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A Study on Support Play in Soccer Games—Relationship between the Distance from the Ball Carrier and the Number of Players

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Abstract

In soccer, support is considered a fundamental offensive play in bringing the ball towards, and in attacking the opponent's goal. However, it is not clear how to objectively analyze the indicators of support play. Thus, this study aimed to examine the relationship between the number of players in support play and their distances from the ball carrier. By using tracking data from three games in the 2019 season of the J1 League; Japan's top soccer league, a total of 1945 cases were analyzed, that dealt with passes that were successfully received during the offensive phase of the game. The following results were observed: • The percentage that three or more players will be present begins to increase nonlinearly at 10.9 m from the ball carrier. • The degree of increase in the "diamond shape" (DS) generation rate begins to increase nonlinearly at 12.7 m from the ball carrier and begins to decrease at 23.6 m. These findings suggest that coordinated support play is possible when three or more players form a DS at a distance of approximately 13 to 24 m from the ball carrier. The validity of the perspectives revealed in this paper needs to be further examined in future studies.

Keywords

Soccer, J-League, Support Play, Distance, Number of Players, Diamond Shape, Tracking Data

1. Introduction

The movements of a player in a soccer game are generally classified into movements with the ball and movements without the ball. A player with the ball

needs a supporting receiver to be able to pass (Griffin et al., 1999). In soccer games, any given player moves without the ball for 85 - 88 minutes (Laurier, 1993; Ooft, 1994; Mercier, 1968; Takii, 2003). Therefore, movements without the ball, such as the movements of supporting receivers, are very important for successful group play.

The Japan Football Association (JFA) has stated that support is an important aspect for reaching the goal, while having possession of the ball (JFA, 2018). In addition, the quality of support is listed as one of the core elements of offense (JFA, 2020). Thus, support is considered one of the most important plays in movement without the ball.

For support practices, many studies and instructional documents have reported on the number of players that are required to provide support, as well as on the distance, angle, and timing.

For the number of players needed for support, the JFA (2018) reported that 10 players are needed, including the goalkeeper (GK). Laurier (1993) and Yoshimura et al. (2002) stated that three to four players are needed. Wade (1967), Ooft (1994), and Mercier & Cros (1964) indicated that two players are needed. Therefore, the numbers of players needed for support vary depending on the instruction manual or study used. Regarding the different roles of players, Okada (2019) stated that after all players have taken the appropriate positions to play to their advantage as a team, players who are near the ball should support the ball carrier. Furthermore, the JFA (2020) defined a "support player" as a player who can immediately support the ball carrier. Ideally, all players should be able to receive a pass; however, realistically, several players around the ball carrier are considered to support players.

The recommended distance for support play varies across manuals and studies. Hughes (1974, 1984, 1996) recommended a distance of approximately 9 - 14 m or 4 - 5 m in the offensive zone and 9 - 27 m in the midfield and defensive zones. Okihara et al. (2000) recommended a distance of approximately 12 m. The JFA (2020), Ooft (1994) and Yoshimura et al. (2002) stated that an appropriate distance is needed. In addition, ambiguous expressions, such as "appropriate" are sometimes found.

Regarding the angle of support, it should be almost 45˚ from the ball carrier (Hughes, 1974, 1984) or at the proper angle (JFA, 2020; Ooft, 1994). When it comes to the angles formed by multiple players, it is necessary for the three players without the ball to form a triangle (Ono, 1998) and it is apparently ideal for these players to then form a diamond shape (DS) with the ball carrier as the starting point (Okada, 2019).

Regarding the timing of support, the following are considered support situations: an ally can pass with the first ball touch (Hughes, 1996), the moment when the ball is passed (Okada, 2019), and every time the ball moves (Matsubara, 2011), when the passer looks up (Sakakibara, 1999), and movements at the appropriate timing (JFA, 2020).

