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Goalkeeper Effectiveness in the Direct Free Hit of Rink Hockey

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Abstract

The objective of this research was to analyse the influence of the factors that intervene in goalkeeper-player the interaction on the effectiveness of direct free hits. The observational methodology was used, and an *ad hoc* observation instrument was created with 11 criteria. The sample consisted of 637 direct free hits from the OK Liga 2015-16. A descriptive analysis of the different variables was made and a correlation analysis between goalkeeper and player behaviour variables with regard to effectiveness in finalization. No interaction variable was identified between goalkeeper and player that had a significant relationship in the efficiency of the goalkeeper's saves ($p > .05$). The most efficient player behaviours were: left laterality (33.3%) and zone 3 where the direct free hit (33.2%) is executed. The goalkeeper behaviours that presented the highest percentages of effectiveness were use of the technical ability to move their arms to stop shots (82.7%) and the initial position of squat (73.8%) and knee on the floor (72%). The information obtained is interesting in helping to understand goalkeeper-player interactions and thus be able to intervene to improve both of their playing performances according to the characteristics of the direct free hit.

Keywords: roller hockey, direct free hit, effectiveness, technical skill, goalkeeper

Introduction

The direct free hit (DFH) in roller hockey (RH) is a one-against-one situation between goalkeeper and player involving a reciprocal influence. An asymmetric duel is established in which the player attempts to score a goal and the goalkeeper to prevent it. The importance of these actions in the game is determined by their greater effectiveness over other roller hockey actions, surpassed only by penalty shots (Brazio, 2006; Vaz, 2011), and because more than 60% of them are taken at decisive points in the game, namely in the last 15 minutes (Trabal, 2017; Trabal et al., 2019a).

Different studies in cooperation-opposition sports have examined the goalkeeper-player relationship in penalty situations. The importance of these studies lies in the fact that since the DFH is exclusive to RH, penalties are the actions in other sports that are most similar to the DFH in RH because of their importance and because they are interactions exclusively between the goalkeeper and player. One of the variables analysed was the initial location of the goalkeeper in the football penalty kick. An initial goalkeeper position to one side, as opposed to the centre of the goal, conditions kicker decisions and their likelihood of aiming the kick towards the area where the goalkeeper has left most space (Masters et al., 2007; Weigelt & Memmert, 2012; Weigelt et al., 2012).

Another variable which has been studied is football goalkeepers' predisposal towards action instead of inaction. In penalty kicks, goalkeepers are known to have a preference for diving towards one side even in the knowledge that remaining still in the centre of the goal (De la Vega et al., 2010) is the most effective option. Using a similar approach, Bar-Eli and Azar (2009) demonstrate that players would rather have their penalty kick stopped by the goalkeeper than shoot outside the goal.

In terms of goalkeeper and player laterality, in ice hockey the efficacy of right-handed goalkeepers is not influenced by the laterality of the player striking the puck. Conversely, left-handed goalkeepers let in more goals struck by right-handed players (Puterman et al., 2010).

The influence of goalkeeper movements just before the kick is actually taken has also captured researchers' interest. Wood and Wilson (2010) state that the football goalkeeper's action of waving their arms is a distraction and increases the penalty taker's anxiety. Van der Kamp and Master (2008) hold that the position of the handball goalkeeper in the goal changes perception of their height, thus influencing the precision of penalty shots.

When players are negatively influenced, their level of anxiety rises and their effectiveness drops (Wilson et al., 2009).

