

The quantification of contacts with impact during professional rugby matches

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Abstract

To gain a complete understanding of a player's total physiological stress exposure the measure of contact with impact in match situations must be addressed. The goal of this study was to quantify the contact stress players were exposed to in a rugby match. 7 Matches in a professional provincial rugby competition were analyzed to determine the frequency of the contact situations for each player. There were 386 (range 306 – 535) impact contacts per match. The forwards were involved in 68% impact contacts with 257 per match (range 199 – 389). The backline players were involved in 125 (range 93 - 148) impact contacts per match. The most frequently occurring impact contact for the whole team was contact with the ground, 108 impacts per match (range 70 – 133) followed by the scrum impact, 81 impacts per match (47 – 100). Lineout contact impacts were the least frequently observed with 2 per match (range 1 – 4). 80% of the impact contacts were recorded at a higher frequency when the team lost as opposed to when they won. These findings have the potential to influence how players are prepared for matches and managed over a season.

Keywords: Rugby, Contact Situation, Game analysis

1. Introduction

The introduction of professionalism in rugby union in 1995 resulted in an increased emphasis on fast, dynamic and physical matches (Eaves and Hughes, 2003) and as a consequence the professional players have more frequent and powerful contact situations. Furthermore, the professional players are exposed to greater training loads, an increased number of competitive matches, along with a decreased recovery time between games and a decreased off-season than the pre-1995 amateur game. These factors have raised a concern among the medical support staff about the physical demands placed on modern professional rugby players and the subsequent increased risk of injuries (Consensus Conference, 2005). Research supporting this concern, particularly the physical contact aspect for the game is not comprehensive Duthie *et al.* (2003). The few studies on the contact situation have not used consistent definitions of contact (Smyth, et al. (1998), McKenzie et al. (1989), Garraway *et al.* (1999), Takarada (2003) and Duthie *et al.* (2003)). For example, Smyth *et al.* (1998) studied the effect of law changes on the contact situation and at the influence of the timing of the ball in the

contact situation. They looked at a the time of contact, the team in possession, the ball carriers details, the pitch location, advantage line crossed, arrival of support players, first actions of the support players, ball to ground or hand, the timings and outcome, as well as the type of contact situation (i.e. scrum etc). Their main findings were that forwards carried the ball into contact significantly more than the backline players and that the majority of contact situations were located in the middle third of the field.

McKenzie *et al.* (1989) described what happened to possession when rugby players went into 'contact' with the ball. This study used the broad term 'contact situations' and classified the contacts according to whether they were "Close" contacts (within 5m), "Intermediate" contacts (within 5-20m) and "Far" contacts. It also determined the body position of the ball carrier in contact as either "Low", "Medium" or "High". This study used these various classifications and specific elements of the contact situations to make an association between the type of contact and the technique of the player with the overall retention of the ball. There was however no mention of the specific nature of the contact situation.

Garraway *et al.* (1999) studied the contact situations in a rugby match, looking specifically at the influence of lifestyle, personality, and other player related factors on injuries in the tackle. They also attempted to describe the detailed circumstances in which the tackles occurred. Their main findings related the speed and the direction of approach of the players involved with the tackle situation to the severity of injury.

Takarada (2003) conducted a study on the extent of muscle damage in rugby players after competitive matches. It was concluded that rugby matches result in serious structural damage to the muscles, the extent of which was highly dependent on the number of tackles, made or received. Furthermore, the study showed that the level of contact experienced by players within a match was substantially more severe than that experienced during practice sessions. However, in addition to tackling, a rugby match involves many other aggressive and forceful forms of contact such as scrums, rucks, mauls and severe contact made with the ground following a fall. For a comprehensive assessment of the impact stresses these aspects of the game should also be given consideration.

To quantify the total contact stress experienced by a player during a match it is important that a well-defined set of criteria is determined. The International Rugby Board (IRB) does not have specific definitions for all of the contact situations described above. They refer only to the tackle, which is defined as "*when the ball-carrier is held by one or more opponents and is brought to the ground*" (IRB Playing Charter, 2005). Therefore a prerequisite for assessing total contact stresses in a match is to have an accurate and valid set of definitions and a reliable and repeatable method of determining these contacts within match situations. Accordingly, the aim of this study was to define the contact situations that occurred during match situations and quantify these contact situations by playing position as they occur in a match.

