Proceeding

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Offensive performance in soccer through lag sequential analysis: The case of a team in the Spanish Second Division-A

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ABSTRACT

We evaluated the attacking play of a Spanish Second Division-A soccer team (10 league matches). The observational method of *Lag Sequential Analysis* was used, with exhaustive mutually exclusive categories based on set criteria. From a retrospective perspective, mean length values were detected for the patterns of the LW, RMIF and GK players (max-lag = -3); short for LMIF (max-lag= -1), LI and LC (max-lag = -2) and long for FOR (max-lag = -5) and LB, RC and RW (max-lag= -4). The prospective perspective revealed mean lengths for RB, RC and CI (max-lag = 3) and short for GK, RMFI and FOR (max-lag = 2). The long patterns correspond to the SSTR, RW, LW and LB players (max-lag =4) and MCI (max-lag =5). The greater relationships between players, in both perspectives, were generated between the full-backs (RB and LB) and the wingers on their side (RW and LW). For the center-backs (RC and LC), the priority relationships are with the other defensive players on their team. The midfielders (RMIF and LMIF) did not show any bifurcations, complementing each other, since when one acts in the retrospective perspective, his partner does so in prospective. It was observed that the chances of winning grow as the number of shots at goal increases, or the chances of losing decrease. We confirm that Lag Sequential Analysis provides detailed, useful

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information about attacking play in soccer. **Key words**: OBSERVATIONAL ANALYSIS, SOCCER, SEQUENTIAL ANALYSIS, OFFENSIVE PERFORMANCE.

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INTRODUCTION

Soccer is a team sport in which two teams of eleven play against each other, establishing a constant confrontation over possession of the ball with the aim of getting it into the opposite team's goal as many times as possible and avoiding it entering their own. In any sport, performance analysis is a fundamental tool for success. The collection of information during the competition is the starting point for appropriate planning of training and future games (Lago, 2008).

Throughout the match, the teams alternate two patterns of play or behavior continuously throughout the game (Gréhaigne, 2001): attacking and defensive. Attacking, or offensive, play has been the main objective of research that has analyzed this sport from a tactical or strategic point of view. The offensive phase is the one that encompasses all the actions carried out by a team to try to retain possession of the ball and progress towards the opposite team's goal with the aim of scoring a goal (Sánchez-Flores, 2014). It starts when the ball is put into play (kickoff, goal kick, throw-in, etc.) or possession of the ball is regained. It ends when a goal is scored, a violation is committed, or possession is lost.

In socio-motor sports such as soccer, each confrontation is characterized by constant dynamic interactions between the players of both teams (Araújo, Duarte, Davids and Hristovski, 2006; Lames and McGarry, 2007; Duarte, Araújo, Folgado, Esteves, Marques, and Davids, 2013; Couceiro, Clemente, Martins, and Machado, 2014; Stöckl, Plück, and Lames 2017). The game could be interpreted as a complex network with a changing structure and topology, where the flow of actions does not remain stable (either in time or in space). From this point of view, players, like the nodes of a network of these characteristics, interact numerous times and in a non-linear way, using the ball as a connecting element as they try to beat their rivals through constant mechanisms of self-organization, where the degree of predictability is low even though the actions respond to a previously established underlying behavior (De Saá-Guerra, Martín-González, Arjonilla, Sarmiento, Rodríguez-Ruiz and García-Manso, 2003; Garganta, 2009; Pena and Touchette, 2012).

The first methodological strategies of performance analysis were taken from individual sports, in which technical and biomechanical criteria were determining factors. However, when applied to team sports these models do not provide an in-depth understanding of the internal logic of the game. If we accept the argument that performance in soccer is the result of a complex interrelation of multiple variables, an analysis of these characteristics would prevent us from understanding all the complexities of the game (Garganta, 2000).

Nowadays, different methods are available (*Data Modeling*, *Data Mining*, *Information Visualization* and *Visual Analytics*) that make it possible to extract information, analyze and diagnose the effectiveness of the different phases of the game and the influence that each of them has on the final result of the match (Stein, Janetzko, Seebacher, Jäger, Nagel, Hölsch, Kosub, Schrek, Keim and Grossniklaus, M., 2017). The applicability and usefulness of these methods has been enhanced by the quality of data available from each game and the technological advances in monitoring (Castellano, Perea, Alday, and Mendo, 2008; Arriaza and Zuñiga, 2016).

