Artículo original / Original Article

ANALYSIS OF PHYSICAL DEMANDS DURING ATTACKING DISPLACEMENTS FINISHED IN LAYUP, TWO-POINT AND THREE-POINT SHOTS

Análisis de las demandas físicas durante los movimientos de ataque finalizados en bandejas, tiros de dos puntos y tres puntos

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Abstract

The main aim of this study was describing physical demands variables at 5-man offense and fast-breaks finished in successful and unsuccessful shooting movements in basketball games. Physical (velocity and distance covered) and technical (two-point, three-point shoot and layups) parameters were quantified. The attacks were separated in 5-man offense and fast-breaks. For identification of 5-man offense beginning, was utilized criterions based on the positional information of players on court. The fast-breaks were considered all attacks that were not identified by the 5-man offense criteria. All velocity and distance covered data from offensive player were summed up in each attack, producing team's velocity and distance covered. Distance covered in 5-man offense with unsuccessful layups were significantly lower than the successful ones. In the comparison between 5-man offense and fast-breaks finished in two-point shots, both variables of the offensive teams were significantly higher for fast-breaks. Greater means also were observed at the distance covered and velocity for the fast-breaks finished with layups. Players need to perform higher distances in their offensive displacements for a better performance in layups actions. Given the greater variability of velocity observed in fast-break situations, a better physical conditioning, aimed specifically to player with constantly participations in these situations, with focus on the variability of its intensity is needed.

Key words: Physical demands; technical actions; 5-man offense; fast-break.

Resumen

El objetivo principal fue describir las variables de las demandas físicas en durante los ataques posicionados y los contraataques terminados en movimientos de tiro exitosos y no exitosos en juegos de baloncesto. Se cuantificaron los parámetros físicos (velocidad y distancia recorrida) y técnicos (los tiros). Los ataques fueron separados en ataques posicionados y contraataques. Todos los datos de velocidad y distancia recorrida del jugador ofensivo se hay sumado en cada ataque, produciendo la velocidad y la distancia recorrida del equipo. La distancia recorrida en lo ataque posicionado con las fallas de bandeja fue significativamente más baja que las exitosas. En la comparación entre los ataques posicionados y los contraataques terminados en tiros de dos puntos, ambas variables de los equipos ofensivos fueron significativamente más altas para los contraataques. También se observaron mayores medios de la distancia recorrida y la velocidad para los descansos rápidos terminados con las bandejas. Los jugadores deben recorrer distancias más largas en sus movimientos ofensivos para un mejor rendimiento en las bandejas. Dada la mayor variabilidad de la velocidad observada en situaciones de contraataques, se necesita un mejor acondicionamiento físico, dirigido específicamente a los jugadores con participaciones constantes en estas situaciones, con enfoque en la variabilidad de su intensidad.

Palabras clave: Demandas físicas; acciones técnicas; ataque posicional; contraataque.

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Sección / Section: Análisis del rendimiento deportivo / Performance analysis in sport

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Introduction

Some performance analysis investigations in basketball have reported many relevant information concerning the physical demands which players are submitted (Ben Abdelkrim, El Fazaa, & El Ati, 2007; Scanlan, Dascombe, Kidcaff, Peucker, & Dalbo, 2015; Scanlan, Dascombe, Reaburn, & Dalbo, 2012; Torres-Ronda, Ric, Llabres-Torres, de Las Heras, & Schelling I Del Alcazar, 2016). Based on the available literature, it is well known that player's physical demands in basketball are performed at intermittent intensities, with high intensity as sprinting and running being predominant during 16,1 % of the live time. On the other hand, displacements performed at moderate intensity represents 29,9 % of the live time, with predominance of low intensities during recovery situations, such as time-outs and free throws (Ben Abdelkrim et al., 2007).