2. Methods

2.1. Subjects

The subjects for the study were professional provincial level players (n = 40) (mean age 23 years (± 3), height 184 cm (± 8) and weight 99 kg (± 15)). The squad selection and amount of match time each player had was external to the control of this study.

2.2. Procedure

Competitive matches (n = 7) from the 2006 Vodacom Cup Tournament, South Africa were digitized and analyzed using a 2-D video analysis software program (SportsCode Elite version 6.5.2, Sportstec, Australia). Matches were obtained from two sources, either Television (n = 3) or directly from a video camera supplied by the analyzed squad (n = 4). The number of contact situations as well as the type of contact that each player was involved in for each game was recorded.

2.3. The contact situation

The term 'Impact Contact' was derived for this particular study and referred to '*a situation in which one or more players actually touch or strike each other or the ground, during a match*'. The ten categories used in this study are described below and formed the basis for counting the frequency of the impact contacts for the entire team, as well as for each position:

1. Aggressor Open Play Impact Contact

Aggressor Open Play Impact Contact occurs when the aggressor (usually the tackler) makes contact with another player (the recipient) in an attempt to displace the recipient in the direction that the aggressor is moving, during open play. That is, the aggressor transmits the greater force towards the recipient.

2. Recipient Open Play Impact Contact

Recipient Open Play Impact Contact occurs when the recipient (usually the ball carrier) receives contact from another player (the aggressor) during open play. That is, the recipient receives the greater amount of force of the two players.

3. Ground Contact

Ground contact Open Play Impact Contact occurs when a player makes a significant impact with the ground during open play (for example receiving a kick-off or diving for the try-line).

4. Scrum Impact Contact

The Scrum Impact contact occurs between the front rows of the opposing teams as they engage.

5. Aggressor Ruck Impact Contact

Aggressor Ruck Impact Contact occurs when a player (usually offensive support players) aggressively "hits" a ruck or players around the fringes of a ruck.

6. Recipient Ruck Impact Contact

Recipient Ruck Impact Contact occurs when a player receives contact (usually defensive support players) at a ruck or around the fringes of a ruck.

7. Line-out Impact Contact

This occurs when a player falls to the ground from an elevated position during a line-out or is brought to the ground after a line-out.

8. Missed Tackle Impact Contact

A missed tackle occurs when a player attempts to bring an opposing player to ground but misses and makes contact with the ground instead.

9. Aggressor Maul Impact Contact

The Aggressor Impact Contact occurs when a player (usually offensive support players) aggressively “hits” a maul or players around the fringes of a maul.

10. Recipient Maul Impact Contact

Recipient Maul Impact Contact occurs when a player receives contact (usually defensive support players) at a maul or around the fringes of a maul.

For the purposes of complete understanding, the following characteristics of rugby have been defined using the International Rugby Boards Playing Charter (2005).

Tackle – A tackle occurs when the ball-carrier is held by one or more opponents and is brought to the ground.

Scrum - A scrum is formed in the field of play when eight players from each team, bound together in three rows for each team, close up with their opponents so that the heads of the front rows are interlocked. The front row is comprised of the loose-head prop, the tight-head prop and the hooker.

Maul – A maul occurs when the player carrying the ball is held by one or more opponents, and one or more of the ball-carrier’s team-mates bind on the ball-carrier. All players involved must be caught in or bound to the maul and must be on their feet and moving towards the goal line. Open Play has ended.

Ruck – A ruck is a phase of play where one or more players from each team, who are on their feet, in physical contact, close around the ball on the ground. Open play has ended.

2.4. Statistical Analysis

The data collected were frequency data and therefore non-parametric. All data were expressed as total observed frequency, median value and \pm range. Reliability, both intra- and inter-individual reliability were assessed using the method described in Hughes et al. (2002). Intra-individual reliability was 0.01% and inter-individual reliability was 0.8%.

3. Results

During the season forty players were selected to play in one or more of the 7 matches analyzed. The average age of these players was 23 years old. The forward players were on average taller (188 cm) and heavier (110 kg) than the backline players at 179 cm and 84 kg respectively (Table 1).