One of the most common strategies used in recent years has been the observational method (Anguera, 1990; Anguera and Blanco, 2003; Anguera, Hernández-Mendo, 2015) and the possibilities provided by the technique known as *Lag Sequential Analysis* (Bakeman and Gottman, 1997; Castellano and Mendo, 2000; Silva, Sánchez Bañuelos, Garganta and Anguera, 2005; Barreira, Garganta, Castellano, Prudente, and Anguera, 2014.). Observation of the behaviors and events that take place during the game makes it possible to systematize and specify the interactions between team members and evaluate explanatory variables about

what happened during the game. From these, we can establish what is really important and discard what has no direct significance or is simply not fundamental for what we wish to study.

The aim of this study is to analyze, through Lag Sequential Analysis, the attacking play shown by a professional Spanish soccer team in Second Division-A in official matches, in which they played at home.

METHOD

To carry our this study, we used an observational method through an active, non-participant observation process, in which the categories of each of the set criteria are exhaustive and mutually exclusive; (Anguera, 1990; Anguera, and Blanco-Vilaseñor, 2003; Anguera, and Hernández-Mendo, 2015). According to the structure proposed by Anguera, Blanco, Hernández-Mendo and Losada (2014), the work would be situated in Quadrant IV, which includes it among Nomothetic (home team and its rivals), Monitoring (10 Second Division-A matches against different rivals) and Multidimensional (dimensions explained in the criteria of the observation instrument) studies. In the case of motor interactions, the results are shown by lag sequential analysis. Lags are represented in both the retrospective (moments prior to participation) and prospective (moments after participation) modes. Lag levels range between R -5 and +5, not considering 0 lag as belonging to the behavior of the evaluated player.

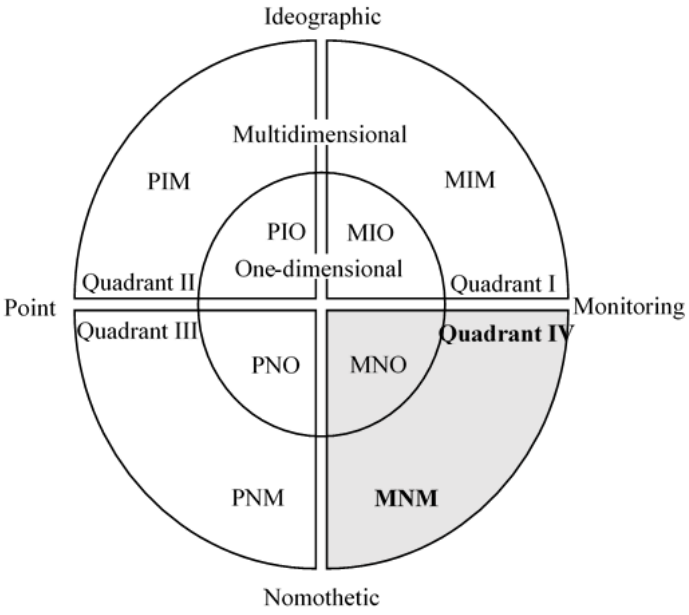


Figure 1. Graphic representation of the eight observational designs, from the superposition of the Units of the study criteria (represented by the vertical diameter), Temporality (represented by the horizontal diameter) and Dimensionality (represented by the concentric circles). There are eight areas, which correspond to the eight observational designs. Adapted from Anguera (2011).

Participants

Spanish professional soccer is structured into different categories (First Division and Second Division-A) with a regular competition system (leagues with a double round-robin system). For the study, 10 randomly

selected Second Division-A matches were analyzed, in which the observed team played at home against ten different rival teams from the same category (results: 4 won; 5 tied; 1 lost). The games were recorded with a professional camera to obtain a wide view of the playing field and so that the maximum number of players were visible in the image at all times.

Table 1. Observation tool with identification of the criteria and the different categories.

