# Inside game ball transitions according to players' specific positions in NBA basketball

# Transiciones de balón del juego interior en función de la posición específica de los jugadores en baloncesto NBA

# Transições da bola de jogo interior de acordo com o jogador posição específica em basquete NBA

Courel-Ibáñez, J.*, Suárez-Cadenas, E. and Cárdenas-Vélez, D.

*Faculty of Sport Sciences, University of Granada, Spain*

**Abstract:** The purposes of this study were to identify players' relationships and detecting ball transitions patterns according to their specific position when using inside pass, in the National Basketball Association (NBA) competition. In total, 808 inside passes (ball possession score differences below 10 points) from 25 matches (NBA Playoffs, 2011) were analysed through systematic observation. A decision tree analysis (Chi-Squared Automatic Interaction Detection) was used to identify ball transitions patterns regarding specific players' position (roots) and passer-receiver interactions (predictors). We detected strong pass and reception sequences of movements according to players' specific position, especially when including interactions between perimeter and post players. Game conditions such as reception zone, pass distance, reception attitude, and defensive helps were also influenced by players' position. Current results point out the outside-inside coordination as an essential key to success in the NBA. It is recommended developing game dynamics focused in taking advantage of the high- and low-post positions, as well as performing supporting actions in the weak side to enhance inside pass options. These findings may have implications in basketball training and competition process, contributing in a better understanding of collective strategies which leads to an accurate designing of practices task focused on increasing inside game options and players' decision-making according to specific competition constraints.
**Keywords:** team sports, sequential analysis, performance, tactics.

**Resumen:** El objetivo de este estudio fue identificar las relaciones entre los jugadores y detectar los patrones de transición del balón en función de la posición específica de juego durante el uso del pase interior en la National Basketball Association (NBA). Se analizaron un total de 808 pases interiores (diferencia en el marcador por debajo de 10 puntos) correspondientes a 25 partidos (Playoffs de la NBA, 2011) a través de observación sistemática. Se utilizó un análisis de árbol decisional (Chi-Squared Automatic Interaction Detection) para identificar los patrones de transición de la pelota en función de la posición específica de los jugadores (raíces) y las interacciones pasador-receptor (predictores). Se detectaron secuencias de movimientos bien definidas entre pasador y receptor de acuerdo a sus posiciones de juego, especialmente si se incluían relaciones entre jugadores del perímetro y del poste. Las condiciones del juego como la zona de recepción, distancia de pase, actitud del receptor, y las ayudas defensivas estuvieron influenciadas

por las posiciones de los jugadores. Estos resultados señalan la coordinación del juego exterior-interior como un aspecto esencial para el éxito en la NBA. Se recomienda desarrollar un juego dinámico centrado en aprovechar la ventaja de las posiciones de poste alto y poste bajo, así como realizar acciones de apoyo en el lado débil para aumentar las opciones de pase interior. Las conclusiones del presente estudio podrían por tanto tener implicaciones en el proceso de entrenamiento y competición de baloncesto, contribuyendo al entendimiento de las estrategias colectivas de los jugadores y con ello al diseño de tareas de práctica centradas en el aumento de las opciones de juego interior y a la mejora de la toma de decisiones de los jugadores que respondan a las demandas específicas de la competición.
**Palabras-clave:** deportes de equipo, análisis secuencial, rendimiento, táctica.

**Resumo:** O objetivo deste estudo foi identificar as relações entre jogadores e detectar padrões de transição da bola de acordo com o jogador posição específica em uso de passe interior em National Basketball Association (NBA). Foram analisados um total de 808 passes interiores (diferença na pontuação abaixo de 10 pontos) por 25 jogos (NBA Playoffs, 2011) através da observação sistemática. A análise da árvore de decisão (Chi-Squared Automatic Interaction Detection) foi utilizado para identificar padrões de transição da bola dependendo do jogador posição específica (raízes) e passador-receptor interações (preditoras). Sequências de movimentos bem definidos entre passer e receptor de acordo com suas posições de jogo, especialmente se as relações entre os jogadores de perímetro e poste incluídos foram detectados. As condições de jogo como a área de recepção, distância para passar, atitude do receptor, e as ajudas defensivas foram influenciados pelas posições dos jogadores. Estes resultados indicam a coordenação do jogo de fora para dentro, como um aspecto essencial para o sucesso na NBA. Recomenda-se a desenvolver um jogo dinâmico centrado aproveitar as posições do pólo de poste alto e baixo, bem como as acções de apoio ao lado fraco para aumentar dentro opções de passagem. Os resultados deste estudo poderiam, portanto, ter implicações para o processo de treinamento e competição de basquete, contribuindo para a compreensão das estratégias coletivas dos jogadores e, assim, a prática do design tarefa focada em opções aumentando dentro do jogo e melhorar a tomada de decisão dos jogadores que atendam às demandas específicas da competição.
**Palavras-chave**: esportes de equipe, análise sequencial, desempenho, táticas.

