union are the tackle and ruck. The ability repeatedly to engage and win the tackle and ruck has been associated with team success. To win the tackle and ruck, players have to perform specific techniques. These techniques have not been studied at the highest level of rugby union. Therefore, the purpose of this study was to identify technical determinants of tackle and ruck performance at the highest level of rugby union. A total of 4479 tackle and 2914 ruck events were coded for the Six Nations and Championship competitions. Relative risk ratio (RR), the ratio of the probability of an outcome occurring when a characteristic was observed (versus the non-observed characteristic), was determined using multinomial logistic regression. Executing front-on tackles reduced the likelihood of offloads and tackle breaks in both competitions (Six Nations RR 3.0 Behind tackle, 95% confidence interval [95% CI]: 1.9–4.6, effect size [ES] = large, $P < 0.001$); Championship RR 2.9 Jersey tackle, 95% CI: 1.3–6.4, ES = moderate, $P = 0.01$). Fending during contact increased the chances of offloading and breaking the tackle in both competitions (Six Nations RR 4.5 Strong, 95% CI: 2.2–9.2, ES = large, $P = P < 0.001$; Championship RR 5.1 Moderate, 95% CI: 3.5–7.4, ES = large, $P < 0.001$). For the ruck, actively placing the ball increased the probability of maintaining possession (Six Nations RR 2.2, 95% CI: 1.1–4.3, ES = moderate, $P = 0.03$); Championship RR 4.0, 95% CI: 1.3–11.8, ES = large, $P = 0.01$). The techniques identified in this study should be incorporated and emphasised during training to prepare players for competition. Furthermore, these techniques need to be added to coaching manuals for the tackle and ruck.

ARTICLE HISTORY
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KEYWORDS
Rugby union; tackle; ruck; performance

Introduction

Rugby union is now amongst the most played and watched sports in the world, with an estimated 6.6 million players across 119 countries (Arnold & Grice, 2016). The sport is characterised by contact events where opposing players physically engage each other to compete for possession of the ball and prevent opponents from scoring points. The most frequently occurring contact events are the tackle and ruck, which occur with a mean of 116 times in an 80-min match (Hendricks, Matthews, Roode, & Lambert, 2014). Because of this high frequency of occurrence, the ability to repeatedly engage and win the tackle and ruck has been associated with overall team success (Jones, Mellalieu, & James, 2004; Ortega, Villarejo, & Palao, 2009; Wheeler, Askew, & Sayers, 2010). For example, Ortega et al. (2009) reported that winning teams completed more tackles and regained ball possession at rucks more frequently than losing teams in the Six Nations competition. The nature of the tackle and ruck also exposes players to high risk of injury, with 72% of all match injuries attributable to these contact events (Williams, Trewartha, Kemp, & Stokes, 2013). For these reasons, rugby union matches have been analysed to identify factors that should guide training of the tackle and the ruck, with the ultimate goal of improving performance and reducing the risk of injury to players (Burger, Lambert, Viljoen, Brown, Readhead, den Hollander et al., 2016; Hendricks et al., 2014; Wheeler & Sayers, 2009).

Based on match analyses studies, it is apparent that players have to execute specific actions and techniques to win the tackle and the ruck (Hendricks et al., 2014; Kraak & Welman, 2014; Wheeler et al., 2010). For example, key tackler techniques associated with positive tackle performance are: (i) tacklers counteracting the ball-carrier fend, (ii) tacklers executing shoulder tackles targeted at the mid-torso of the ball-carrier and (iii) tacklers leg-driving after contact (Hendricks et al., 2014). Although these studies refined the methods used to analyse the tackle and ruck performance during matches, and identified technical characteristics that should be coached during training to effectively prepare players for competition, work to date has noteworthy limitations. These limitations include the following: the use of a sample of matches in one competition (typically Super Rugby); account not being made of match situation (time period, match status, field position); or events and actions that are not described in enough technical detail to guide training or improve match strategies.