In RH, the only studies that analyse DFHs address the influence of their effectiveness on final rankings (Trabal et al., 2019b) and goalkeeper-player interaction (Trabal, 2017; Trabal, 2019; Trabal et al., 2019a). The behavioural guidelines in DFHs recommend that players use a feint shot to condition the goalkeeper by putting them off-balance and forcing them to adopt different initial positions (IPs) to contend with the player's action (Trabal, 2019; Trabal et al., 2019a). The IPs used most frequently by Spanish goalkeepers are kneeling (KN) and the half-screen (HS) (Trabal, 2019, Trabal et al., 2019a). In goalkeeper-versus player situations, the goaltender is advised to move forward sufficiently to reduce the angle of the shot while also not leaving too much lateral space to avoid being dribbled (Folguera, 2000; Trabal, 2017; Trabal et al., 2019a). On the other hand, players must strike a balance between not getting too close to the goalkeeper to keep them from stealing the ball with their stick and finding the distance that offers a good angle of shot (Massari, 2017, Trabal, 2017).

The study of DFHs enables us to understand the relational characteristics between goalkeeper and player and sheds light on the factors that determine one of the most important actions in RH. Due to the lack of studies on goalkeeper-player interactions in RH and the enormous importance of the goalkeeper as a crucial element in teams' ultimate performance (Trabal, 2016), the objective of this study was to identify the most-used goalkeeper and player behaviours in DFHs and to ascertain their influence on the effectiveness of DFHs. The emphasis was placed on the behaviours of both goalkeeper and player because there is a reciprocal influence between them in DFH.

Methodology

Design

The observational methodology was used because of the possibilities it affords to analyse goalkeeper-player interaction in its natural context without either one of them feeling conditioned. This allowed us to analyse the behaviours that spontaneously arise in their competitive environment and to quantify the athletes' behaviours (Anguera & Hernández-Mendo, 2013, 2014). The design was periodic, nomothetic and multidimensional.

Participants

The sample was comprised of the 650 DFHs taken in the 240 matches in the OK Liga 2015-16. Thirteen DFHs were ruled out because of poor image quality.

Instruments

An ad-hoc observation instrument was created with a field format combined with a system of categories. The observation instrument was comprised of criteria pertaining to player and goalkeeper behaviour and the outcome of the action (Table 1). The instrument was validated through an expert peer-reviewed procedure involving six coaches, one goalkeeper and one player, all of them with level-3 qualifications in RH and at least ten years' experience in the OK Liga. The consensus surpassed 90% on all criteria and categories. The reliability of the instrument was determined by analysing the 52 DFHs on the first two days of the championship, and intraobserver concordance tests ($k = 0.992$) and interobserver concordance tests ($k = 0.984$) were performed.

Procedure

The DFH sequences were downloaded from the platform of the Royal Spanish Skating Federation and viewed using the Kinovea v. 0.8 (17) software. Excel 13 was used to generate the records. Finally, the data were statistically processed using the SPSS v.23 software.

Statistical Analysis

A descriptive analysis of the variables was performed by calculating the frequencies and percentages, as well as the percentages of effectiveness obtained in each variable, and a correlational analysis using Pearson's chi-squared test among the variables of the goalkeeper's and player's behaviours together with the DFH outcome variable. The players' percentage of effectiveness in the DFHs was calculated (E%) (DFHs which end in goal $\times 100$ /total DFHs) and the percentage of goalkeeper effectiveness (GE percentage) (DFHs which do not end in goal $\times 100$ /total DFHs).