The quantification of technical indicators during basketball games has also been an object of investigation by previous performance analysis studies. Some of these studies have analyzed the performance in basketball through discriminant analysis of technical variables such as two and three-point shots, free throws, offensive and defensive rebounds (García, Ibáñez, De Santos, Leite, & Sampaio, 2013; Garcia, Ibanez, Gomez, & Sampaio, 2014; Gómez, Lorenzo, Sampaio, Ibáñez, & Ortega, 2008; S. Ibáñez et al., 2008; Lorenzo, Gómez, Ortega, & Ibáñez, 2010; Sampaio, Janeira, Ibáñez, & Lorenzo, 2006). Particularly with studies that proposed a determination of winning and losing teams by using game related statistics, researchers have attributed the successful performance in 2-point field goal (Garcia et al., 2014; Gómez et al., 2008; Lorenzo et al., 2010) and assists (García et al., 2013; Gómez et al., 2008; S. Ibáñez et al., 2008) for winning teams when considering offensive actions (Lorenzo et al., 2010). Moreover, defensive rebounds also have been reported in literature as the most important defensive action to perform in order to be successful in the game (García et al., 2013; Gómez et al., 2008). Among these technical variables studied, the shooting performance has received greater attention to performance analysis literature, due its importance in process of achievement of sportive success (S. J. Ibáñez, García, Feu, Parejo, & Cañadas, 2009). There are also other studies with performance analysis in basketball which have tried finding relationships between shots efficacy and other variables such as fatigue (Mulazimoglu, Yanar, Tunca Evcil, & Duvan, 2017), defensive pressure (Csataljay, James, Hughes, & Dancs, 2013) and anthropometric and physical characteristics of players (Gomes et al., 2017) . Given the increased investigation of physical demands during basketball games in several conditions and situations (Conte et al., 2015; Scanlan, Tucker, et al., 2015) its seems reasonable consider that physical demands also have an important participation in the offensive displacements, which could influence the shooting efficiency. Therefore, these game situations are considered an important aspect to be explored for a better understanding about physical demands of teams with better shooting performance.

In the literature concerning the performance analysis in team sport, it has been found studies that relates technical and running performance (Mangan, Ryan, et al., 2017; Ross, Gill, & Cronin, 2014; Vickery et al., 2016). For instance, the studies from (Mangan, Malone, et al., 2017) have reported a lower distance covered by the team who has a better performance at direct passes in Gaelic Football. The investigation of physical demands in association with technical indicators have a great potential to provide information for coaches and support staff for improvement of the athlete's performance. These analyses receive a greater importance when it is applied during offensive moments of the game, because it is the moment when players are planning and executing their most variety of their offensive displacements. So, it seems important understand the running displacements of players performance during successful and unsuccessful 5-man offensive and fast-breaks in basketball matches. Some of the current available in literature have highlighted the importance in associate technical indicator and values of running performance in competitions game settings (Filetti, Ruscello, D'Ottavio, & Fanelli, 2017; Wisbey, Montgomery, Pyne, & Rattray, 2010). Besides of many studies proposed the quantification of running performance and technical indicator in several modalities (Barnes, Archer, Hogg, Bush, & Bradley, 2014; Clarke et al., 2017; Hoppe, Slomka, Baumgart, Weber, & Freiwald, 2015; Rampinini, Impellizzeri, Castagna, Coutts, & Wisløff, 2009; Ross et al., 2014; Vickery et al., 2016), there is a few quantity of studies

which have tried a relationship between running and technical performance (Filetti et al., 2017; Mangan, Ryan, et al., 2017), or even data analysis concerning the 5-man offense and fast-break situations, which is an important aspect of offensive performance in team sports with high quantity of displacements, as in basketball. Based on that, it seems that describing the physical demands by velocity and distance covered analysis in attacking situations with different sorts of finalization would be an interesting contribution to know how players are submitted in terms of physical demands considering their to shooting performance.

Therefore, the main aim of this study was describing physical demands variables at 5-man offense and fast-breaks finished in successful and unsuccessful shooting movements in basketball games. The specific aims were: 1-) Verify if there is significant difference at physical demands between 5-man offense and fast-breaks finished in successful and successful shooting movements, 2-) Verify if there is significant difference at physical demands between 5-man offense and fast-break situations.

Methods

Six basketball official games videos were used in the present study. From these six studies, there were found 510 situations of 5-on man offensive and 59 fast-breaks. The games studied are from the 2011/2012 season of first division of “Novo Basquete Brasil” championship (NBB). The games were filmed, which were measured the positional data of the players. Ethics committee of university approved the research (n° 19787213.1.0000.5404) and all subjects involved gave their consent by signing their respective consent terms. All the games were filmed at gymnasium of the home team. Were used four digital cameras (JVC GZHD10, 30 Hz), positioned at 12-meter high at the gymnasium’s corners, having each pair of cameras framing a half of the court. The video frequency where data were collected was 7.5 Hz (Barros et al., 2011, 2007; Misuta, Menezes, Figueroa, Cunha, & Barros, 2005)

The Dvideo® software was used for the calibration of the videos, temporal synchronization, 2D reconstruction and the measures of position over time, by using videogrametry analysis. The videos were calibrated using a 16-point reference system, which values were based on real coordinates, defined by the intersectional lines on the court. The temporal synchronization was performed by cutting the video at the frame with an event registered by the four cameras at the same time. The coordinates measures procedure was obtained by manual tracking performed by Dvideo® system expert operators, which were trained how to use the software. The criterion adopted for the player's position was the middle point between player’s feet on the court. Then, the values of computer screen coordinates were transformed by using Direct Linear Transformation (DLT) method. The player's position (2D coordinates) were smoothed using **Low-Pass Butterworth Filters** (fourth order and 0.2 Hz cutoff frequency).