With the exception of the Rugby World Cup (played quadrennially), winning the Six Nations or the Championship competition is the ultimate measure of team success in

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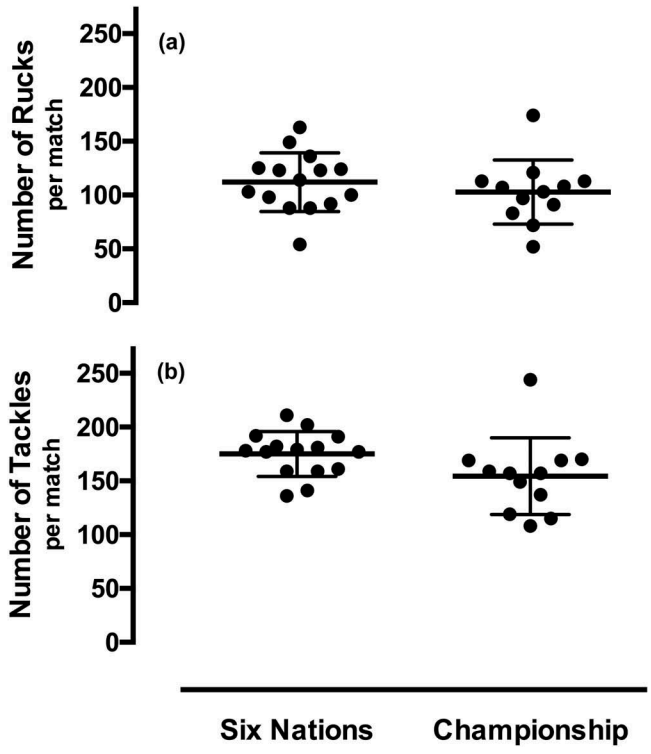

Figure 1. Mean number of ruck (a) and tackle (b) events per match for each competition. Data are reported as mean ± standard deviation.

International rugby union. However, research on these International competitions has been limited to the reporting of tackle and ruck frequency statistics (Jones et al., 2004; Kraak & Welman, 2014; van Rooyen, 2012). World Rugby has recently highlighted a need to improve the technical abilities of all professional rugby union players (Quarrie et al., 2016), yet there is insufficient data to inform coaches of the technical demands and requirements to perform the tackle and ruck at the highest level of rugby union. Knowledge of the most effective tackle and ruck contact techniques in the Six Nations and the Championship could improve current coaching strategies and training design. Hence, the purpose of this study was to identify technical determinants of tackle and ruck performance at the highest level of rugby union.

Methods

Approach to the problem

This study followed a similar approach to Hendricks et al. (2014), Hendricks, Roode, Matthews, and Lambert (2013) and Sewry, Lambert, Roode, Matthews, and Hendricks (2015) by using retrospective video analyses to determine the relationship between technical actions and performance outcomes in rugby union. In brief, video footage was analysed using Sports Code elite version 6.5.1, using an Apple iMac (Apple Inc., Cupertino, California USA). The analysis software allowed control over the speed at which each movement can be viewed, and the recording and saving of each coded instance into a database. During the analyses, the analyst could pause, rewind and watch the footage in slow motion. The highest frame frequency the analyst could slow down the motion of the footage was to 25 Hz. Instances were coded using determinants and definitions described earlier (Hendricks, Karpul, Nicolls, & Lambert, 2012; Hendricks & Lambert, 2010; Hendricks et al., 2014), and those developed specifically for this study (Table 1). A tackle event was defined as any event where 1 or more tacklers (player or players making the tackle) attempted to stop or impede the ball-carrier (player carrying the ball) whether or not the ball-carrier was brought to ground (Fuller et al., 2008; Hendricks & Lambert, 2010). Each tackle was coded for tackle-contact determinants (first instance of contact), post-tackle determinants, match-situation determinants and tackle outcomes (tackle break, offload, possession lost, ruck formed). If the outcome of the tackle was a ruck, the determinants of the ruck and the outcome of the ruck were subsequently coded. All video footage was obtained from the South African Rugby Union Video Database. To avoid bias towards a specific team or period during the competitions, each match was randomly selected using an on online random number generator (www.random.org). The study was approved by the University of Cape Town Human Research Ethics Committee (HREC Ref: 517/2015).

Matches

All matches from the 2014 Six Nations (n = 12) and 2014 Championship (n = 15) competitions were completely analysed for this study. This equated to a total of 4479 coded tackle contact events (Championship = 1853 tackles; Six Nations = 2626 tackles) and 2914 ruck events (Championship = 1234 tackles; Six Nations = 1680 tackles).