Table 1
Criteria and categories of the observation instrument

Criteria	Categories
Player behaviours	
Laterality	Hand the player uses to grip the stick: right-handed/left-handed.
Feints before hit	Possibility of player simulating a direct strike on goal: feint before hit/no feint before hit.
Continuity of movement	The player can execute stick and ball movements without stopping during the direct free hit: there is continuity/there is a pause and no continuity/pause and no continuity.
Technical skill of the player (TSP)	Technical action by the player to shoot at goal: hit/drag or stab/dribble.
Final direction of movement	Final direction by the ball to the player's stick before it is struck from the taker's standpoint in dribbling: from right to left/from left to right.
Finalisation zone of the action (ZFA1 and ZFA2)	ZFAF1= zone of the rink from which the ball it hit: Z1/Z2/Z3/Z4/Z5 and ZFAF2 = right zone/left zone/FD point (Figure 1).
Goalkeeper behaviours	
Initial position of the goalkeeper (PI)	Stance the goalkeeper takes before performing the technical skills: squat (SQ)/kneeling (KN)/half-screen (HS)/stretched out on the ground (SG)/other initial positions.
Technical skill of the goalkeeper (TSG)	Technical action employed by the goalkeeper: screen (SCR)/closing step (CS)/opening legs/arm movements (AM)/pulling the mitt from the stick (PMS)/other technical skills.
Final location of the goalkeeper	Location of the goalkeeper on the rink at the time of the hit: in the goalkeeper area/ the semicircle of the goalkeeper area/in front of the goalkeeper area (Figure 3).
Distance between goalkeeper and player	Separation between goalkeeper and player when the player hits the ball at goal: more than 1.5 metres/less than 1.5 metres.
Result of the action	Result of the hit: goal/no goal.

Ethical Considerations

Since the study was performed within an official competition open to the public, the informed consent of the athletes was not required in accordance with the ethical requirements established by the American Psychological Association (2002).

Results

According to the data shown in Table 2, there was no statistically significant relationship between the goalkeeper and player behaviour variables in relation to DFH effectiveness. GE percentage in the DFHs in the 2015-16 OK Liga was 70.3%, which corresponds to an E% of 29.7%.

Player Behaviours

Table 3 displays all the data resulting from the descriptive analysis of player behaviours. Only in 17.4% of the DFHs did the hitter feint before striking. When the players executed the DFH with a feint before the hit, they scored 31.5% of the DFHs and scored 29.3% when they did not.

Table 2

Relationships between player and goalkeeper behaviours and DFH effectiveness

Criteria	χ^2	Sig.
Player behaviours		
Laterality	1.972	.160
Feints before hit	.223	.637
Continuity of movement	.010	.919
Technical skill of the player	.900	.825
Final direction of the movement	4.245	.751
Action finalisation zone 1 (zones 1 to 5)	3.300	.509
Action finalisation zone 2 (right/left/central)	.003	.999
Goalkeeper behaviours		
Initial position	4.979	.418
Technical skill of the goalkeeper	10.812	.213
Final position of the goalkeeper	3.667	.160
Distance between goalkeeper and player	.230	.632

With regard to the continuity of movement variable, the players presented a preference for executing the DFH continuously in 76.5% of the shots.

Table 3

Characteristics of player behaviour in DFHs

Criterion	Category	DFHs taken	%DFHs taken	Goals from DFHs	E%	GE%
Laterality	Right-handed	430	67.5	120	27.9	72.1
	Left-handed	207	32.5	69	33.3	66.7
Feints before hit	Yes	111	17.4	35	31.5	68.5
	No	526	82.6	154	29.3	70.7
Continuity of movement	Yes	487	76.5	144	29.6	70.4
	No	150	23.5	45	30	70
Technical skill of the player	Hit	110	17.3	30	27.3	73.3
	Drag/stab	56	8.8	17	30.4	69.6
	Dribble	471	74	142	30.1	69.9
Final direction of the movement	Right-left	179	38	52	29	71
	Left-right	292	62	90	30.8	69.2
Action finalisation zone 1	1	48	7.5	15	31.3	68.7
	2	279	43.8	81	29	71
	3	187	29.4	62	33.2	66.8
	4	9	1.4	1	11.1	88.9
	5	114	17.9	30	26.3	73.7
Action finalisation zone 2	Right	343	53.84	102	29.7	70.3
	Left	259	40.66	73	29.6	70.4
	Centre	35	5.5	14	29.8	70.2

Note. DFHs taken: direct free hits taken; %DFHs taken: percentage of direct free hits taken; Goals from DFHs: goals scored from direct free hits; E%: player effectiveness percentage, GE%: goalkeeper effectiveness percentage.