Table 1: Descriptive statistics of player characteristics (n = 40)

Player	Average Age (yrs)	Average Height (cm)	Average Weight (kg)
Backline Players (n = 18)	22 (min 19, max 31)	179 (min 170, max 197)	84 (min 72, max 99)
Forwards (n = 22)	23 (min 20, max 30)	188 (min 175, max 200)	110 (min 92, max 124)
Total (n = 40)	23 (min 19, max 31)	184 (min 170 max 200)	99 (min 72, max 124)

The season consisted of 19 weeks between February and May 2006. The first 5 weeks were pre-season training, the next 7 weeks were matches, then was a bye week before the final 6 matches, weeks 14 - 19 (see table 2).

Table 2: Playing Season of the 2006 Vodacom Cup Tournament.
(* - indicates matches that were filmed and analyzed.)

WEEK	OPPONENT	SCORE	Points For	Points Against
1	Pre-season	-		
2	Pre-season	-		
3	Pre-season	-		
4	Pre-season	-		
5	Pre-season	-		
6	* Mighty Elephants	26 – 17 (l)	17	26
7	* Lions	24 – 20 (l)	20	24
8	* Griquas	42 – 48 (w)	48	42
9	* Wildebeests	51 – 19 (l)	19	51
10	Valke	21 – 27 (w)	27	21
11	Pumas	14 – 15 (w)	15	14
12	Border	9 – 18 (w)	18	9
13	BYE			
14	Leopards	35 – 28 (l)	28	35
15	* Griffons	21 – 43 (w)	43	21
16	* Eagles	15 – 70 (w)	70	15
17	* Blue Bulls	45 – 35 (l)	35	45
18	Cheetahs	13 – 23 (w)	23	13
19	Boland	14 – 12 (l)	12	14
Average whole season			29	25
Average matches analyzed			36	32

Table 2 shows that the matches against the Elephants, the Lions, Griquas, the Wildebeests, the Griffons, the Eagles and the Blue Bulls were recorded and analyzed. The 7 matches were considered to be fairly representative of the whole season as the points difference between the 7 available matches (4) was very similar to the points difference for all the games over the entire season (4) (Table 2).

The team had an average of 386 impact contacts per game (min 307, max 535). The highest number of contacts that occurred in a game was 535, in match 4 against the Wildebeests (Figure 1). The lowest number of contacts that occurred in a game was 307, in match 3 against Griquas (Figure 1).

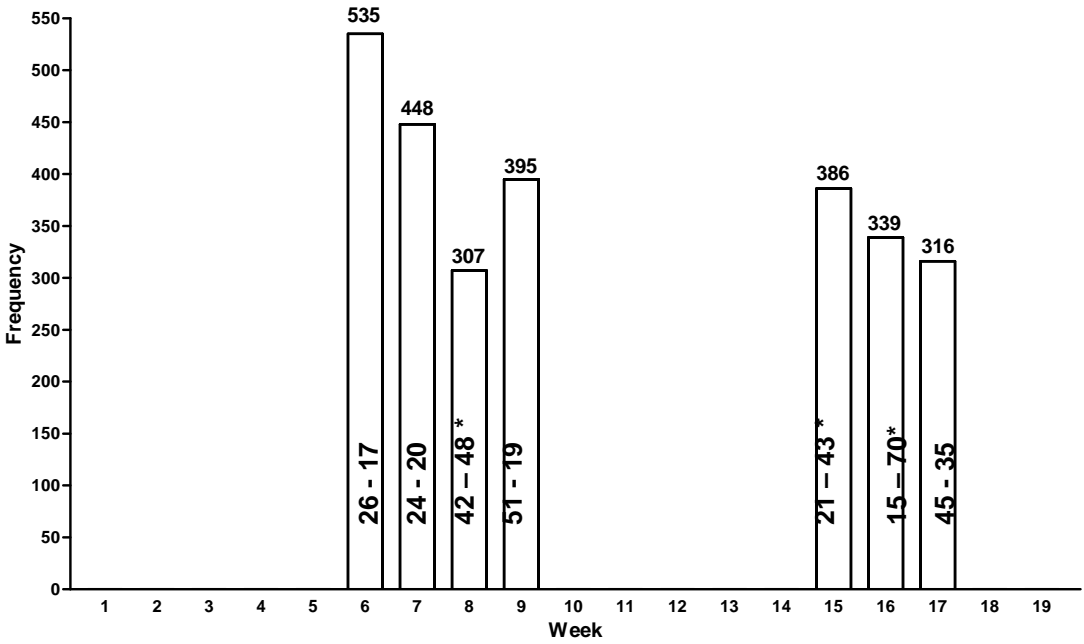


Figure 1: The Total Number of Impact Contacts observed per match along with the associated match score. * Represents a win.