Identification and selection of variables

The variables needed to be valid (represent relevant and important aspects of tackle and ruck technique and performance), and the definitions thereof had to be clear and unambiguous. The validity of variables was assessed using methods described by O'Donoghue (2009). In brief, variables and operational definitions were based on published peer-reviewed studies in the area, and through consultation with coaches, sport scientists and rugby union administrators. To ensure the logical and content validity for describing attacker and defender actions, the list was more inclusive than exclusive. After the list of variables was established, a panel of coaches, sport scientists and rugby union administrators was consulted to review the validity and relevance of the variables, and the lucidity of the operational definitions. The panel agreed that the list and definitions for tackle and ruck descriptors were appropriate and clear, and no further changes were required.

Coding of variables

Each tackle was coded for tackle-contact determinants, post-tackle determinants, match-situation determinants and tackle outcomes. If the outcome of the tackle was a ruck, the determinants of the ruck and the outcome of the ruck were subsequently coded. Tackle contact determinants were for when the ball-carrier contacted the tackler. The variable categories coded at this point were the type of tackle, the direction of the tackle, body region of the ball-carrier struck and the presence of a ball-carrier fend. Post-tackle determinants were for after the initial contact was made and consisted of variable categories such as

Table 1. Tackle descriptors and definitions.

Contact	Description
Type of tackle	
Arm tackle	Tackler impedes ball-carrier with upper limbs
Collision tackle	Tackler impedes ball-carrier without the use of arms
Jersey tackle	Tackler holds ball-carrier's jersey before impeding ball-carrier with upper limbs
Lift tackle	Tackler raises ball-carrier's hips above ball-carrier's head
Shoulder tackle	Tackler makes contact with their shoulder as the first point of contact
Smother tackle	Tackler uses chest and wraps both arms around ball-carrier
Tap tackle	Tackler trips ball-carrier with hand on lower limb below the knee
Missed tackle	Tackler fails to tackle the ball-carrier, thus allowing the ball-carrier to advance during open play
Direction of tackle	
Front	Tackler makes contact head-on with ball-carrier
Side	Tackler makes contact with the ball-carrier's side
Oblique	Tackler makes contact with ball-carrier at an angle
Behind	Tackler makes contact with ball-carrier from behind
Body region of ball-carrier struck	
Legs	Area between tackler's hips and toes
Mid-torso	Above the tackler's hip level to the level of the tackler's arm pit
Shoulder/arm	From the tackler's arm pit level to the shoulder level, including the arm/hand
Head and neck	Above the shoulder (contact with the head/neck)
Ball-carrier fend	
Absent	Provided no fend
Moderate	Provided a light to moderate fend (e.g., swat or slap technique)
Strong	Provided strong fend (e.g., push technique)
Post contact	
Leg drive by tackler	
Absent	No leg drive
Moderate	Moderate knee movement, with no high lift
Strong	High, rapid knee lift
Leg drive by ball-carrier	
Absent	No leg drive
Moderate	Moderate knee movement, with no high lift
Strong	High, rapid knee lift
Territorial change	
The direction of progression the tackler and ball-carrier made (as a single unit) with reference to the gain line (an imaginary line that is drawn through the middle of the set piece/breakdown) from the point of contact to the point where both players went to ground.	
Ball-carrier	Ball-carrier advances over the gain line.
Tackler	Tackler advances over the gain line
None	Neither the ball-carrier nor the tackler advance over the gain line
Tackle outcomes	
Offload	The ball-carrier is able to pass the ball to a teammate during the tackle
Tackle break	The ball-carrier successfully penetrates the attempted tackle and continues to advance
Ruck formed	When an offload or tackle break does not occur, and either player goes to ground to form a ruck. A ruck is a phase of play whereby 1 or more players from each team, who are on their feet, in physical contact, close around the ball on the ground (worldrugby.org).
Possession lost	The attacking team is unable to advance through an offload or tackle break, or form a ruck, and lose the ball either through an infringement or error
Ruck and match-situation descriptors and definitions	
Ruck	Description
Number of players at ruck: attack	
0–2	Number of attacking players actively engaging in the ruck contest
3–5	Number of attacking players actively engaging in the ruck contest
6–8	Number of attacking players actively engaging in the ruck contest
Number of players at ruck: defence	
0–2	Number of defending players actively engaging in the ruck contest
3–5	Number of defending players actively engaging in the ruck contest
6–8	Number of defending players actively engaging in the ruck contest
Ball-carrier falling direction	
Forward	Ball-carrier falls with the ball positioned between the ball-carrier and the opposition's try-line
Sideward	Ball-carrier falls with the ball positioned between either side-line
Backward	Ball-carrier falls with the ball positioned between the ball-carrier's own try-line
Active ball placement	
Yes	Ball-carrier actively placed the ball after going to the ground to continue play
No	Ball-carrier fails to actively placed the ball after going to the ground to continue play
Ruck arrival time: attack	
Early	Ball-carrier teammates are first to arrive and engage in the ruck
Late	Tackler teammates are first to arrive and engage in the ruck
Activity at the ruck: attack	
Clearing	Attackers are actively driving opponents off the ball
Protecting the ball	Attackers are positioned over the ball to prevent opponents access
Clearing and protecting	Attackers actively clears the ruck first, before protecting the ball
Protecting and clearing	Attackers actively protects the ball first, before clearing the ruck
Activity at the ruck: defence	
No pressure	Defenders are not actively attempting to regain possession
Early counter ruck	Defenders compete for the ball without the use of their hands before attackers had secured possession