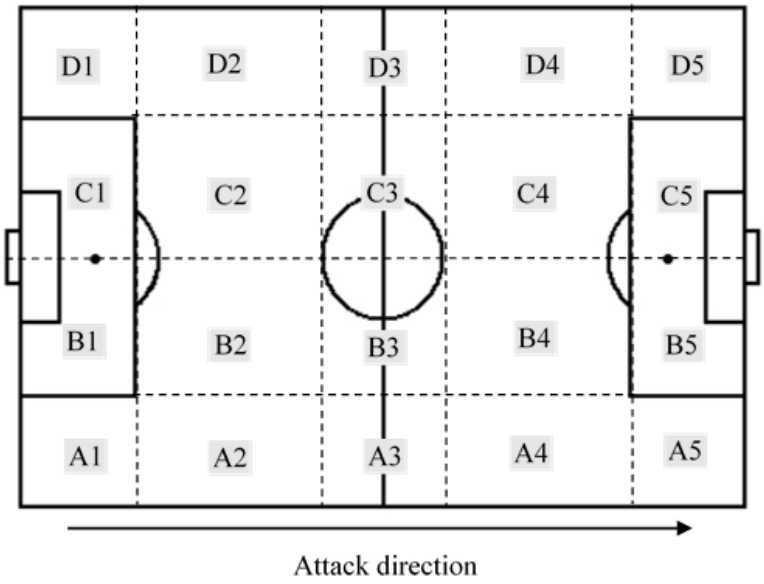
INSTRUMENT OF OBSERVATION

Criteria	Category	Code	Criteria	Category	Code
Team	Local Team	A	**Player**	Goolkeaper	GK
	Away Team	B		Left back	LB
Subrol start play	Kick Off	KO		Right back	RB
	Throw In	TI		Centre right	CR
	Goal Kick	GK		Centre left	CL
	Free Kick	FK		Right midfielder	RMIF
	Off Side	OS		Left midfielder	LMIF
	Corner Kick	CK		Right winger	RW
	Penalty Kick	PK		Left winger	LW
Subrol end play	Goal	GOA		Second striker	SS
	Throw of	TO		Forward	F
	Botton line	BL	**Actions with ball**	Pass	PAS
	Fault	FA		Driving with the ball	DWB
	Off side	OS		Recovery	REC
	Go through the end line	GTEL		Exchange of the ball	EOB
	Penalty kick	PK		Throws	THR
				Clearance	CLE
Numerical proportion	Numerical Equality	NE	**Places of game**	4 Horizontals and 5 Verticals (To see figure 2)	A1,A2, A3,A4,A5 B1,B2,B3, B4 ,B5 C1,C2, C3,C4,C5 D1, D2, D3,D4,D5
	Numerical Superiority	NS			
	Numerical Inferiority	NI			

Instrument of observation

We use the SOCCAF v.5 system (Robles, 2012) for the Development of our observational tool. We used and adapted several of the criteria proposed by the author, which helped us to design our own ad hoc observation tool. The criteria used were: **1:** Team; **2:** Start of play; **Criterion 3:** End of play; **4:** Actions with the ball; **5:** Players; **6:** Numerical proportion; **7:** Areas of play.

Figure 2. Graphic representation of the twenty areas of play (4 horizontal and 5 vertical) established for the areas of play criterion of the observation instrument.



The LINCE v.1.1 program (Gabin, Camerino, Anguera and Castañer, 2012) is the recording instrument used to visualize and code the matches, while lag sequential analysis was determined with the GSEQ 5.1. software.

Control of the quality of the data

The findings of research cannot be more reliable and valid than the evaluation procedures by which they are obtained (Kent and Foster, 1977). Two guidelines have been used to assess the quality of the data (Blanco-Villaseñor and Anguera, 2003):

Qualitative: consensual agreement has been used (4 experienced observers), since this strategy is usually used in the observational method (Anguera, 1990).

Q*uantitative:* Cohen's kappa coefficient (Cohen, 1960) was used to calculate intraobserver reliability, a measure of agreement between two observations for qualitative variables. For its evaluation, the scale suggested by Landis and Koch (1977) was used. The concordance criteria used were: very good agreement 0.81-1.00; good agreement 0.61-0.80; moderate agreement 0.41-0.60; low agreement 0.21-0.40; insignificant 0.00-0.20; no agreement <0.0. The data were exported to the GSEQ 5.1 software program (Quera, Bakeman and Gnisci, 2007) to produce an error detection file and calculate the reliability (Cohen's Kappa coefficient). The results obtained are between 0.76 and 1.00.

RESULTS

Table 2. shows the behavior pattern in the relationships and interactions between players on the same team.

Table 2. Adjusted residuals of the interactions, retrospective (left) and prospective (right), between the players of the home team. Lag sequential analysis allows patterns of behavior to be identified with a greater probability than that expected due to the effect of chance with p<.05.Values above 1.96 are shown in parentheses.