Figure 2 shows the highest number of contacts experienced by a single player in each of the 7 games. Again the highest number is from the match played in week 6 and the lowest is from the game played in week 8. The highest number of individual contacts was recorded by one of the forwards in each of the 7 matches.

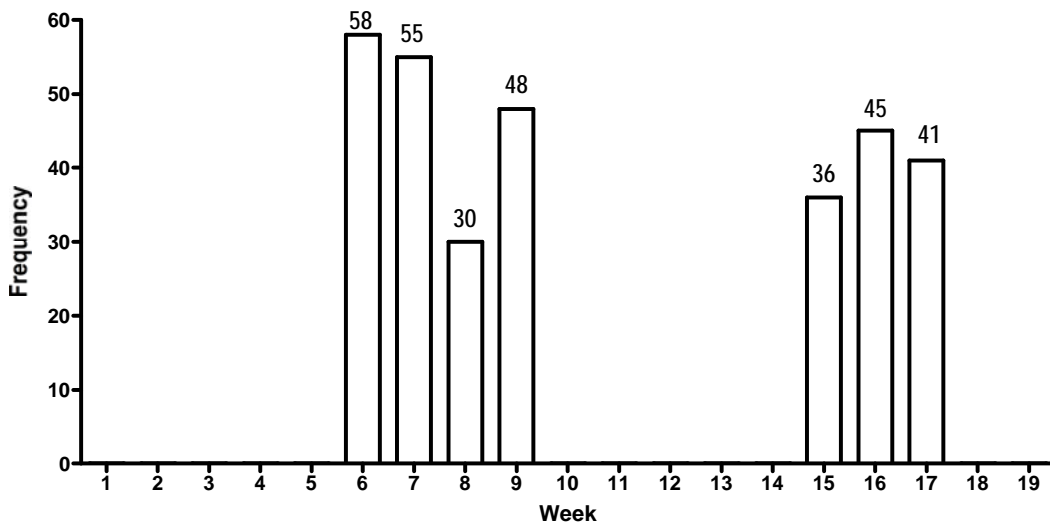


Figure 2: The Highest Number of Impact Contacts observed for a single player per match.

Figure 3a show that the forwards have an average of 257 impact contacts per game, whereas the backline players (Figure 3b) only have an average of 125 impact contacts (range 93 – 148). The highest number of impact contacts in a game for the forwards was 389 whereas the highest number a backline player was only 148, which is lower than the minimum number of impact contacts by the forwards in a game (199). Therefore, 68% of all impact contacts that occur during a match involve the forwards.

Figure 4 shows the various categories of Impact Contact and their total occurrence per match. When examining the whole team (Figure 4a), it is evident that the most contact that the players are involved in during a match is Ground Contact (108, range 70 - 133) followed by the Scrum Impact Contact (81, range 47 - 100) made by the forwards. Line-out Impact Contacts occur the least (2, range 1 - 4).

The forwards were involved in all ten categories of Impact Contact (Figure 4b). The most frequently observed impact contact was made at the scrum (an average of 81 per match with a range between 47 and 100) followed by impacts contacts that the players made with the ground (58 ground impacts per match, range 37 – 84). The forwards were involved in an average of 35 aggressor tackle impacts and 29 recipient tackle impacts (the range of data is 22 – 49 for the aggressor tackle impacts and 20 – 40 for the recipient tackle impacts). The average number of maul related impact contacts during a match was substantially less than the ruck related impact contacts (14 maul related impact contacts (9 aggressor (range 6 – 13) and 5 recipient (range 2 - 6)) vs. 48 ruck related impact contacts (31 aggressor (range 14 – 69) and 17 recipient (range 9 - 32))). In the majority of impacts, where the situation could be either an aggressor or recipient, the forwards of the analyzed team were more frequently observed as being the aggressor rather the recipient (see Figure 4b and compare the data for the aggressor vs. recipient for the tackle impact contacts, the ruck impact contacts and the maul impact contacts). The final two impact contact categories were the least frequently observed. The missed

tackle impact was observed on average 3 times per match (range 2 – 6) and the lineout impact contact was observed twice per match (range 1 – 4).