Physical and Technical parameters quantification: MatLab® Software was used to develop algorithm for the treatment and quantification of physical and technical parameters of the players during the games. The physical demands parameters calculated were the velocity and distance covered of players during the game. The velocity data were obtained from the derivation of time-position curve, and distance covered was calculated as cumulative sum of the player displacement considering two successive frames. Technical parameters performed by the teams were quantified in each 5-man offense. The parameters collected were the two-point shoot, three-point shoot and layups (succeeded and unsuccessful). We used the scouting mode of Dvideo® software in order to register the actions. The scouting process registered the layups, two-shots and three-shots actions, classified in successful or unsuccessful results.

Identification of 5-man offense and fast-breaks: The attacks were classified as 5-man offense and fast-breaks. The 5-man offense classification was based on the positional information of players on the court. The beginning of the positioned attack was defined as the instant when the player with the ball possession cross the half-court line and the five defensive players are in front of player with ball possession, as described at the figure 1. The fast-breaks classification consists of all offensive attacks ended at shooting or layups actions that were not classified as 5-man offense attack. The velocity and distance covered data from the five players of offensive team were registered to calculate the velocity and total distance covered mean values.

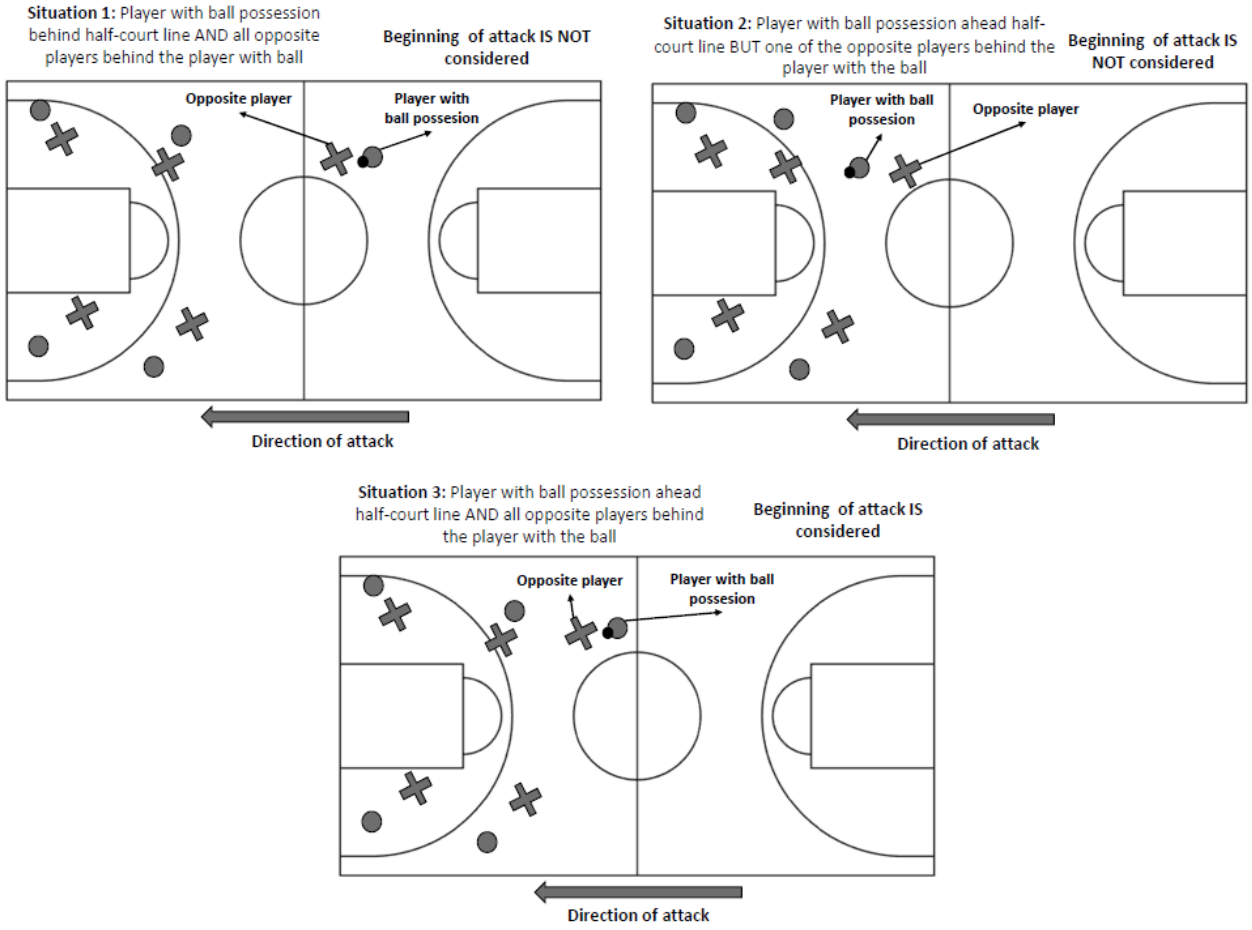

Figure 1: The criteria used for identification of 5-man offensive beginning.