(*Continued*)

Table 1. (Continued).

Contact	Description
Late counter ruck	Defenders compete for the ball without the use of their hands after attackers had secured possession
Jackal	A defender competes for the ball using his hands after a tackle was made but before a ruck is formed
Ruck outcome	
Possession maintained	Attacking team maintains possession of the ball after the ruck contest and it's available to play
Attack lost possession	Attacking team fails to maintain possession of the ball after the ruck contest
Match situation	
Match period	Each match was divided into 4 periods of 20 min (1st, 2nd, 3rd and 4th period)
Match status	Whether the attacking team was winning, losing or drawing at the time of the contact event, based on the score
Field position (Vertical)	The field was divided into vertical quadrants between the 2 try-lines with quadrant A representing the area closest to attacking team's own try-line, and quadrant D representing the area closest to the opposition try-line
Field position (Horizontal)	The field was divided into horizontal quadrants between the 2 touch lines with quadrant 1 representing the area furthest away from the camera, and quadrant 4 representing the area closest to the camera view

leg drive by tackler, leg drive by ball-carrier and territorial change. After coding for tackle-contact determinants and post-tackle determinants, the outcome of the tackle was recorded. The ball-carrier either offloaded the ball, broke the tackle, lost possession of the ball or a ruck was formed. If a ruck was formed, ruck determinants and the outcome of the ruck were coded – number of attacking and defending players at the ruck, ball-carrier falling direction, whether ball-carrier actively presented the ball, the activity of the supporting players at the ruck and whether possession was maintained by the attacking team. Match determinant variables were coded both for the tackle and ruck, and consisted of match location (home vs. away), match time (in quarters), match status (score at the time of the contact event) and field position (vertical and horizontal quadrants).

One analyst coded all the variables. The analyst studied the variables and their corresponding definitions to make certain that each variable was understood. When the analyst observed behaviours that fulfilled the definitions (e.g., *Jersey tackle* – tackler holds ball-carrier's jersey before impeding ball-carrier with upper limbs), the event was coded. Despite using only 1 coder and all efforts to increase the objectivity of the methods, subjectivity is likely when human observation analyses performance (O'Donoghue, 2009).

Reliability

For intra-coder reliability, 2 matches were each coded twice using the variables and definitions described earlier. Coding of the same game was separated by at least 1 week (Wheeler et al., 2010). A second analyst followed the same procedure for the same 2 games for inter-reliability. Kappa statistics ($\kappa \pm$ standard error) evaluated intra- and inter-coder reliability for each randomly selected match (James, Taylor, & Stanley, 2007; Viera & Garrett, 2005). Kappa values between 0.81 and 0.99 represent excellent agreement between repeated measures, and values between 0.61 and 0.80 represent "substantial agreement" (James et al., 2007; O'Donoghue, 2009; Viera & Garrett, 2005). Intra-coder reliability for match 1 and match 2 was as follows: overall for match 1: contact variables $\kappa = 0.98 \pm 0.16$, post-contact variables $\kappa = 0.95 \pm 0.18$, ruck variables $\kappa = 0.85 \pm 0.15$ and match-situation variables $\kappa = 0.97 \pm 0.22$; overall for match 2: contact variables $\kappa = 0.98 \pm 0.16$, post-contact variables $\kappa = 0.96 \pm 0.19$, ruck variables $\kappa = 0.94 \pm 0.14$ and match-situation variables $\kappa = 0.97 \pm 0.22$. Total intra-coder reliability for the 2 matches was as follows: contact variables $\kappa = 0.98 \pm 0.16$, post-contact variables $\kappa = 0.96 \pm 0.19$, ruck 19 variables $\kappa = 90 \pm 0.15$ and match-situation variables $\kappa = 0.97 \pm 0.22$.