Dirección para correspondencia [Correspondence address]: Javier Courel Ibáñezs. University of Granada, Faculty of Sport Sciences. Carretera de Alfacar. s/n. 18071. Granada (Spain). E-mail: Javier.courel.ibanez@gmail.com

## Introduction

Investigations on tactical behaviours in team sports such as basketball has gained importance in the last years, searching for a better understanding of players' adaptive response to the emergent cooperation and opposition situations which describes game performance during the match contest (Glazier, 2010; Grehaigne & Godbout, 2013). Information of this nature contributes in explaining "how" and "why" players should interact one way or the other to succeed, supporting both the training and competition process in defining the team's game style and developing playing tasks according to the competition demands (Maslovat & Franks, 2008; McGarry, 2009). To this purpose, observational analysis has been shown to be a consisten method to objective recording spontaneous behavioral events of one or more players within a natural environment, allowing the assessment of emerging spontaneous and creative comportments which enrich the quality and external validity of records obtained (Anguera, Blanco, Hernández-Mendo, & Losada, 2011; Cárdenas, Conde, & Courel-Ibáñez, 2013).

In modern basketball, playing effectively in the inside constitutes an essential offensive aim since increases scoring-rates providing close shooting chances, enlarge rebounding opportunities and force opponents' defensive misplacement contributing in better shooting options (Gómez, Lorenzo, Ibáñez, & Sampaio, 2013; Mavridis, Tsamourtzis, Karipidis, & Laios, 2009). For this reason, recent studies have been focused on detecting, describing and understanding game factors to better explain inside pass (i.e., pass received by a player stepping the paint) performance in elite basketball (Courel-Ibáñez, McRobert, Ortega, & Cárdenas, 2016; Courel-Ibáñez, Suárez-Cadenas, Ortega, Piñar, & Cárdenas, 2013). These reports describe greater ball possession effectiveness when using inside pass - nearby 20% of total match possessions - both in top-16 Euroleague teams (63.3% vs. 49.8%) and top-8 NBA teams (63.9% vs. 51.8%). More importantly, a variety of game performance indicators have been shown to increase inside game successfulness, suggesting players to adopt a dynamic attitude in the weak side before getting the ball, while their teammates are developing individual and collective actions to create free space and enhance effective passing and shooting options (Courel-Ibáñez et al., 2016). Thus, it seems that dynamic interactions with and without the ball like pick and roll, or dive cut for an alley-oop may account for these differences, emphasizing the importance of tactical analysis exploring outside-inside players' coordination (Gupillotte, 2008; Lamas et al., 2011).

An interesting approach made in NBA basketball (Fewell, Armbruster, Ingraham, Petersen, & Waters, 2012) studied teams as a strategic network, defining players as nodes and ball movements as links. As a result, they were allowed to predict ball transitions patterns using network metrics, which can usefully quantify team decisions about how to most effectively coordinate players. Particularly in the NBA, players are strongly characterised according to their specific role in the court, mainly identifying shooters, passers, defenders, and all-around players (Sampaio, McGarry, Calleja-González, Sáiz, i del Alcázar, & Balciunas, 2015). This lead to the suggestion that collective tactics are defined considering players' individual skills, chiefly if considering simple interactions like 2vs.2 or 3vs.3 situations. The purpose of this study was therefore to identify ball transitions and players' relationships according to their specific position when using inside pass in NBA playoffs teams.