The backline players were observed in only 8 of the 10 impact contacts as they are not required to participate in either the scrum or in the lifting phase of the lineout (see Figure 4c). The most frequently observed impact contact was made with the ground (an average of 50 per match with a range between 33 and 66). The backline players were involved in an average of 29 aggressor tackle impacts and 31 recipient tackle impacts (the range of data is 17 – 34 for the aggressor tackle impacts and 24 – 37 for the recipient tackle impacts). The average number of ruck related impact contacts during a match was almost double the number of maul related impact contacts (8 ruck related impact contacts (3 aggressor (range 1 – 11) and 5 recipient (range 1 - 13)) vs. 4.5 maul related impact contacts (2.5 aggressor (range 2 – 3) and 2 recipient (range 1 - 4)). The average data for the impacts where the situation could be an aggressor or recipient, the backs of the analyzed team were equally observed as being either the aggressor of the recipient (see figure 4c and compare the data for the aggressor vs. recipient for the tackle impact contacts, the ruck impact contacts and the maul impact contacts). The final impact contact category was the least frequently observed. The missed tackle impact was observed on average 3 times per match (range 2 – 5).

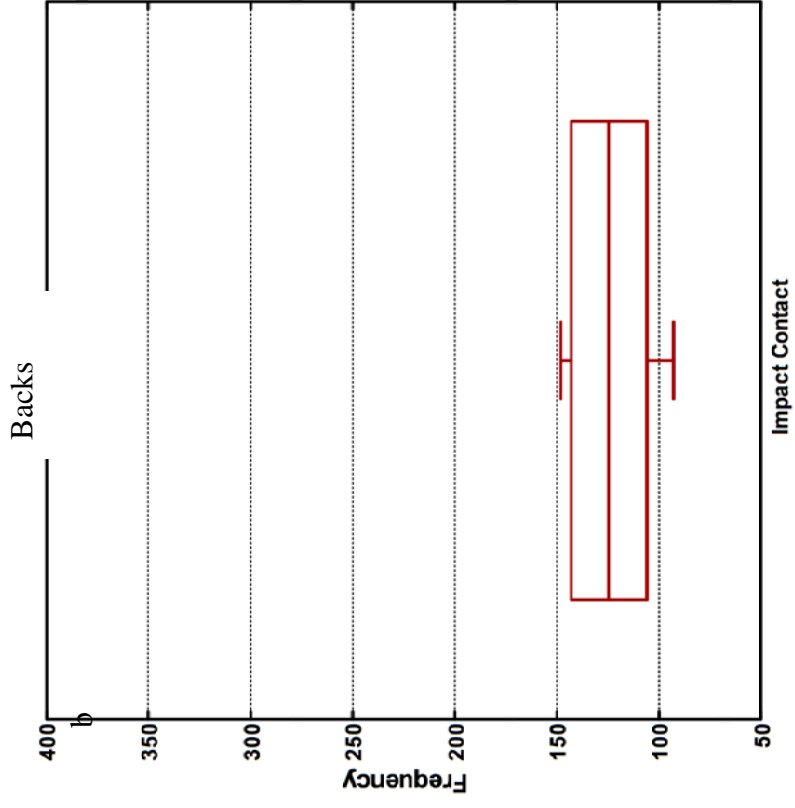
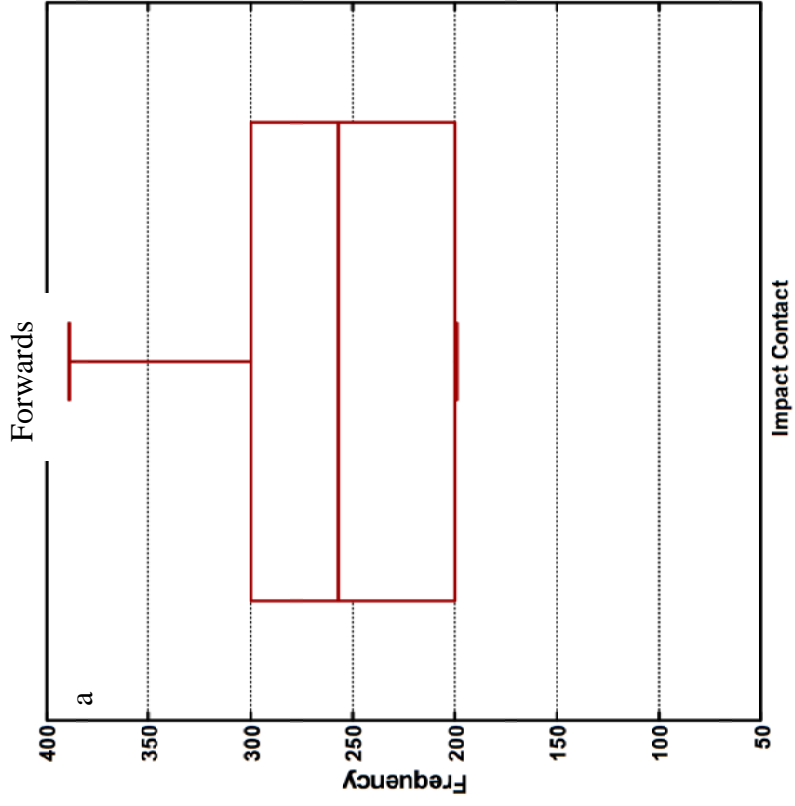