Inter-coder reliability for match 1 and match 2 was as follows: overall, for match 1: contact variables $\kappa = 0.81 \pm 0.15$, post-contact variables $\kappa = 0.87 \pm 0.18$, ruck variables $\kappa = 0.77 \pm 0.14$ and match-situation variables $\kappa = 0.98 \pm 0.13$; overall for match 2: contact variables $\kappa = 0.85 \pm 0.15$, post-contact variables $\kappa = 0.93 \pm 0.18$, ruck variables $\kappa = 0.88 \pm 0.14$ and match-situation variables $\kappa = 0.96 \pm 0.13$. Total inter-coder reliability for the 2 matches was as follows: contact variables $\kappa = 0.84 \pm 0.10$, post-contact variables $\kappa = 0.92 \pm 0.12$, ruck variables $\kappa = 0.87 \pm 0.10$ and match-situation variables $\kappa = 0.97 \pm 0.09$.

Statistical analyses

Cohen's ES (d) and the Student's t-test compared the number of tackle and ruck events per match between the 2 competitions. ESs of <0.19, 0.2–0.59, 0.6–1.19 and 1.2> were considered trivial, small, moderate and large, respectively (Hopkins, Marshall, Batterham, & Hanin, 2009). A two-tailed P-value was used for all tests, with the a priori alpha level of significance set at $P < 0.05$. Data are reported as mean ± standard deviation.

Multinomial logistic regression identified technical contact determinants and match situations that were associated with tackle (offload, tackle break, ruck formed) and ruck (possession maintained) performance outcomes. All determinants were computed in one model, including the match-situation determinants. Separate models were conducted for each competition (Six Nations and Championship) and each contact event (tackle and ruck) – i.e., 4 multinomial logistic regression models with all relevant determinants were computed. Relative risk ratios (RRs) and 95% confidence intervals (95% CIs) are reported. The RR is a ratio of the probability of the event (outcome) occurring in the observed determinant versus the non-observed determinant. To perform this analysis, determinant variables are computed relative to a referent or base variable. For example, for type of tackle, the base variable was shoulder tackle. For interpreting the multinomial logistic regression, if the RR of the variable is more than 1, the comparison determinant is more likely to occur, and if the RR of the variable is less than 1, the base variable is more likely to occur. The magnitude of this likelihood is represented by the RR value. RR values between 1.0 and 1.19, 1.2 and 1.89, 1.9 and 2.9, 3.0 and 5.69, and 5.7 and 19 were considered trivial, small, moderate, large and

very large, respectively (www.sportsci.org). The alpha was set at $P < 0.05$. Similar analyses of rugby union performance can be found in Hendricks et al. (2014, 2013) and Sewry et al. (2015). The suitability and equations for logistic regression can be found in Hamilton (2012) and Huck (2012). All statistics were computed using STATA 12 (StataCorp, College Station, TX USA).

Results

Number of contact events

Players in the Six Nations competition performed 175 ± 21 tackle per a match (Figure 1). This was greater than the number of tackles in the Championship (154 ± 36 tackles, $d = 0.7$, moderate, $P = 0.07$). The number of ruck events recorded per a match was 112 ± 27 for the Six Nations, and 103 ± 30 for the Championship ($d = 0.3$, small, $P = 0.41$).

Technical determinants related to tackle outcome

Being tackled from the front reduced the likelihood of offloads and tackle breaks in both competitions (Table 2 and Table 3). Fending during contact increased the chances of offloading and breaking the tackle in both competitions. Moderate ball-carrier leg drive decreased the probability of offloading in the tackle in the Championship, whereas strong ball-carrier leg drive in the Six Nations increased the probability of offloading in the tackle. To break the tackle, ball-carrier leg drive increased the probability of a positive outcome in both competitions.

Table 2. Multinomial logistic regression for offload and tackle break in the Six Nations.