## Methods

### Sample

A total of 808 inside passes where recorded from 25 matches of the 2010 NBA Playoffs series. Games were randomly selected including eight teams (four per conference) with a minimum of two matches and at least one victory and one defeated per each, excluding overtime games. Ball possessions recorded had a score difference below 10 points (average = 1.58 ± 4.56 points). The choice of this specific sample was deliberate; first, NBA is the most important basketball club competition of the world; second, Playoffs confronted best season teams for become the champion, thus the maximum competitive degree was expected until the end of the game; and third, possessions with short score differences ensure high players' activation and concentration levels (Erčulj & Štrumbelj, 2015).

### Variables

Inside pass was considered when the receiver player was stepping the zone or paint (Courel-Ibáñez, et al., 2013; 2015). Variables pertaining to players' specific position, players' actions, game condition and ball possession effectiveness were included in the analyses. Players' specific position was classified as Point Guard (PG), Shooting Guard (SG), Shooting Forward (SF), Power Forward (PF), and Center (C).

Players' action before passing and receiving the ball was analysed based on Lamas et al.'s proposal (2011). Passer action included: (i) Ball Dribbled (BD): individual actions by dribbling the ball, (ii) Ball not Dribbled: Ball not Dribbled (BND): similar to BD but without a dribble, using only body displacements techniques (i.e., ball fakes, jab step), (iii) On ball screen (OBS): one or more players try to free a teammate with the ball by interposing their body to the path of the defender, (iv) Positional (P): player states without making BD or BND. Receiver action included: (i) OBS and

roll (OBS&roll): the screener moves towards the basket after blocking and received the ball, (ii) Out of ball screen (OoBS): similar to OBS but freeing a teammate without the ball, (iii) OoBS and roll (OoBS&roll): Similar than OBS&roll when performing OoBS, (iv) Space Creation Without Ball (WB): previous movement without the ball to create space and received properly, (v) Dive cut (DC): displacement from the outside toward the basket, (vi) Positional (P): player states with no previous actions.

Besides, a series of categorical variables previously defined and used elsewhere in NBA inside pass ball possession analysis (Courel-Ibáñez, et al., 2016) related to game condition (pass/reception zone, pass/reception distance, receiver's attitude, and defensive help) and ball possession effectiveness (successful and unsuccessful) were also recorded.

### Procedures

Four pairs of observers specialising in basketball analysed all games after a 3-week training period. The observers' objectivity (inter-observer reliability) and reliability (intra-observer reliability) were assessed using the multi-rater k free index (Randolph, 2008) and Cohen's Kappa respectively. Scores obtained were over 0.87 in all cases, therefore objectivity and reliability were classified as 'almost perfect agreement' (Altman, 1991). Ball possessions were recorded using the LINCE software (Gabin, Camerino, Anguera, & Castañer, 2012), flexible digital recording software that allows data exportation for its treatment on statistical packages.

### Statistical Analysis

Descriptive analysis included frequencies, means with standard deviations and percentages with standard errors. Chi-Square was used to analyse relationships between players' specific position (both passer and receiver), players' actions (both passer and receiver), and conditional variables studied. Source of differences detected were further interpreted by studying the adjusted standardised residuals (ASRs) (Agresti, 2002). Strength of associations was measure considering values from 1.96 to 2.58 as little ($p< .05$), 2.58 to 3.29 as weak ($p< .005$) and over 3.29 as strong ($p< .001$) (Field, 2009). Effect size was calculated through Cramer's $V$ considering

.10 = small effect, .30 = medium effect, and .50 = large effect (Fritz, Morris, & Richler, 2012). Then, decision tree analysis was used to determine inside pass effectiveness according to performance indicators predicted (Gómez, Battaglia, Lorenzo, Lorenzo, Jiménez, & Sampaio, 2015). The exhaustive CHAID (Chi-Squared Automatic Interaction Detection) algorithm was used to classify relationships between independent categorical variables through completing three steps on each root of the root, finding the predictor that exert the most influence on the dependent variable. Significant level was set at $p< .05$, considering a maximum of 100 iterations and a minimum change in expected cell frequencies of .001. Two models were conducted: one considering the passer position and the other the receiver position as dependent variable. Strength of associations was studied recurring In order to avoid reporting too optimistic predictive models, a leave-one-out-cross-validation process was performed by splitting data into a training sample to estimate and compare the total and the partial models (Norusis, 2004). Independence of observations was assumed, as interactions between players during ball possessions constitute an unpredictable task and environment-related functional information (Duarte, Araújo, Correia, & Davids 2012). Statistical analyses were conducted in IBM SPSS v. 20.0 for Macintosh (Armonk, NY: IBM Corp.).