Table 4*DFHs taken and E% in DFHs in relation to player laterality*

Criterion	Right-handed			Left-handed		
	DFHs taken	%FDs taken	E%	DFHs taken	%FDs taken	E%
Hit	80	18.6	26.3	30	14.5	30
Drag/stab	46	10.7	23.9	10	4.8	60
Dribble	304	70.7	28.9	167	80.7	32.3
<i>n</i>	430	100		207	100	
			27.9			33.3

Note. DFHs taken: direct free hits taken; %DFHs taken: percentage of direct free hits taken; Goals from DFHs: goals scored from direct free hits; E%: player effectiveness percentage.

The analysis of TSP shows that dribbling was the most-used skill (74%), followed by hitting (17.3%) and dragging/stabbing (8.8%). Players reached the highest levels of effectiveness (30.4%) when making the DFH by dragging or stabbing the ball. The analysis of the TSP in relation to laterality reveals that dribbling was the preferred technical skill in both groups. Dragging/stabbing was the skill used least by left-handed players (4.8%) (Table 4).

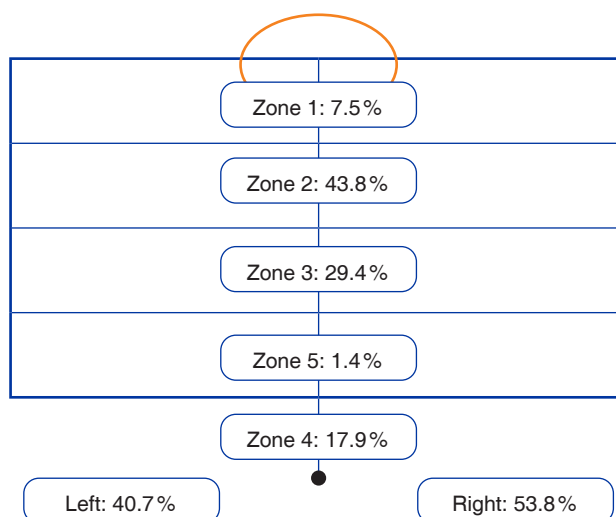
DFHs taken: direct free hits taken; %DFHs taken: percentage of direct free hits taken; Goals from DFHs: goals scored from direct free hits; E%: player effectiveness percentage.

The most-used final direction of movement was left-right (62%). These final movements, analysed according to player laterality, show that right-handed players finalised DFHs to their right and to the goalkeepers' left 63.2% of the time, while left-handed players did so in the same way 59.9% of the time.

With zone division according to their being closer to or further away from the goal, ZFA1, we can see that most shots were taken at goal from zones 2 (43.8%) and 3 (29.4%). Zone 4, with only 1.4% of the DFHs taken, was the least favourite. By laterality, ZFA2, 53.8% of the DFHs were made from the right zone, 40.7% from the left and 5.5% from the DFH point (Figure 1).

Goalkeeper Behaviours

The IPs used most by goalkeepers were KN (49.1%), HS (28.2%) and SQ (16.8%). Goalkeepers reached the highest levels of effectiveness by positioning themselves in KN (72%) and SQ (73.8%) and the lowest levels in HS (66.1%). In terms of TSG, they used CS in 35.6% of the DFHs and SCR in 24.6%, with a GE percentage of 68.3% and 75.2%, respectively. The TSG with AM

Figure 1*Percentage of finalisation of DFHs according to finalisation zone*

is where goalkeepers reached the highest GE percentage, 82.7% (Table 5).

The analysis of the relationship between the IP and the three TSGs most used by goalkeepers enables us to identify three noteworthy combinations. The most important one was KN+CS in 34.1% of the DFHs, the second was SQ+SCR in 12.3% of the DFHs and the third was HS+PMS in 6.6% of the DFHs (Figure 2).