Figure 3: A box and whisker plots showing the median Total number of impact contacts observed for the forwards (a) and the backline players (b) over the matches ($n = 7$) analyzed and the range of total impact contact frequencies.

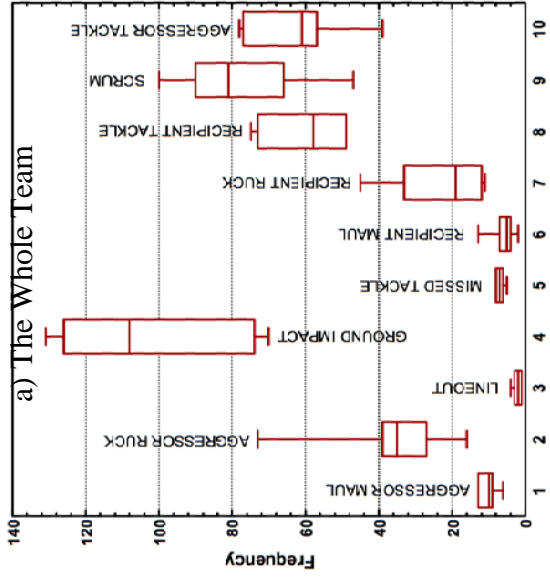
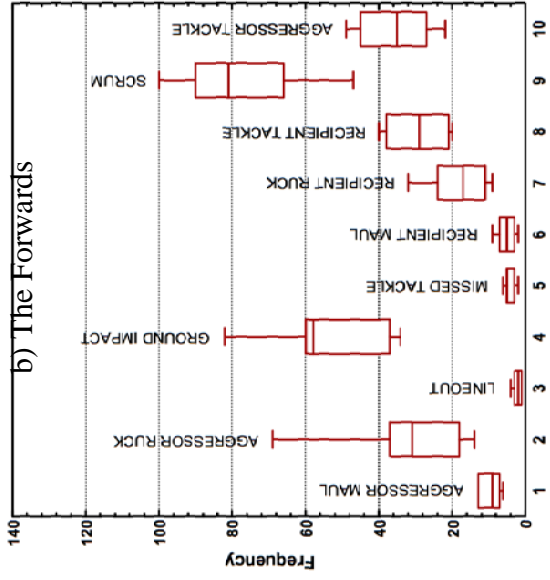
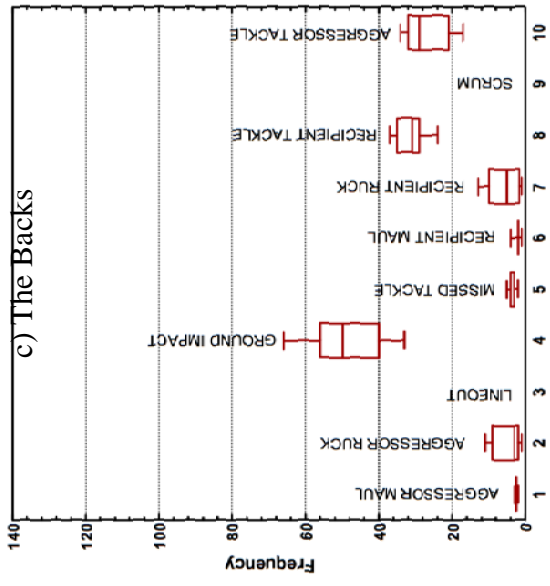