As mentioned above, the objectification (quantification) of the indicators of

support play, such as the number of supporters, the distance and angle of supporters, and the timing of support, is not clear. In addition, one person is not enough to support a player in a game, and there is a need to consider the distance, angle, and timing when examining the support play by multiple players.

Therefore, on the basis of the studies of Okada (2019) and Ono (1998), we assumed that the receiver requires at least three allies to achieve group support play and that the receiver and three allies must form a DS. We assumed that these conditions are necessary. In addition, by referring to the studies by Hughes (1974, 1984, 1996) and Okihara et al. (2000), we chose the moment when the receiver first touches the ball as the scene for analyzing the presence of players in 1-meter increments from within 5 to within 30 m of the ball carrier, and the occurrence of DSs and each distance. The purpose of this study was to examine the relationship between the number of players and their distance from the ball carrier.

2. Methods

2.1. Specimens

The specimens are three games from the 2019 season of Japan's top league, namely, the Meiji Yasuda Seimei J1 League (hereafter referred to as "JL"). The games were played between the top four teams of the league and were chosen to be within one goal of each other to minimize the effect of goal difference on performance (Team A vs. Team B [result: 0-0], Team C vs. Team A [result: 2-2] and Team C vs. Team D [result: 2-1]). In these three games, a total of 1945 cases were analyzed using tracking data licensed for the purposes of this study from Data Stadium Corporation.

2.2. Analysis Methods

2.2.1. Characteristics of the Data Used

The tracking system involved a special camera installed in the stadium that takes pictures of the entire pitch and generates data on the movements of players, balls, and referees (J-League, 2015). The data format used in this study is a spreadsheet containing spatiotemporal information at the time of occurrence of ball play (player's first and last ball touch). The information stored in the file, including the time of play, name of play (trap, pass, tackle, etc.), coordinates of all players on the field (the origin is the center of the pitch), distance to the ball carrier, and team holding the ball, is arranged in chronological order.

2.2.2. Extraction of Cases for Analysis

The cases analyzed were all instances in which the receiver first touched the ball passed by an ally in the offensive phase (**Figure 1**). As for the selection of cases, from a total of 3990 cases wherein the player first touched the ball in both offensive and defensive situations, 2609 cases wherein the player received a pass from an ally were first selected. Then, cases in which a receiver received a crossed ball or a final pass leading to the shoot were excluded from the analysis, because

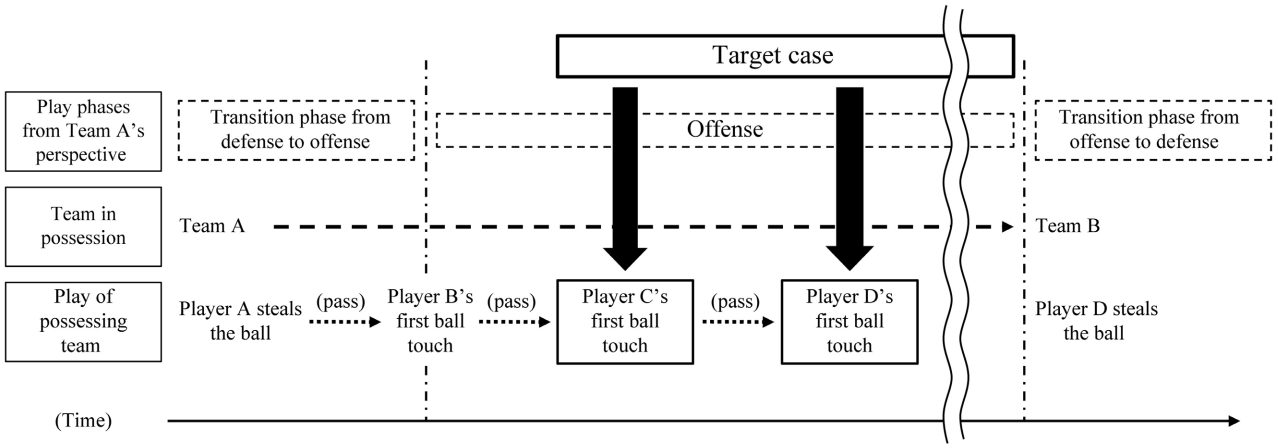

Figure 1. Analysis of target cases.