Statistical analysis: The values of distance covered and velocity are expressed as mean (SD) of the sum of five players from offensive and defensive teams. For the verification of data normality, the test of Kolmogorov-Smirnov (Massey, 1951) was used. The Mann-Whitney test (Hollander, Wolfe, & Chicken, 2013) were used in order to verify the differences velocity and distance covered between succeeded and unsuccessful attacks (terminated in two-point, three-point-shoots and layups), and the differences of velocity and distance covered between 5-man offensive and fast-breaks (terminated in two-point, three-point-shoots and layups). The test was also used to verify the differences between successful two-point attacks (shoots and layups) and tree-point attacks. The significance level was set at $p < 0,05$. For the graphical data, firstly was calculated the mean curve based on all plotted curves of velocity performed by the players in each attacking situation observed, as illustrated in figure 2. Then, there was made an interpolation procedure in order normalize the values of velocity, generating all vectors of velocity with the same size.

Results

Considering the attacks analyzed (n = 569), 90% were 5-man offense and 10% were fast-breaks. Among the attacks ended in offensive actions, 43,3 % were two-point shots (46,7% succeeded 53,2% unsuccessful). The three-point attacks represented 36,2% of the total attacks, 34,0 % succeeded shoots and 66,0% unsuccessful shoots. Layups were represented in 20,5% of the total attacks, being 57,3% unsuccessful and 42,7% succeeded attacks. The data of physical demand obtained in 5-man offense are described in the table 1, whereas the physical demand of fast-breaks is described in the table 2. The analyzed results refer to the mean of distance covered, and velocity performed by offensive team during 5-man offense and fast-breaks situations. The distribution of the velocity and distance covered over time of attack situations are illustrated at figures 3 to 7.

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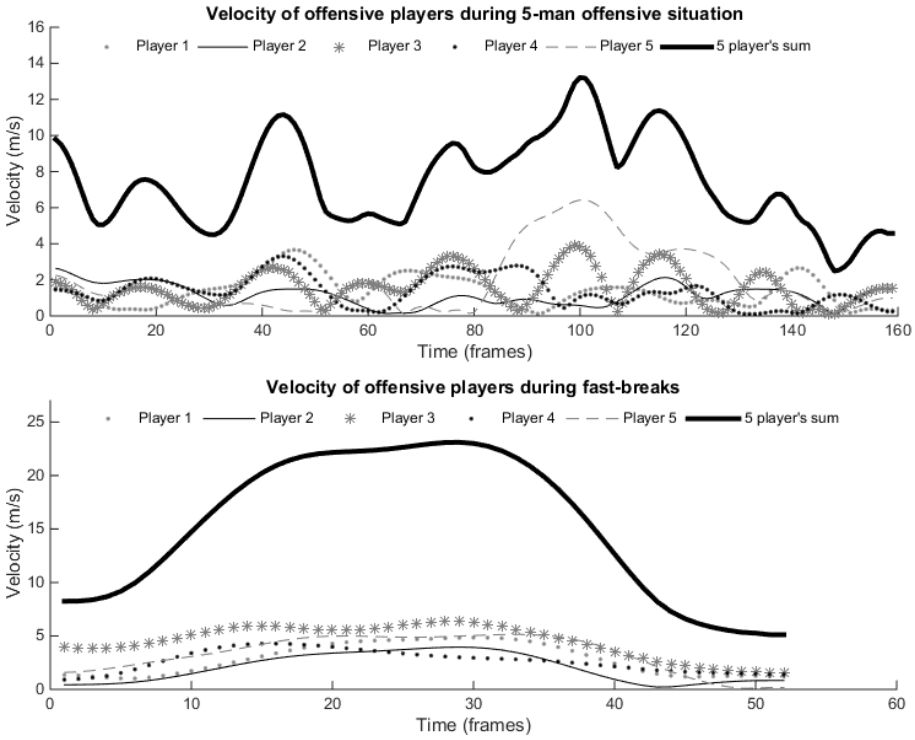

Figure 2: Representation of velocity dynamics during 5-man offense and fast breaks situations