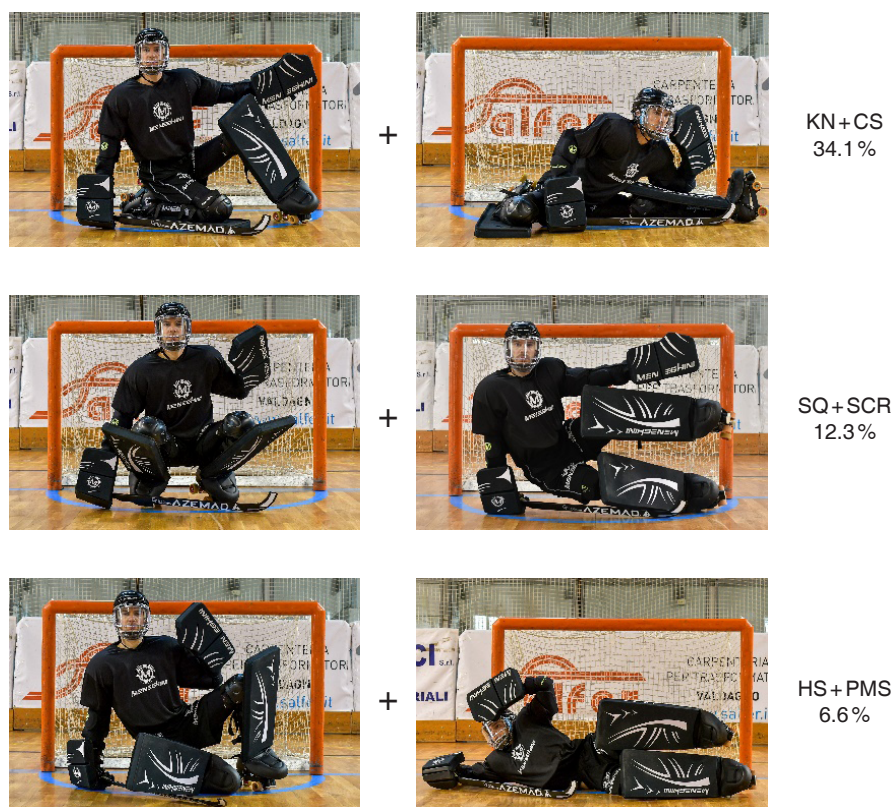
With regard to final goalkeeper position, in 59.2% of the DFHs they were in the semicircle of the goalkeeper area, where the GE percentage was 72.1% (Figure 3). In 18.7% of the DFHs when the goalkeeper was positioned in front of the semicircle of the goalkeeper area, they obtained the highest GE percentage (72.3%). However, when the goalkeeper was located within the goalkeeper area, effectiveness dropped to 63.8%.

Table 5
Characteristics of goalkeeper behaviours in DFHs

Criterion	Category	DFHs taken	%DFHs taken	Goals from DFHs	E%	GE%
Initial position	Squat	107	16.8	28	26.2	73.8
	Kneeling	313	49.1	88	28	72
	Half-screen	180	28.2	61	33.9	66.1
	Stretched out on the ground	23	3.6	8	34.8	65.2
	Other	14	2.2	4	26.6	73.4
Technical skill of the goalkeeper	Screen	157	24.6	39	24.8	75.2
	Closing step	227	35.6	72	31.7	68.3
	Opening legs	43	6.8	13	30.2	69.8
	Arm movement	52	8.2	9	17.3	82.7
	Pulling the mitt from the stick	93	14.6	33	35.5	64.5
	Other	65	10.2	23	35.4	64.6
Final location of the goalkeeper	Within the goalkeeper area	141	22.1	51	36.2	63.8
	Over the semicircle	377	59.2	105	27.9	72.1
	In front of the goalkeeper area	119	18.7	33	27.7	72.3
Distance between goalkeeper and player	More than 1.5 m	409	64.2	124	30.3	69.7
	Less than 1.5 m	228	35.8	65	28.5	71.5

Note. DFHs taken: direct free hits taken; %DFHs taken: percentage of direct free hits taken; Goals from DFHs: goals scored from direct free hits; E%: player effectiveness percentage; GE%: goalkeeper effectiveness percentage.