these cases were not instances representative of the general positioning of players attempting to achieve passes. When a player received a pass in a set piece, that case was excluded because their placement was affected by the set piece. When the GK received the pass (catch, trap, etc.) and when a player received the pass from the GK, the field player is often placed to prepare for a long feed from the GK; this type of case was also excluded. After removing cases in accordance with the exclusion criteria described above, 2209 cases were finally shortlisted. Lastly, a total of 1945 cases, wherein the receiver received the ball via a pass made in the offensive phase of the game, were selected for analysis in this study. The reason that passes during the transition phase from defense to offense were not selected for analysis is that the positioning of players is likely to be affected by their prior placement during the defensive phase.

JFA (2020) was used as a reference for the classification criteria for the play phase. The game states were divided into four phases: offensive phase, transition phase from offense to defense, defensive phase, and transition phase from defense to offense. In the current study, the transition phase from defense to offense was defined in the tracking data as the period at which possession switches to the offensive team until the first pass connects with a receiver. The offensive phase was then defined as the period after the transition up to the point when the opposing team obtains possession.

2.3. Analysis Items

2.3.1. Relationship between the Distance from the Ball Carrier and the Number of Players Available for Support

The distribution of players (cumulative relative frequency) within each concentric distance from within 5 m to within 30 m (per meter) relative to the ball carrier was calculated (**Figure 2**). To examine the distance at which multiple players can provide support while working together, the number of instances in which three or more players were present at each distance per meter was represented on a graph, and the points where this ratio increased nonlinearly were calculated from the intersection of two regression lines drawn before and after each point.

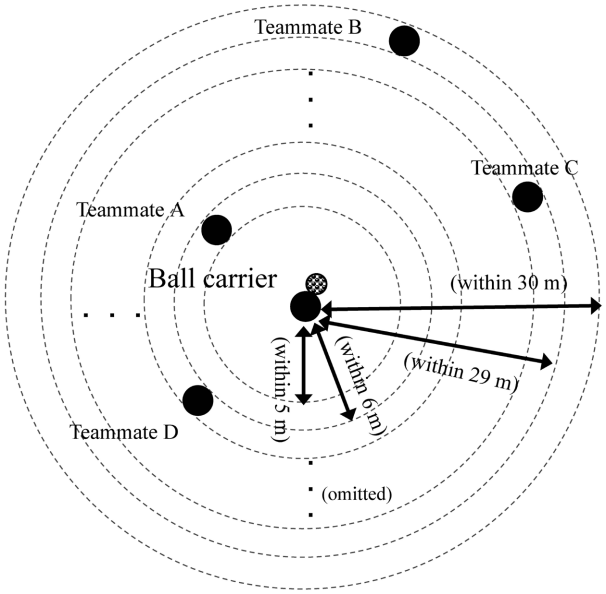

Figure 2. Concentric distance range from the ball carrier.

2.3.2. Distance That Allows Multiple Players to Work Together for Support Play

We calculated the rate of DS occurrence within each concentric distance per meter from within 5 m to within 30 m of the ball carrier (Figure 2). To examine the distance at which multiple players can provide support while working together, the DS occurrence rate per meter was represented on a graph, and the points at which the occurrence rate increased and decreased in a nonlinear manner were calculated from the intersection of two regression lines drawn before and after each point.

The DS occurrence rate is the percentage of the total number of occurrences in 1945 cases. Analysis target cases wherein 2 or more DSs formed simultaneously were considered as one occurrence. The DS occurrence in this study was defined as follows: any instance wherein angles CAB, CAD, ACB, and ACD in quadrilateral ABCD, which is formed by connecting ball carrier A and three teammates (B, C, and D), are greater than 0˚ and less than 90˚ (Figure 3). The magnitude of each angle was determined from the XY coordinate values of the four corresponding points obtained from the tracking data.