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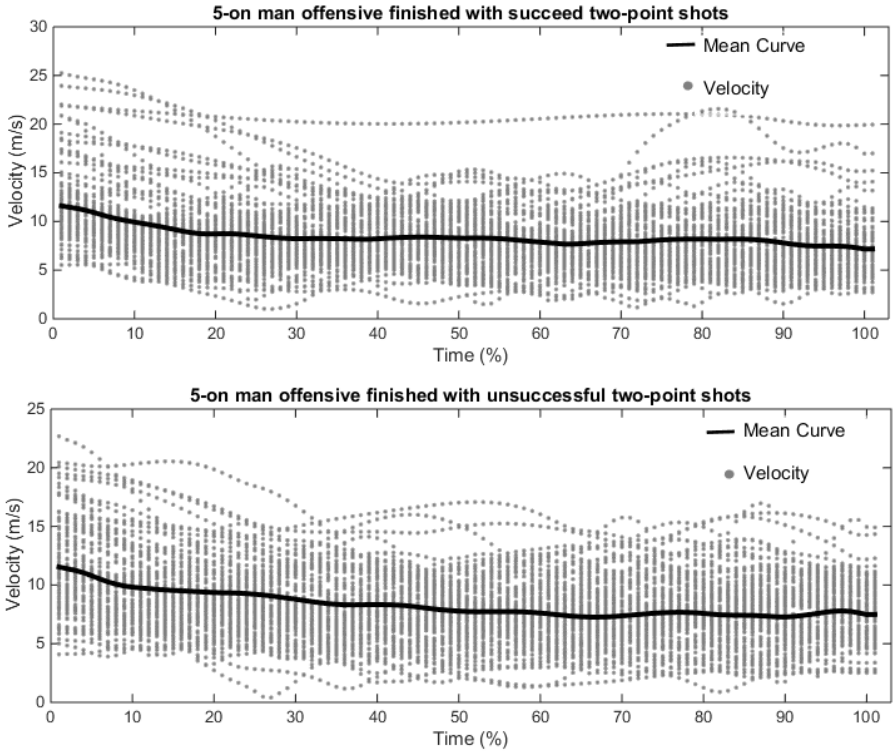

Figure 3: Sum of velocity of five offensive player during 5-on man offensive finished with two-point shots.

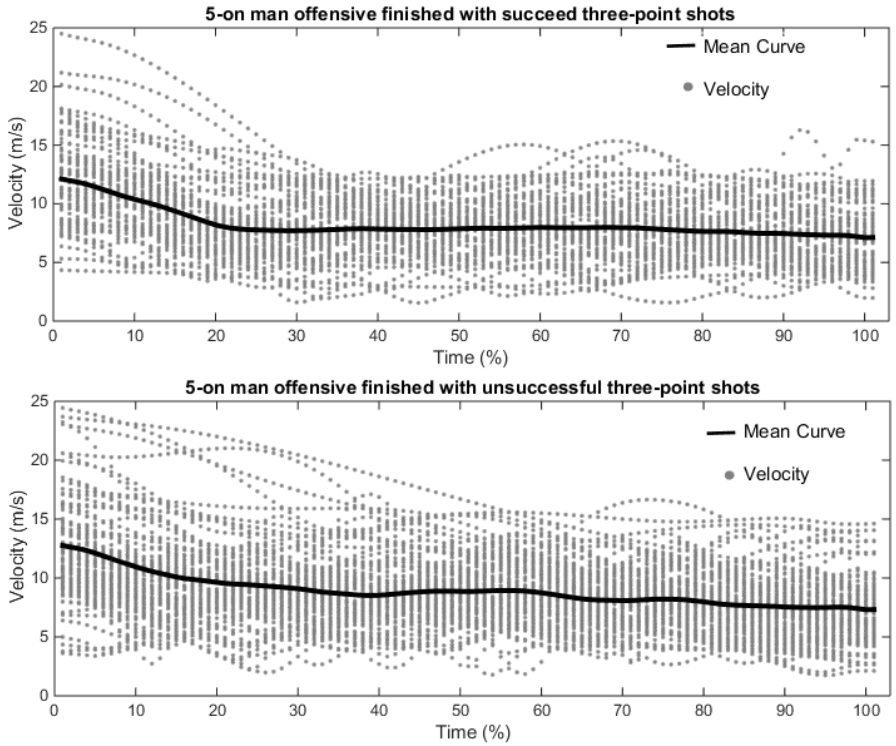

Figure 4: Sum of velocity of five offensive player during 5-on man offensive finished with three points.