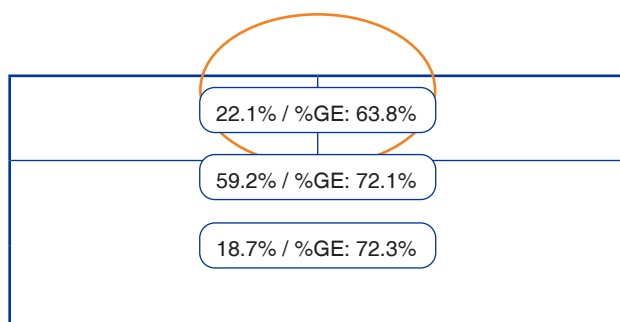
Figure 2
Percentage of use of the main IP + TSG combinations



Picture source: authors.

Figure 3

Zone of goalkeeper protection area the with percentages of goalkeeper occupation and percentages of GE achieved in each zone



The distance between the goalkeeper and the player at the time of the shot on goal was more than 1.5 metres in 64.2% of the DFHs, while in the other 35.8% of DFHs it was under 1.5 metres. In the latter, the goalkeepers showed an effectiveness of 71.5%, higher than the 69.7% attained when goalkeeper and player were further away from each other.

Discussion

The main objective of this research was to identify the influence of the goalkeeper and player behaviour variables on the effectiveness of DFHs. The results enable us to assert that these variables have no influence on these shots' effectiveness.

DFHs are primarily taken by right-handed players (67.5%), confirming the results found by Kingman and Dyson (1997), who demonstrated that 72.2% of all shots in a RH match were executed by right-handed players. These results make sense considering that the OK Liga has more right-handed players (82%) than left-handers (18%). In DFHs, the effectiveness of left-handed players is higher (33.3) than right-handers (27.9%). The advantage of left-handed players tallies with the results reported by Bauman et al. (2011) in football and those of Puterman et al. (2010) in ice hockey. One explanation which may account for this advantage is the effect of perceptive frequency (Hagemann, 2009). According to this theory, goalkeepers have greater difficulty in perceiving the actions of left-handed players out of lack of habit because they are less familiar with this kind of stimuli, which is why goalkeepers find it more difficult to identify the movements of left-handed players.

In DFHs, dribbling is the TSP used most often (74%), while shots only account for 17.3%. Unlike the TSPs used in a match, within the dynamic of cooperation and opposition of a match, shots proved to be the most-used technical skill, attaining values over 50% (Brazio,

2006; Kingman & Dyson, 1997). This difference can be explained because the DFH is a goalkeeper-player interaction in which the player encounters no opposition from any defender to get near the goal and can dribble the goalkeeper. Conversely, in an RH match, the shot is a necessary resource to score a goal from a distance since defenders take action to prevent someone a player from the rival team getting close to the goal (Vaz, 2011).

The most frequent DFH finalisation zones are zones 2 (43.8%) and 3 (29.4%). They are ideal in terms of precision and distance from the goalkeeper; they are close enough to the goal to make a precise shot using a technical skill, while also being far enough from the goalkeeper to have a good angle and prevent the goalkeeper from intercepting the ball, particularly from zone 3, which is the most effective (33.2%) one. In the zones further away from the goal, player angle of shot is improved to the detriment of precision, as reflected in the E% in zones 4 (11.1%) and 5 (24.3%). It is worth noting that shots from zone 5 are more effective than those from zone 4 even though the zone is further away. This can be explained by the fact that 95.6% of DFHs from this zone are quick shots directed straight at goal, preventing the goalkeeper from coming out and narrowing the angle. It transpired that from zone 1, which is quite close to the goal and has the limitation of having a narrow angle of a shot and a high likelihood of the goalkeeper intercepting the ball (Trabal, 2019), the E% is above average (31.3%). This can be explained by the fact that when the player leaves this zone, they have already tricked the goalkeeper and their shot goes unopposed.