3. Results

3.1. Relationship between the Distance from the Ball Carrier and the Number of Players Available for Support

Figure 4 shows the cumulative relative frequencies of the number of people at each distance from the ball carrier. The percentage of instances in which a given player had three or more teammates within the following distances were as follows: within 5 m (0.1%), within 10 m (6.2%), within 15 m (41.5%), within 20 m (74.8%), within 25 m (91.7%), and within 30 m (97.5%). As the distance increased, these percentages first increased gradually, increased steeply, and then

increased gradually again. When the number of people increased to four or more, the percentage of people present tended to increase with increasing distance, similar to a case with three or more people.

Figure 5 shows a graph indicating the percentage of three or more players at each distance in all 1945 cases during the reception of a pass in the offense phase. The point at which the percentage increased nonlinearly was calculated from the intersection of the two regression lines drawn before and after the increase ($Y = 0.0237x - 0.1769$ and $Y = 0.0793x - 0.7807$). The results showed that the nonlinear increase occurred when the distance from the ball carrier was 10.9 m and when the percentage in which three or more players are present was 8.0%.

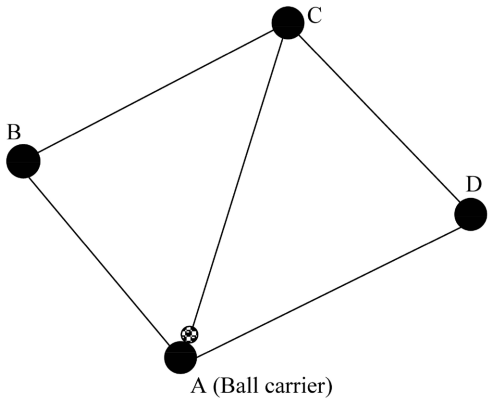

Figure 3. Diamond shape.

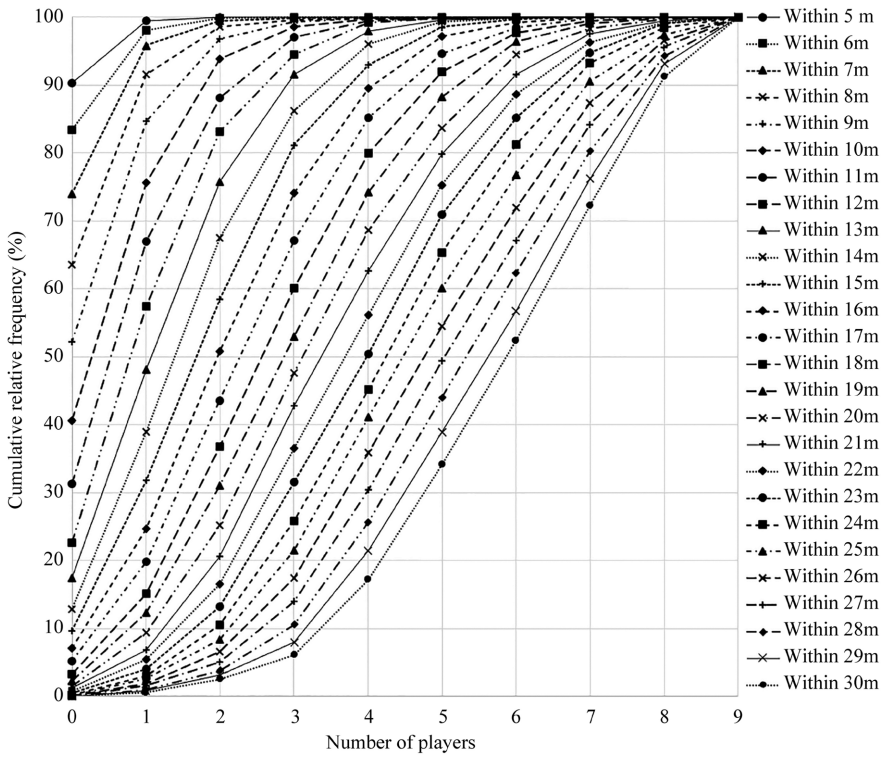

Figure 4. Cumulative relative frequency of the number of players at each distance from the ball carrier.