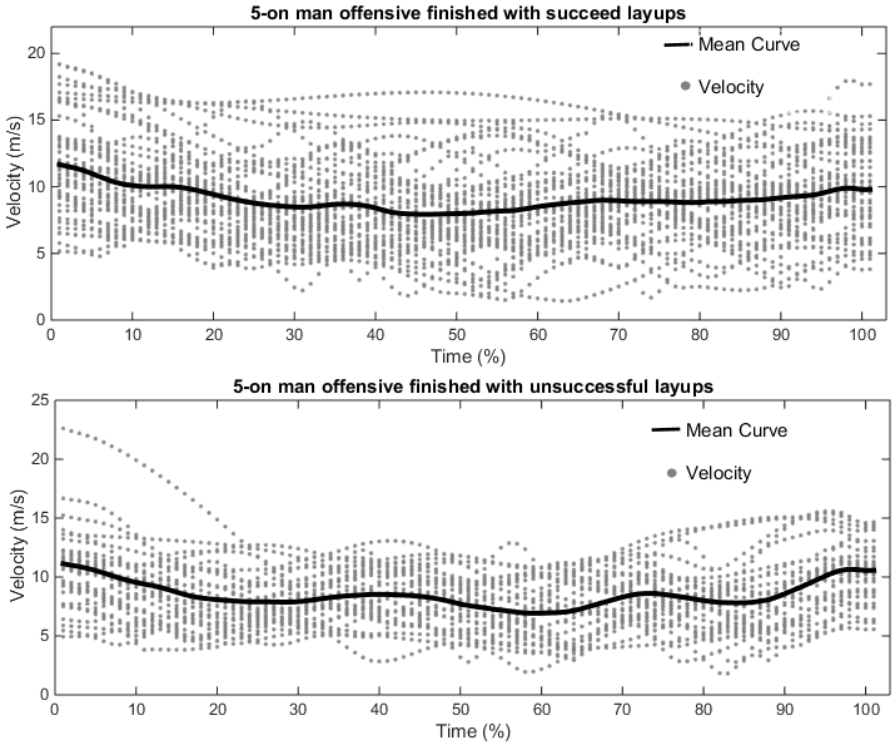

Figure 5: Sum of velocity of five offensive player during 5-on man offensive finished with layups.

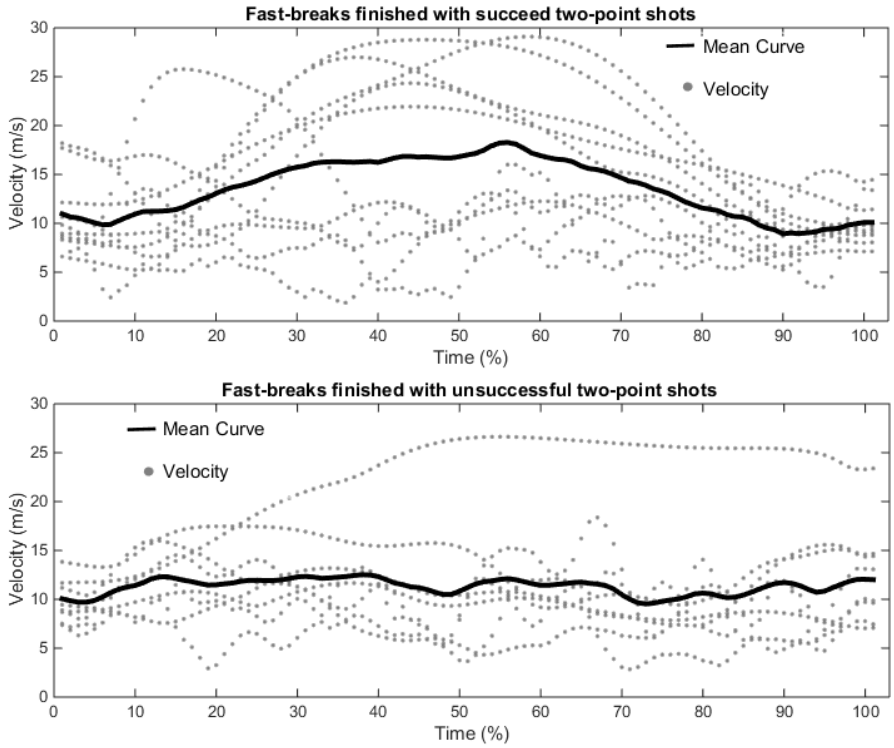

Figure 6: Sum of velocity of five offensive player during fast-breaks offensive finished with two-point shots.