## Results

### Players' specific position

Outside players were likely to pass the ball (PG: 40.7%, SG: 22.8%, SF: 21.7%, PF: 10.7%, C: 4.0%) and inside players commonly received it (PG: 6.6%, SG: 6.2%, SF: 18.2%, PF: 38.8%, C: 30.2%). Associations between passer and receiver specific positions were detected when performing inside pass ($X2(16)=107.921$; $p<.001$; $V= .18$). In particular, seven pairs of players were positively associated: PG pass with PF reception (ASR=2.9; n=146), SG pass with SF reception (ASRs=3.4; n=49), SF pass with PF reception (ASRs=2.5; n=82), PF pass with SF (ASRs=3.3; n=27) and SG (ASRs=2.2; n=10) and PG (ASRs=2.0; n=10) reception, and C pass with PG reception (ASRs=2.9; n=6). Besides, combinations between same specific positions were negatively likely (ASRs>-1.96).

**Table 1.** Frequency distribution (in percentages) and relationships of variables studied regarding players' specific position.

| | Passer position | | | | | Receiver position | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *PG* | *SG* | *SF* | *PF* | *C* | *PG* | *SG* | *SF* | *PF* | *C* |
| **Passer action** | | | | | | | | | | |
| Ball Dribbled (BD) | 42.9 | 42.1 | 39.1 | **23.3n** | 34.4 | 37.7 | 34.0 | 41.1 | 37.0 | 43.4 |
| Ball Not Dribbled (BND) | **6.4n** | 12.6 | 12.6 | **18.6p** | **21.9p** | 18.9 | 12.0 | 11.0 | **8.4n** | 12.8 |
| On Ball Screen (OBS) | **16.6p** | 16.4 | 14.4 | **<0.1n** | **<0.1n** | **1.9n** | **0.0n** | **5.5n** | **19.9p** | 15.7 |
| Positional (P) | 34.0 | **29.0n** | 33.9 | **58.1p** | 43.8 | 41.5 | **54.0p** | 42.5 | 34.7 | **28.1n** |
| **Receiver action** | | | | | | | | | | |
| OBS and roll (OBS&roll) | **19.0p** | 19.1 | 14.4 | **<0.1n** | **3.1n** | **1.9n** | **<0.1n** | **7.5n** | **20.6p** | **19.4p** |
| Out of Ball screen (OoBS) | **2.5n** | **6.6p** | 5.2 | 4.7 | **0.0n** | 3.8 | <0.1 | 2.7 | 3.2 | **7.0p** |
| OoBS and roll (OoBS&roll) | **3.7n** | 8.2 | 6.3 | 7.0 | 3.1 | 9.4 | **18.0p** | **13.7p** | **3.2n** | **0.4n** |
| Space Creation Without Ball (WB) | **9.5p** | **3.3n** | 4.6 | 8.1 | 6.2 | 1.9 | **0.0n** | 6.8 | **9.0p** | 6.2 |
| Dive Cut (DC) | **31.0n** | 30.6 | 40.2 | **44.2p** | 46.9 | **64.2p** | **72.0p** | **46.6p** | **28.0n** | **23.1n** |
| Positional (P) | 34.4 | 32.2 | 29.3 | 36.0 | 40.6 | **18.9n** | **10.0n** | **22.6n** | 36.0 | **43.8p** |
| **Pass distance** | | | | | | | | | | |
| Exterior | 85.6 | 82.0 | 81.6 | 84.9 | 84.4 | 88.7 | 82.0 | 84.2 | **88.1p** | **77.3n** |
| Interior | 14.4 | 18.0 | 18.4 | 15.1 | 15.6 | 11.3 | 18.0 | 15.8 | **11.9n** | **22.7p** |
| **Pass zone** | | | | | | | | | | |
| Frontal | 40.8 | 39.3 | 37.9 | 45.3 | 40.6 | 43.4 | 38.0 | 41.1 | 37.0 | 43.8 |
| Lateral | 59.2 | 60.7 | 62.1 | 54.7 | 59.4 | 56.6 | 62.0 | 58.9 | 63.0 | 56.2 |
| **Reception zone** | | | | | | | | | | |
| High post | **63.7p** | 53.6 | 59.2 | **46.5n** | **46.9n** | 47.2 | **42.0n** | 54.8 | **69.8p** | **49.8n** |
| Low post | **36.3n** | 46.4 | 40.8 | **53.5p** | **53.1p** | 52.8 | **58.0p** | 45.2 | **30.2n** | **50.2p** |
| **Reception distance** | | | | | | | | | | |
| Strong side | 69.2 | 69.4 | 64.4 | 80.2 | 59.4 | 67.9 | 76.0 | 61.6 | 71.4 | 68.9 |
| Weak side | 30.8 | 30.6 | 35.6 | 19.8 | 40.6 | 32.1 | 24.0 | 38.4 | 28.6 | 31.1 |
| **Reception attitude** | | | | | | | | | | |
| Positional | 39.9 | 37.7 | 36.8 | 44.2 | 46.9 | **18.9n** | **14.0n** | **28.8n** | **44.1p** | **49.6p** |
| Dynamic | 60.1 | 62.3 | 63.2 | 55.8 | 53.1 | **81.1p** | **86.0 p** | **71.2p** | **55.9n** | **50.4n** |
| **Defensive help** | | | | | | | | | | |
| Help | 51.1 | 56.8 | 54.0 | 58.1 | 50.0 | 47.2 | 62.0 | **41.8n** | 57.6 | 55.6 |
| No Help | 48.9 | 43.2 | 46.0 | 41.9 | 50.0 | 52.8 | 38.0 | **58.2p** | 42.4 | 44.4 |
| **Effectiveness** | | | | | | | | | | |
| Successful | 62.3 | 64.5 | 61.5 | 68.6 | 78.1 | 73.6 | 74.0 | 64.4 | 58.8 | 66.1 |
| Unsuccessful | 37.7 | 35.5 | 38.5 | 31.4 | 21.9 | 26.4 | 26.0 | 35.6 | 41.2 | 33.9 |