	Six Nations			
Offload (vs. ruck formed)	RR	95% CI	Interpretation	*P*-value
Time quarter in match (1st quarter)				
3rd quarter	1.6	1.1–2.2	Small	0.01
Tackle direction (Front)				
Behind	3.0	1.9–4.6	Large	<0.001
Oblique	1.5	1.2–1.9	Small	0.001
Side	1.9	1.4–2.7	Small	<0.001
Fend (absent)				
Moderate	1.4	1.0–1.9	Small	0.02
Strong	4.5	2.2–9.2	Large	<0.001
Leg drive by ball-carrier (Absent)				
Strong	2.3	1.6–3.2	Moderate	<0.001
Tackle break (vs. ruck formed)				
Type of tackle (shoulder tackle)				
Jersey tackle	2.9	1.3–6.4	Moderate	0.01
Time quarter in match (1st quarter)				
4th quarter	0.5	0.3–0.8	Small	0.01
Match location (away)				
Home	1.5	1.0–2.2	Small	0.04
Match status (losing)				
Winning	0.4	0.2–0.8	Small	0.009
Tackle direction (front)				
Oblique	2.3	1.5–3.4	Moderate	<0.001
Side	4.0	2.5–6.5	Large	0.000
Fend (absent)				
Moderate	5.1	3.5–7.4	Large	<0.001
Leg drive by ball-carrier (absent)				
Moderate	14.9	5.7–39.3	Very large	<0.001
Leg drive by tackler (absent)				
Moderate	0.1	0.1–0.2	Moderate	<0.001
Vertical field position (Quadrant A)				
Quadrant B	0.5	0.2–1.0	Small	0.06
Quadrant C	0.3	0.1–0.6	Small	0.002
Quadrant D	0.3	0.1–0.7	Small	0.004

Data are reported as relative risk ratios (RRs) and 95% confidence intervals (95% CIs). RR interpretation and *P*-value are also reported.

Table 3. Multinomial logistic regression for offload and tackle break in the Championship.

	Championship			
Offload (vs. ruck formed)	RR	95% CI	Interpretation	*P*-value
Type of tackle (shoulder tackle)				
Jersey Tackle	3.0	1.3–6.8	Large	0.008
Tackle direction (front)				
Behind	2.7	1.3–5.8	Moderate	0.01
Oblique	1.6	1.1–2.3	Small	0.02
Side	1.7	1.0–2.8	Small	0.03
Fend (absent)				
Moderate	2.5	1.6–3.9	Moderate	<0.001
Strong	6.4	1.5–26.6	Very large	0.01
Leg drive by ball-carrier (Absent)				
Moderate	0.4	0.3 – 0.6	Small	<0.001
Strong				
Horizontal field position (Quadrant 1)				
Quadrant 3	0.6	0.4–1.0	Small	0.05
Quadrant 4	0.5	0.3–0.8	Small	0.003
Tackle break (vs. ruck formed)				
Type of tackle (shoulder tackle)				
Jersey tackle	2.3	0.9–5.7^	Moderate	0.07
Tackle direction (front)				
Oblique	2.7	1.7–4.2	Moderate	<0.001
Side	3.9	2.3–6.5	Large	<0.001
Fend (absent)				
Moderate	5.5	3.8–8.1	Large	<0.001
Leg drive by ball-carrier (Absent)				
Moderate	11.9	6.2–22.6	Very large	<0.001
Leg drive by tackler (absent)				
Moderate	0.1	0.1–0.2	Moderate	<0.001
Horizontal field position (Quadrant 1)				
Quadrant 4	0.5	0.3–0.9	Moderate	0.01

Data are reported as relative risk ratios (RRs) and 95% confidence intervals (95% CIs). RR interpretation and *P*-value are also reported.

Technical determinants related to ruck outcome

For the ruck, actively placing the ball increased the likelihood of maintaining possession (Six Nations RR 2.2, 95% CI: 1.1–4.3, ES = moderate, $P = 0.03$; Championship RR 4.0, 95% CI: 1.3–11.8, ES = large, $P = 0.01$). In the Six Nations, ball-carriers falling sideward after the tackle had a higher probability of maintaining ball possession during the ruck contest (RR 3.2, 95% CI: 1.5–6.8, ES = large, $P = 0.003$). In the Championship, having 3–5 defending players actively engaging in the ruck decreased the likelihood of the attacking team maintaining possession of the ball by 85% (RR 0.15, 95% CI: 0.0–0.5, ES = small, $P = 0.003$).