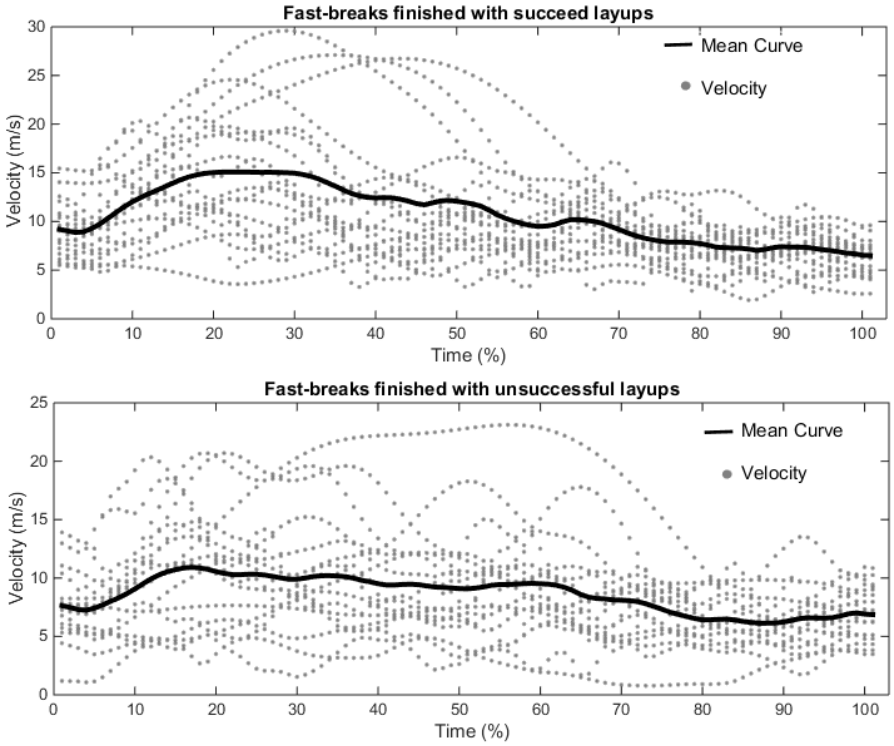

Figure 7: Sum of velocity of five offensive player during fast-breaks offensive finished with layups.

Table 1: Mean (SD) of offense team's distance covered (m) and velocity (m/s) during different 5-man offense situations.

5-man offense					
Offense team's distance covered (m)			**Offense team's Velocity (m/s)**		
2 points			**2 points**		
Succeeded	**Unsuccessful**	**Total**	**Succeeded**	**Unsuccessful**	**Total**
78,7 (32,8)	75,9 (30,7)	77,2 (31,6)	8,4 (2,33)	8,3 (1,7)	8,3 (2,0)
3 points			**3 points**		
Succeeded	**Unsuccessful**	**Total**	**Succeeded**	**Unsuccessful**	**Total**
73,7 (31)	71,6 (31,2)	73 (31,0)	8,1 (1,8)	8,8 (2,0)	8,6 (1,9)
Layups			**Layups**		
Succeeded	**Unsuccessful**	**Total**	**Succeeded**	**Unsuccessful**	**Total**
77,9 (36,5) *	68,1 (24,4)	73,8 (32,2)	9,0 (2,0)	8,4 (1,61)	8,7 (1,9)
2pt + 3pt + layups			**2pt + 3pt + layups**		
Succeeded	**Unsuccessful**	**Total**	**Succeeded**	**Unsuccessful**	**Total**
76,3 (33,3)	73,8 (30)	62,21 (25,4)	8,4 (2,1)	8,5 (1,8)	7,1 (1,6)

* Significant difference (p<0,05) to the unsuccessful attacks.

Table 2: Mean (SD) of offense team's distance covered (m) and velocity (m/s) during different fast-break situations.

Fast-breaks					
Offense team's distance covered (m)			**Offense team's Velocity (m/s)**		
2 points			**2 points**		
Succeeded	**Unsuccessful**	**Total**	**Succeeded**	**Unsuccessful**	**Total**
159 (66,6)	118,3 (64,4)	139,5 (68,0) **	10,7 (3,0)	8,6 (2,7)	9,6 (3,0) **
3 points			**3 points**		
Succeeded	**Unsuccessful**	**Total**	**Succeeded**	**Unsuccessful**	**Total**
-	-	-	-	-	-
Layups			**Layups**		
Succeeded	**Unsuccessful**	**Total**	**Succeeded**	**Unsuccessful**	**Total**
160,5 (88,7)	138,8 (74,1)	150 (80,6) **	13,6 (4,4)	11,3 (4,5)	12,5 (4,5) **
2pt + 3pt + layups			**2pt + 3pt + layups**		
Succeeded	**Unsuccessful**	**Total**	**Succeeded**	**Unsuccessful**	**Total**
157,9 (73,2)	124 (67,0)	143 (71,8)	11,7 (3,7)	9,5 (3,5)	10,6 (3,8)