LOCAL TEAM PLAYERS CRITERIA										
RETROSPECTIVE						PROSPECTIVE				
R=-5	R=-4	R=-3	R=-2	R=-1	C.C.	R=1	R=2	R=3	R=4	R=5
		RC (2,22)	RC (2,49)	Ø	GK	LC (4,03)	LC (4,03) LB (3,24) RC 2,96)			
	RW (2,19)	RW (2,86)	RC (4,16) RW (3,87)	RC (2,19) WR (2,03)	RB	RW (4,32) RC (3,91)	RW (5,87) RC (2,73)	FOR (2,46)		
			GK (3,24) LW (2,83) LC (2,47) LMF (2,3)	LC (3,8) MCI (2,5)	LB	WL (7,09) LC(2,69)	LW (7,51)	LW (3,42)	CD (2,38)	
	LB (2,18)	LC (2,05)	RB (2,73) GK (2,96)	RB (3,91) LC (2,96)	RC	LC (5,66) RB (2,19)	RB (4,16) LC (4,13) GK (2,49)	GK (2,22)		
			GK (4,5) RC (4,13)	RC (5,66) GK (4,03) LB (2,69)	LC	LB (3,82) RC (2,96)	LB (2,83)	RC (2,05)		
		RW (2,35)	RW (2,49)	Ø	RMIF	Ø	LW (2,6)			
				LC (2,2)	LMIF	LB (2,52)	LB (2,52)	LW (2,67)	Ø	FOR (3,00)
	LW (2,54) SSTRI (2,23)	SSTR (3,65) LW (2,29)	RB (5,78) RMIF (2,6) FOR (2,46)	RB (4,32)	RW	RB (2,03)	RB (3,87) RMFI (2,49) FOR (2,28)	RB (2,86) RMFI (2,35)	RB (2,19)	
		LB (3,42) LMFI (2,67)	LB (7,61)	LB (7,09)	LW	LB (2,47)	RW (2,29)	Ø	RW (2,54) FOR (2,07)	
					SSTR	Ø	Ø	BD (3,64)	BD (2,23)	
LMFI (3,00)	LW (2,07)	RB (2,46)	Ø	Ø	FOR	Ø	RW (2,46)			

As can be seen, for the **retrospective perspective**, the values of the length of the pattern are medium for the LW, RMIF and GK players (max-lag = -3); short for the LMCI player (max-lag = -1) and LB and LC players (max-lag = -2); long for the FOR player (max-lag = -5), and the RB, RC and RW players (max-lag = -4). The SSTR player does not activate any categories.

The number of different categories that form the patterns varies between 1 and 4. The players establish different patterns depending on the position they occupy in the game (in all the matches observed, the dominant formation was 1-4-2-3-1, with the attacking variant 1-4-4-2). The full-backs form patterns, mainly, with the wingers and the defenders (Pattern of RB with RC and RW; Pattern of LB with LC, LMIF, LW and GK). The centre-backs form patterns with the other defenders (Pattern of RC with RB, GK, LC and LB; Pattern of LC with RC, GK and LB). The wingers employ more diverse patterns (Pattern of RW with RB, RMIF, SSTR, FOR and LW; Pattern of LW with LB and LMIF). The FOR player, however, establishes simpler patterns (Patterns of FOR with LMFI, LW and RB).

Regarding the itineraries of the patterns, it should be noted that in the RB, LB, RC, LC, RW and LW positions bifurcations were detected in one or more lags, which shows the high variability of associations created by these players. On the other hand, the GK, RMIF, LMIF and FOR players show more stable associations, causing simpler ways to connect with the itineraries and not requiring bifurcations. In the team analyzed, the SSTR position is not activated with other positions in the matches evaluated.

For the **prospective perspective,** the length values of the patterns are medium for RB, RC and LC (max-lag = 3) and short for the GK, RMIF and FOR positions (max-lag = 2). The players with long patterns are SSTR, RW, LW and LB (max-lag = 4) and MCI (max-lag = 5). The number of categories that form the patterns in this perspective ranges between 1 and 3. The players created these patterns based on the positions occupied in the team's game system (Table 2).

In relation to the itineraries, in the GK, RB, LB, RC, LC, RW and LW positions there were bifurcations in one or more lags, which shows high variability in the behavior of these players. In the other positions, the itineraries to reach these players are unidirectional (Table 2).

Table 3 shows the number of actions performed by each player in the home team studied, obtaining information on the importance of certain members of the team.

In terms of the number of actions, a large number is observed for two players who occupied the positions of midfielder (RMFI and LMFI). MFI performed 371 (12.51%) of the total passes (10 matches), with 699 actions taken. We think that both players had a high probability of relating to the other members of the team because of their spatial location, which is determined by the tactical organization of the team. The third player in order of importance in terms of passing, is the left-back (LI) with a total of 337 passes (11.36%). In terms of total actions, he is surpassed by the wingers (RW and LW) due to the greater influence of these players on driving the ball.