Figure 4: The average occurrence of the different impact contacts by the whole team (a), the forwards (b) and the backs (c) with the minimum and maximum observed frequencies.

There were differences for the average number of impact contacts when the data were expressed according to whether matches were won or lost. In 8 out of the 10 impact contacts there were more impact contacts observed when the match was lost as opposed to when the match was won (Figure 5). The remaining 2 impact contact categories (Aggressor Maul and Lineout contacts) were similar whether the matches were won or lost.

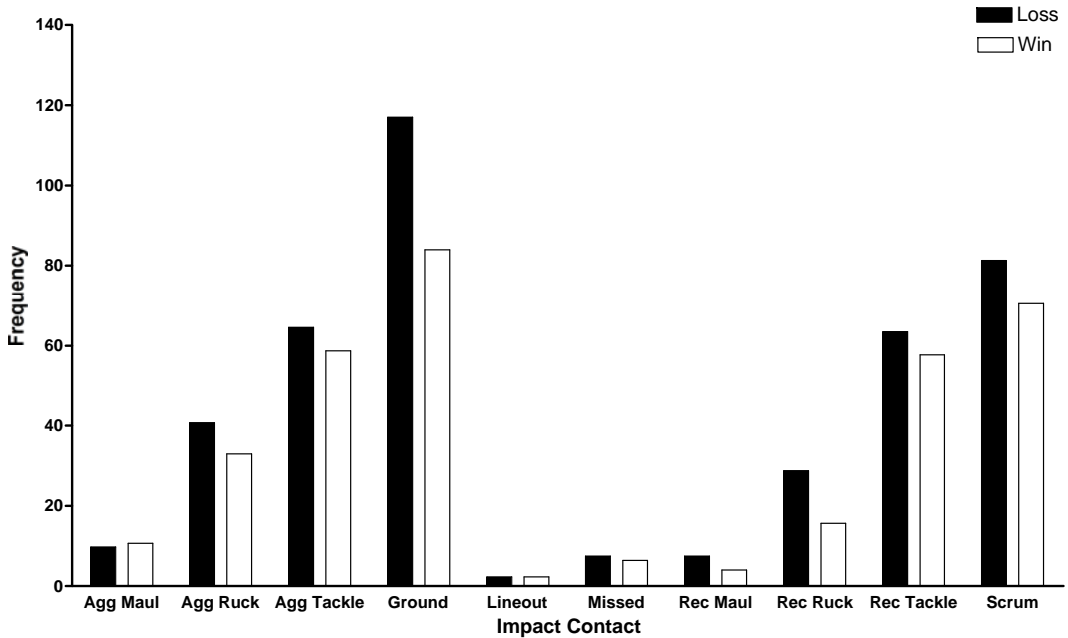


Figure 7: The mean number of Impact Contacts Observed during matches that were either won (n = 3) or lost (n = 4).

4. Discussion

The first finding of this study was that there were on average 386 impact contacts observed for the whole team per match. There was much variation (228 impact contacts) between the highest number of impact contacts (535 in match 4) and the lowest number (307 in match 3) of impact contacts observed over the seven different matches. The number of contacts from this study are significantly higher than the number of contacts data reported by Smyth *et al.* (1998), McKenzie *et al.* (1989) and Takarada (2003), who found an average of 63, 34 and 14 contacts per match respectively. However, these differences can be explained by the different methodologies used in the studies. Smyth *et al.* (1998) and McKenzie *et al.* (1989) described the technique of the ball carrier in a contact situation and how this related to ball retention. It is highly probable that their data correspond to the data for the recipient rucks (20), mauls (6) and tackle (60) situations of the current study. In addition it is also reasonable to suggest that Smyth *et al.* (1998) and McKenzie *et al.* (1989) reported the scrum situation as it was observed, not by the number of players that were involved in the impact contact, as documented by this study ($81/5 = 16$). If

these assumptions are accepted then the ball-in-contact situation reported for this study was 102. A comparison of the ball-in-contact data, between this study (102) and the studies of Smyth *et al.* (1998) (63) and McKenzie *et al.* (1989) (34) is more appropriate.