** Significant difference (p<0,05) to the 5-man offense attacking situation.

Discussion

The main aim of the present study was describing physical demands variables at offensive displacements and fast breaks finished in successful and unsuccessful shooting movements. Focusing on the charts presented, we may acclaim that the physical demands presented a higher variability during fast-breaks than at 5-man offense situations, as for succeed and unsuccessful conclusions. Among the different sorts of finalization of 5-man offense analyzed, the unsuccessful layups finalization curves presented the most intense variability. For the other types of finalization (two and three points), both curves of velocity have presented more stability. Indeed, 5-man offense situations don't present great variation of velocity due mainly on the restrict court's area available for players increase velocity, producing movements with short displacements durations (Matthew & Delextrat, 2009). Studies have reported the predominance of 57% of total number of displacements distances covered with 1-5 m range, and mean of duration up to 3s for the majority of high intensity movements (Ben Abdelkrim et al., 2007; Conte et al., 2015). On the other hand, during Fastbreak situations, which often is performed in full court, presents a great requirement of high intensity movements (Klusemann, Pyne, Foster, & Drinkwater, 2012). This difference of playing court area during the performance of displacements may have substantial influence on the higher variability of fast-break's curves than 5-man offensive's ones. Another factor that could be associated to the higher variability of curves is the lack of involvement of some players, in terms of physical efforts, during fast-breaks, considering that the fitted curve is a representation of the sum of 5 player's velocity/distance covered, and that in basketball there is an strong incidence of several situations of numerical superiority, having the 1 on 1, 2 on 1, 1 on 0, 3 on 2 and 4 on 3 as the most commons in basketball (Evangelos, Alexandros, & Nikolaos, 2005; Monteiro, Tavares, & Santos, 2013).

We also aimed verifying any significant difference at physical demands between 5-man offense and fast-breaks finished in successful and successful shooting movements, and between 5-man offense and fast-break situations. In the comparison between successful two-points shoots and three-points shoots 5-man offense, there weren't found any significant difference, as well as in the comparison between successful and unsuccessful 5-man offense finished with two-point shots and between successful and unsuccessful 5-man offense finished with three-point shots. However, the distance covered by players in attacks finished in unsuccessful layups were lower than attacks finished with successful layups (68,1 ± 24,4m e 77,9 ± 36,5, respectively). These differences suggest that for an efficiency in shoots performance there is needed that players get closed to the basket during their offense moments, requiring constantly displacement of players and the use of ball screens. Indeed, the study of Gómez et al., (2015) demonstrates the importance of dribbler's and screener's displacements for a better effectiveness to get succeed in the ball possession, due it possibility of create more space and more tactical variability for dribbler's actions. So, the greater values found for distance covered in successful layups shows how important is perform constantly organized displacements during 5-man offense for a successful attack, considering that the team with ball possession needs creating spaces at the opponent defense, increasing the chances of an effective infiltration, and then, perform offensive action with better efficiency.

The similarity founded in the means at two-point and three-point attacks, for both succeeded and unsuccessful attacks may indicate that the offensive displacements of the players tend to have similar physical demands regardless of shoots efficiency. However, when attacks with two-point and three-point shots were compared, we expected that the values of physical demands could be different for successful and unsuccessful attacks. This would be feasible, because for a better development of attack, it would be required a longer displacements, demanding greater levels of physical demands, due the fact of quality of attack being related to the capacity of tactical variation through constant movement provide the offensive players better conditions in decision making process (Angel Gomez, Lorenzo, Sampaio, Ibanez, & Ortega, 2008). The similarity of means in these situations indicate that these offensive displacements may have being performed at the same intensity level.

In the comparison between 5-man offense and fast-breaks finished in two-point shots, both variables of distance covered (77,2 ± 31,6m e 139,5 ± 68m) and velocity (8,3 ± 2m/s e 9,6 ± 3m/s) of the offensive teams were significantly higher for fast-breaks. Greater means also were observed at the distance covered (73,8 ± 32,2m e 150,2 ± 80,6m) and velocity (8,7 ± 1,9m e 12,5 ± 4,5m) for the fast-breaks finished with layups. Considering that, accordingly to Evangelos et al. (2005), that the "2 on 1" and "3 on 2" are the most frequently fast-break situation found in basketball, fast-breaks demands higher volumes and higher intensities, due the necessity of players performs highly intense displacements – frequently with an opposite player - at the defensive baseline to offensive zone, during offensive transitions, making general physical efforts performed by players during fast-breaks being higher than positional attacks.

Conclusions

Considering the lower values of distance covered at 5-man offense finished with unsuccessful layups compared to the succeed ones, it may conclude that players needs to perform higher distances in their offensive displacements when it is desirable to have a better performance in layups actions. The great variability of physical demands seems to be more frequently observed during fast-breaks than 5-man offensive situations, leading us to considering a better physical conditioning, aimed specifically to player with constantly participations in these situations, with focus on the variability of its intensity. Besides, an individual analysis of physical demands during offensive displacements is also presented as an interesting perspective to be explored in the relationship between physical performance and shoots effectiveness.

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