In terms of dribbling, the wingers (RW and LW), in addition to the player who occupies the position of attacking midfielder (SSTR), are the ones who make the most use of this resource. It is the responsibility of all the players to drive the ball, but for some of them (e.g. wingers) this technical action has greater weight and importance than for others. There are players who, due to their game play, tactical involvement or technical abilities, have greater responsibility when carrying out certain technical/tactical actions. In the team studied, the wingers (RW and LW) and the forward (FOR) are the ones who scored the highest percentage in the ten

games analyzed.

Table 3. Actions with the ball by players of the home team. Frequencies and percentages of each of the actions determined in our observational instrument are presented for each of the players in the total number of matches.

PLA.	Pass		Dribbling		Driving with the ball		Clearance		Recovery		Shoot	
	Frec	%	Frec	%	Frec	%	Frec	%	Frec	%	Frec	%
GK	187	6,30	0	0	48	3,48	29	6,55	103	**15,28**	0	0
RB	272	9,17	5	1,68	96	6,97	76	**17,16**	83	**12,31**	8	5,26
LB	337	**11,36**	12	4,03	125	9,07	66	**14,90**	54	8,01	6	3,95
RC	210	7,08	3	1,01	67	4,86	69	**15,58**	74	10,98	2	1,32
LC	248	8,36	1	0,34	60	4,35	63	**14,22**	79	11,72	3	1,97
RMFI	371	**12,51**	37	12,42	162	11,76	38	8,58	70	10,39	21	13,82
LMIF	364	**12,27**	22	7,38	155	11,25	36	8,13	87	**12,91**	14	9,21
RW	279	9,41	59	**19,80**	211	**15,31**	21	4,74	34	5,04	28	**18,42**
LW	249	8,40	66	**22,15**	198	**14,37**	25	5,64	50	7,42	24	**15,79**
SSTR	271	9,14	63	**21,14**	153	11,10	12	2,71	27	4,01	12	7,89
FOR	178	6,00	30	10,07	103	7,47	8	1,81	13	1,93	34	**22,37**

Where: Frec is the total actions per player and %, the percentage with respect to the total team members. The values in bold represent the most significant ones in each of the aspects analyzed.

DISCUSSION

Team play has been shown to be the key element of success in attack, interactions between the players and passing being the most important indicators for describing a team's style of play. In recent years, successful teams have been transforming the patterns of attack that precede the scoring of the goal. Specifically, they have evolved from the use of more individual behaviors (such as dribbling or driving the ball) to fundamentally team behaviors such as centers or short passes typical of associative playing styles such as "tiki-taka" (Gyarmati, Kwak and Rodríguez, 2014) and defense/attack transitions along the side corridors (Grant, Reilly, Williams and Borrie, 1998; Griffiths, 1999; Barreira, Ribeiro, Garganta and Anguera, 2010; Machado, Barreira and Garganta, 2011).

In this regard, the study of interactions between the players of the studied team has allowed us to identify the most frequent relationships between them. When the full-backs (RB and LB) have been taken as a criterion, a clear relationship with the wingers on the same side (RW and LW) is shown, in both the retrospective and prospective perspectives. For the centre-backs (Rc and LC), the priority relationships are with the other defensive players in their team. In general, and for both perspectives, the behavior patterns are short, coinciding with the data provided by Robles and Castellano (2012) when studying the Spanish national team that participated in the 2008 European Championship and the 2010 World Championship.

The players who occupy midfield positions (RMIF and LMIF) showed patterns without bifurcations, complementing each other in their participation, since when one acts primarily in the retrospective

perspective, his partner does so in the prospective. These data give us information about the distribution of functions of two players who, although acting in similar areas of the field, are usually players that complement each other in their function. In this regard, one of them acts with more freedom to reach areas of the opposite goal, while his partner gives the defensive balance to the team. The fact that they do not present bifurcations suggests that the relationships that they establish with the other players allows them to generate varied relationships with attacking or defensive players as a consequence of the spatial position in which they act. Several studies coincide in stating that these are the most important players in a soccer team (Duch, Waitzman and Amaral, 2010; Kannekens, Elferink-Gemser and Visscher, 2010; Clemente, Martins, Wong, Calamaras and Mendes 2015; Maneiro-Dios and Amatria, 2018).