Discussion

This is the first study to identify technical determinants and their association both with tackle and ruck performance in professional International competition. In both competitions, ball-carriers are more likely to offload or break the tackle if they execute a fend and drive the legs after contact, whereas tacklers can prevent an offload or tackle break by executing a front-on shoulder tackle with leg drive. The ball-carrier and tackler technical determinants associated with tackle contact success in this study are comparable to contact techniques associated with success in Super Rugby (Hendricks et al., 2014;

Sewry et al., 2015; Wheeler et al., 2010). Furthermore, these ball-carrier and tackler technical determinants reduce the risk of injury in the tackle (Burger, Lambert, Viljoen, Brown, Readhead, den Hollander et al., 2016). The commonality of both ball-carrier and tackler contact techniques associated with success in International competitions, and considering previous reports in Super Rugby, provides strong empirical evidence for the importance of these contact techniques for performance. While coaches and coaching manuals might recommend some of these techniques, for example, front-on shoulder tackles (Hendricks, den Hollander, Tam, Brown, & Lambert, 2015; Hendricks, Jordaan, & Lambert, 2012; Hendricks & Sarembock, 2013), other contact techniques such as fending are not part of standard contact training (Hendricks & Lambert, 2010; Hendricks et al., 2014).

While previous research on the ruck has attempted to show the importance of winning the ruck for overall team success (Kraak & Welman, 2014) and the relationship between ruck strategies and ruck outcomes (Wheeler, Mills, Lyons, & Harrinton, 2013), this is the first study to report on the technical requirements to win the ruck contest. From an attacking perspective, ball-carrier actions immediately after the tackle were the most notable determinants of ruck success. Justifiably, ball-carriers falling sideward and then actively placing the ball makes it harder for the immediate defenders to compete for the ball on the ground. For defence, 3–5 defending players actively engaged in the ruck increased the likelihood of regaining possession of the ball. This finding supports the study of Kraak and Welman (2014), which showed the defending team is more likely to win the ruck when more defenders than attackers are present. If a tackle does not result in losing the ball, an offload, or tackle break, a ruck is formed – 65% of all tackles in this study resulted in a ruck. For coaching, coaches should include tackle and ruck techniques in the same drill. For example, after demonstrating the techniques to carry the ball into contact, the ball-carrier should also be expected to fall sideward and place the ball.

Although the magnitude of effects were small to moderate, field position, match location, match status and match quarter were associated with tackle and ruck performance. These factors influence the design of task constraints for technical training drills and plans for match strategy (Burger, Lambert, Viljoen, Brown, Readhead, & Hendricks, 2016; Headrick et al., 2012; Hendricks et al., 2013).

Recently, contact phases of rugby union, specifically the tackle, have come under scrutiny, alongside a recommendation by a World Rugby expert group to improve the technical abilities of all professional rugby union players (Quarrie et al., 2016; Tucker, Raftery, & Verhagen, 2016). Subsequently, a call for the development of a contact-skill programme was made (Hendricks, Till, Brown, & Jones, 2016). The results of this study provide evidence to assist the design of such a programme and highlight techniques that should be emphasised during training. Also, the contact techniques associated with success in this study are recommended for other standards of play.

Even though the objective of this study was achieved, effective execution of contact techniques also relies on player's physical conditioning and tactical awareness (Hendricks & Lambert, 2014; Hendricks et al., 2013; Sewry et al., 2015). Physical fatigue reduces player's technical contact ability (Burger, Lambert, Viljoen, Brown, Readhead, & Hendricks, 2016; Gabbett, 2008). Similarly, mental fatigue reduces technical ability in football players, and probably affects contact technique in rugby union (Smith et al., 2016). Tactically, the quality and speed of the defence have been positively associated with winning contact situations (Hendricks et al., 2013; Sewry et al., 2015). Although more work is required to improve understanding of relationships amongst technique, fatigue, tactics and performance, coaches should consider these factors when designing and developing contact-technique training.

Conclusion

This is the first study to identify technical determinants of tackle and ruck performance in the Championship and Six Nations competitions. Fending and leg driving during contact increased the likelihood of a ball-carrier offload or tackle break, while front-on shoulder tackles with leg drive decreased the likelihood of a ball-carrier offload or tackle break. To win ruck contests, ball-carriers should fall sideward and actively place the ball, whereas the defending team need to commit 3–5 players to increase their chances of winning the ruck. These techniques should be incorporated and emphasised during training to prepare players for competition. Furthermore, these techniques need to be added to coaching manuals for the tackle and ruck.

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