Takarada (2003) conducted a study into the contact situation with the emphasis on the tackle situation and muscle damage. The tackle situation in this study was not fully defined, although it could refer to the tackle described by the International Rugby Board (IRB 2005). The tackles were recorded if the player tackled or was tackled from in front (i.e. front-on). These data (Takarada, 2003) are partially comparable with the tackle data, the recipient and aggressor tackles observed in the current study. However, the current study does not differentiate between front-on, side-on or tackles from behind and this might be part of the reason that the data are so different (14 tackles per match from Takarada, (2003) and 124 tackles per match from the current study. Another reason for the difference could simply be due to the different playing styles of South African and Japanese rugby.

The second finding from this study was that the forwards were involved in 68% of all of the impact contacts. It was also noted that the highest value obtained for the backs (148) was lower than the lowest value recorded for the forwards (199). The average number of contacts made by the forwards during a match was 257, with only 83 of these impact contacts being directly related to set pieces that only the forwards participate in. It therefore means that the remaining 174 impact contacts that the forwards were involved in occurred in open play. These 174 open play contacts by the forwards represent 1.4 times the total number of impact contacts observed by the backline players. These findings are consistent with the positional profiles of forwards and backs in the literature. Duthie *et al.* (2003) states that the total work of the forwards is much greater than that of the backs, as the forwards spend a far greater amount of time involved in physical contact with the opposition than the backline players do. For example, the forwards took the ball into contact situations on average 51 times compared to the 11.1 times the backs carried the ball into contact (Smyth *et al.* 1998). Docherty *et al.* (1988) found that props spent 16% of their time competing for the ball, whilst the centres only spent 3.3 % of their time in similar activities. All of these findings are stating that the forwards are involved in substantially more contact related play than the backs are. This may have a substantial effect on the ability of the forwards to recover from matches if both players are allotted the same rest and recovery times.

The data tended to show that there were more impact contacts per match when the team lost than when they won. Further study would need to be conducted to determine whether this was a specific feature of the analyzed team or it was a true reflection of the performance of a losing team. Interestingly the recipient ruck and maul impact contacts were observed on average 50% more frequently when the analyzed team lost than when they won. This would suggest that the players are trying to play more of a running game in an attempt to score additional points. The likely result of this strategy is that the opposition is committing extra defenders to the ruck and maul situations to prevent the attacks from being successful. Players who have lost a game have therefore experienced a greater number of impact contacts than they would have done if they had won. Traditional training methods would suggest that extra training sessions during the

week might be required to correct the errors from the previous match and to prepare for the new match. This strategy can add further contact stresses to the players in addition to those they received in the game and those that they will receive during future matches. However the time between the matches remains constant irrespective of victory or defeat and this will also have a significant effect on player's recovery strategies.

In summary for the support staff to monitor and manage professional rugby players properly, they need to have an understanding of the complete physiological stress imposed on the players, not only during training but also during competitive matches. This study has provided definitions of the various impact contact situations that occur in rugby matches. Using these definitions support staff can quantify the contact experienced by the players or team during a match and therefore add to their understanding of the overall stresses imposed on that player or team. This understanding of the stresses imposed on individual players and teams can help coaches and management to better structure the intensity of training sessions and the allocation of recovery periods in order to prolong the playing careers of their rugby players.

5. Conclusions

This study clearly shows that there is a difference between the number of contact situations that the forwards and backline players are involved in during each competitive match. As Takarada (2003) has shown, rugby matches result in serious structural damage to the muscles, the extent of which was highly dependent on the number of tackles. Thus, other forms of contact are likely to also be related to muscle damage. This means that each week the forwards would experience greater muscle damage than the backs and this would largely contribute to an increase in their total physiological stress. Our recommendation is therefore that within a professional squad, the forwards and backs should not undergo a generic training program and that a monitoring system should be put in place in which the amount of contact experienced during the matches could be taken into account when developing the training program and the amount of recovery time.

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