The description made by Trabal (2019) and Trabal et al. (2019a) of Spanish goalkeepers' style is confirmed by the results of this study: the simultaneous use of HS and KN as initial positions and the associations between the initial positions and the KN+CS and HS+SCR technical skills. The use of SQ in DFHs, an IP that is not used in the other actions in the game, can be accounted for by the rules on taking DFHs, which force the goalkeeper to take a SQ at the beginning of the DFH and prevents them from taking up another IP until the player makes contact with the ball. When the TSP is a shot or a drag straight at goal, the goalkeeper has very little time to react and goalkeepers perform the technical skill directly after the SQ to attempt to block the shot. Furthermore, in many cases the technical skill chosen by the goalkeeper to stop shots is SCR, and this technique is easy to pull off from the SQ (Trabal, 2017).

SCR and CS are the two TSGs used most. The high frequency with which SCR is employed is due to the fact that the goalkeeper reacts with this technique in 74.5% of shots at goal. These results tally with theoretical

contributions on the use of SCR to counter shots to create a body position that covers a greater amount of space (Folguera, 2000; Trabal, 2017). The frequent use of CS is understandable because of its association with the KN IP; in 49.1% of DFHs, goalkeepers position themselves with KN, and from this IP it is very easy to move to CS since the goalkeeper only has to drop down on his behind (Folguera, 2000).

Although the results of DFHs have not shown a significant relationship between the goalkeeper's final position and their effectiveness, differences were observed in the GE percentage according to the goalkeeper's position with regard to the line in the goalkeeper area. The goalkeeper's GE percentage increases as they move further away from the goal line. These results support the recommendations of Folguera (2000) and Trabal (2019) in terms of the advantage of goalkeepers moving further out of the goal to narrow down the opposing player's angle of shot. However, the results in terms of the distance between the goalkeeper and the player prevent us from supporting recommendations made to players in one-on-one situations of not to approach goalkeepers too much in order not to lose the angle of shot and subsequently the ball (Folguera, 2000; Massari, 2017; Trabal, 2017).

The tenuous relationship between goalkeeper and player behaviours in the effectiveness of DFHs can be explained by the interaction established based on previous knowledge and the specific conditions of the environment. Goalkeeper and player were seen to maintain an interaction of opposition with mutual influence. Goalkeepers' and players' habits allow them to constantly adapt to the other's actions. This goalkeeper-player adjustment harmoniously establishes a link between skills with opposing objectives, integrated appropriately into the respective activity. This interaction can help us understand why there are no factors that might explain effectiveness based on the capacity to adapt to the changes that occur between opponents. Over the years, numerous major changes have taken place in goalkeeper and player habits alike (Folguera, 2000; Mori, 1988). Every time a goalkeeper or player manages to overcome their adversary, the latter is forced to find a solution to deal with their rival's skills, hence there is a constant flux of disequilibrium and equilibrium. A relational analysis of the interaction between the goalkeeper's and the player's respective technical skills would enable us to address the interactions involved in this opposition to establish causal relationships between goalkeeper-player habits.

The information obtained in this study is of interest in helping us to gain an understanding of goalkeeper and player interactions and thus be able to intervene to improve their skills by designing training sessions and boosting their performance.

Conclusions

In the OK Liga 2015-16, goalkeepers were found to use the initial kneeling position with the technique of stopping with a closed step and the squatting position with the screen as the main chain of actions to counter a DFH.

No statistically significant relationships were found between player and goalkeeper behaviours and the effectiveness of DFHs in RH. The most effective player behaviours were left laterality and executing the DFH from zone 3. Regarding goalkeepers, the highest GE percentages were attained by using the technical skill of arm movements and the initial positions of squatting and kneeling.

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