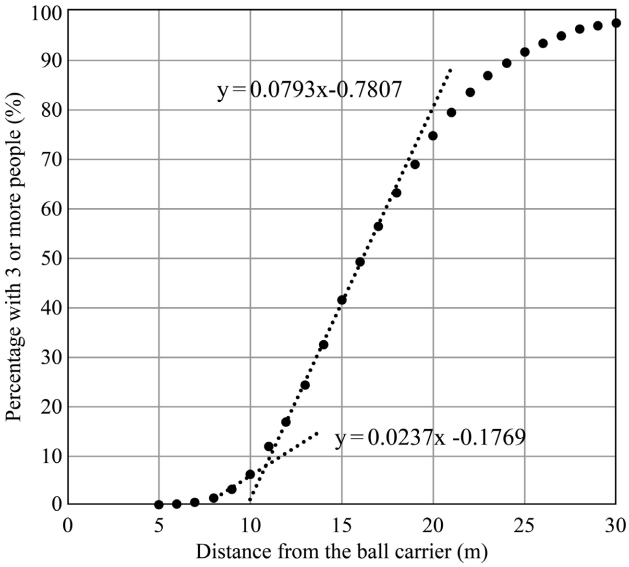

Figure 5. Percentage of ball carriers with three or more players at each distance from the ball carrier.

3.2. Distance Where Multiple Players Can Work Together to Make Coordinated Support Plays

Figure 6 shows the percentage of DS occurrences at different distances from the ball carrier. The DS occurrence rates were as follows: within 5 m (0%), within 10 m (2.2%), within 15 m (23.0%), within 20 m (57.2%), within 25 m (81.0%), and within 30 m (94.3%). As the distance increased, the percentage first increased gradually, increased steeply, and then increased gradually again.

As shown in Figure 6, the points at the DS occurrence rate that became larger and smaller in a nonlinear manner were calculated from the intersection of two regression lines drawn before and after each point ($y = 0.0242x - 0.2204$, $y = 0.0649x - 0.7359$; $y = 0.0649x - 0.7359$, $y = 0.0231x + 0.2524$). The results showed that the point at which the degree of increase was nonlinearly large occurred at 12.7 m from the ball carrier and with a DS occurrence rate of 8.6%. By contrast, the point at which the increase was nonlinearly small occurred at 23.6 m and at an occurrence rate of 79.9%.

4. Discussion

By referring to Okada (2019) and Ono (1998), we hypothesized that to achieve effective support play on offense, there should be three or more players around the ball carrier and that these players should form a DS relative to the ball carrier. In the current study, the relationship between the number of players and the distance from the ball carrier was examined.

With respect to the relationship between distance and number of players, the percentage in which there are three or more players increases nonlinearly at 10.9 m. If the teammates of the ball carrier are too close to the ball carrier during the game, the available space for play is narrowed, thus creating an advantageous