The wingers (RW and LW) have longer patterns, as well as a greater number of bifurcations. In addition, they frequently show greater relationships with more offensive players on their own side of the pitch. This would confirm the suggestion put forward by Teixeira et al. (2011), who state that the players preferably use their dominant leg to handle the ball, becoming intermediary players within their area of intervention. However, the volume and characteristics of the behavior of both players, although similar, are not the same. In our case, it is the RS player who performs the most interactions with other teammates and a greater number of bifurcations than his opponent. This will not always be the same in all teams, since it will depend a lot on the profile and characteristics of the players who occupy these positions (Bojinov and Bornn, 2016).

In general, studies that have tried to relate the success achieved in the attack phase with the number of players participating in it seem to indicate that the number of players involved in the action is small (Castelo, 1994). Success in the attack phase depends on both the type of relationships that are established and the organization zones of the game. It has been found in our study that successful actions are short and involve the participation of few players, represented in short patterns in the retrospective perspective. We think that the style or model of play used by the teams should be taken into account. This is confirmed by the study by Garganta (1997), which compares patterns of behavior in play that ends in goal of five European teams at the highest level.

It is universally accepted that passing is a key technical element of offensive play. It allows the team to progress with the ball and thereby look for a goal efficiently. In relation to the passing category, the team under study made a total of 2966 passes (a mean of 296.6 passes per game). These data are similar to those provided by Maya-Jariego and Bohórquez (2013) in a study of First Division teams from the same country (230 and 281 per team). Armatas (2009) points out that the difference between the best and the worst classified teams in a competition usually lies in the number of passes that they perform. The best tend to make twice as many passes as the worst. The number of passes alone is an important aspect, but in order to understand its true significance it is necessary to include the criterion of their quality. The teams that present a very high percentage of accurate passes are usually those that perform best in tournaments (Casais, Lago, Lago, Iglesias and Gómez, 2011). However, the team's performance level criterion is not the only variable that differentiates teams by virtue of the number of passes they make. In this same regard, when we study the final of the European Championship held in France in 2016, we can observe differences in the number of passes performed by the two teams that played (France 700, Portugal 500) (Martín-González, Díaz, Ramos, Arriaza, Da Silva and García- Manso, 2017).

If we understand volume of passes as an important aspect for identifying a team's game model, we observe that the data obtained are similar. Therefore, we should look for other aspects that serve as an identifier of these models and differentiate the play of some teams from that of others.

The two midfielders (RMIF and LMIF) have the greatest weight in this type of actions, with percentages of 12.51% and 12.27%, respectively. The data obtained coincide with those provided by Sánchez-Flores (2014), who stated that the players who occupy positions in the creation area account for 15% of the passes performed. Other authors such as Carlin (2010) and Bloomfield, Remco and O'Donoghue (2007) consider these players as key elements of the game system, so they must present high technical and tactical abilities with which to handle the numerous and varied situations they face during the game.

In relation to the Shots category (SHOOT), there were a total of 152 (15.2 per game). The data obtained are lower than those found by Castellano and Hernández-Mendo (2000), with an average of 26.9 shots per match, Perea (2008) with 24.7 per game, and Robles (2012) with 23.4. The players who make the most shots are the forwards, which coincides with the aforementioned study by Robles and Castellano (2012). A possible explanation could be established for the team analyzed in our study.

Buraczewski and Cicirko (2011) establish higher total frequencies and percentages, in both total shots and goals, for the teams that achieve success compared with those that do not. Also, Szwarc (2004) records more shots for the winning teams and also with greater effectiveness, similar to the data of Yamanaka, Hughes and Lott (1993) and Bishovets, Gadjiev and Godik (1993). However, what a greater number of shots does not ensure is the idea of a combinative game, since most of the shots at goal are achieved in short moves (Hughes and Churchill, 2005), although it is true that having more possession time guarantees a greater number of attack situations (Gómez and Álvaro, 2003).

CONCLUSIONS

Based on our data, we can affirm that the use of evaluation techniques such as observational methods and sequential analysis has allowed us to approach the study of game dynamics in competition and build a conceptual map of the interactions that are established between members of a soccer team. The study of the game action has allowed us to verify the stable relationships that are manifested in the attacking behavior of the team analyzed, rejecting the idea of a random behavior in the communications between players. Occupation of the pitch and attempts to get a goal were two of the most important aspects identified in this sample. The spatial location of the players within the system conditions the possible connections between players. These are mediated by the different game systems used and by the tactical variants that are developed during a match. In the matches evaluated, there is an increase in the chances of success (winning the match) as the number of shots increases, especially those aimed between the goalposts.

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