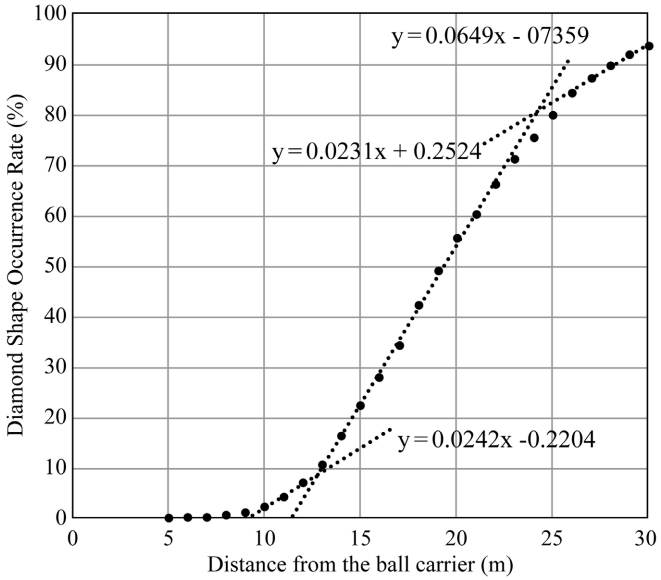

Figure 6. Diamond shape occurrence rates at each distance from the ball carrier.

situation for the defensive team (Okada, 2019; JFA, 2020). This suggests that a distance of approximately 11 m or more from the ball carrier is the distance at which three or more players can effectively provide support to the ball carrier. It was also found that at 10.9 m, the percentage in which three or more people are present was 8.0% (out of a total of 1945 cases).

Regarding the relationship between the distance from the ball carrier and the rate of DS occurrence, the distances at which the degree of increase in the DS occurrence rate began to increase and decrease nonlinearly were 12.7 and 23.6 m, respectively. This finding can be explained as follows: a distance of less than 12.7 m from the ball carrier is too close to effectively form a DS; at distances greater than 23.6 m, the distance between players needs to be prevented from expanding too much and from causing the connection between them to become too thin (Okada, 2019). These factors reduced the degree of increase in the DS occurrence rate. Therefore, a range of 12.7 m to 23.6 m from the ball carrier is the distance at which DS can be effectively formed. At distances between 12.7 and 23.6 m, the percentage in which three or more people are present ranged from approximately 23% to 88% (**Figure 5**), and the percentage of DS occurrences ranged from 8.6% to 79.9% (**Figure 6**) (out of a total of 1945 cases). Okada (2019) stated that always forming a DS is ideal but can be difficult to achieve because of the influence of the defensive team's play, which prevents the offensive team from creating an advantageous situation. We believe that a distance where three or more players can be present and where a DS can be formed can be regarded the practical support distance in the game.

These results suggest that the presence of three or more players at a distance of approximately 13 to 24 m from the ball carrier and the formation of a DS are necessary for coordinated support play. This is an objective indicator that has

been shown by Japan's top-level teams, and we believe that it can serve as a standard for evaluating and teaching support play.

5. Summary

This study aimed to examine the relationship between the number of players in support play and their distances from the ball carrier. By using tracking data from three games in the 2019 season of the J1 League; Japan's top soccer league, a total of 1945 cases were analyzed, that dealt with passes that were successfully received during the offensive phase of the game. By using the ball carrier as a reference point, the numbers of players per meter from within 5 m to within 30 m were calculated, and the occurrence rate of a "diamond shape" (DS) was clarified. The results of this study are as follows:

- The percentage in which three or more players are present begins to increase nonlinearly at 10.9 m from the ball carrier.
- The percentage in which three or more players are present at the same distance was 8.0% of 1945 cases.
- The degree of increase in the DS generation rate begins to increase nonlinearly at 12.7 m from the ball carrier and begins to decrease at 23.6 m.
- From 12.7 to 23.6 m, the percentage in which three or more players are present in all 1945 cases was approximately 23% to 88%, and the DS occurrence rate ranged from 8.6% to 79.9%.

These results suggest that coordinated support play is possible when three or more players are present at a distance of approximately 13 to 24 m from the ball carrier and these players are forming a DS. This study clarified the relationship between the number of players and the distance at which support play may be possible on the basis of tracking data. Although the validity of these perspectives needs to be further investigated in the future, based on the real world scenarios and situations in professional games, this study has provided a fresh perspective regarding a more practical and concrete approach to support play.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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