Bolt numbers indicate positive (p) or negative (n) significant associations between specific players positions (Chi-Square $p < .05$; ASRs $> \pm 1.96$).

Table 1 shows distribution and relationships between variables studied. Passer action, receiver action, pass distance, and reception zone were significantly associated according to players specific position, as follows: passer position was related to passer action ($X2(12)=56.711$; $p<.001$; $V=.16$), receiver action ($X2(20)=50.158$; $p<.001$; $V=.13$), reception zone ($X2(2)=12.182$; $p=.016$; $V=.12$). On the other hand, re-ceiver position was related to passer action ($X2(12)=47.852$; $p<.001$; $V=.14$), receiver action ($X2(20)=168.219$; $p<.001$; $V=.23$), pass distance ($X2(4)=12.900$; $p=.012$; $V=.13$), re-ception zone ($X2(4)=32.733$; $p<.001$; $V=.20$), reception attitude ($X2(4)=43.117$; $p<.001$; $V=.23$) and defensive help ($X2(4)=12.847$; $p=.012$; $V=.13$).

Adjusted residual analysis revealing the level of associa-

tions between players' specific positions and players' actions is depicted in figure 1. Regarding passing actions, BD was unlikely performed by PF (ASRs=-3.3; n=20), BND was seldom seen in PG (ASRs=-3.5; n=21) but mostly in PF (ASRs=2.3; n=16) and C (ASRs=2.0; n=7), OBS was typically in PG (ASRs=2.3; n=54) and very rarely in PF and C (n=0), and P was quite frequent in PF (ASRs=4.6; n=50) but not in SG (ASRs=-2.2; n=53). Regarding receiver actions, OBS&roll was regularly performed by PF (ASRs=3.3;

n=64) and C (ASRs=2.1; n=47) but rarely by outside players (n<10), OoBS was frequent in C (ASRs=2.1; n=47) whilst OoBS&roll in SG (ASRs=3.9; n=9) and SF (ASRs=4.9; n=20), WB was prevalent in PF (ASRs=2.0, n=28), DC was more likely in PG (ASRs= 4.6; n=34), SG (ASRs= 5.7; n=36), and SF (ASRs=3.2; n=68) than PF (ASRs=-3.3; n=87) and C (ASRs=-4.6; n=56), and P was common in C (ASRs= 4.2; n=106).
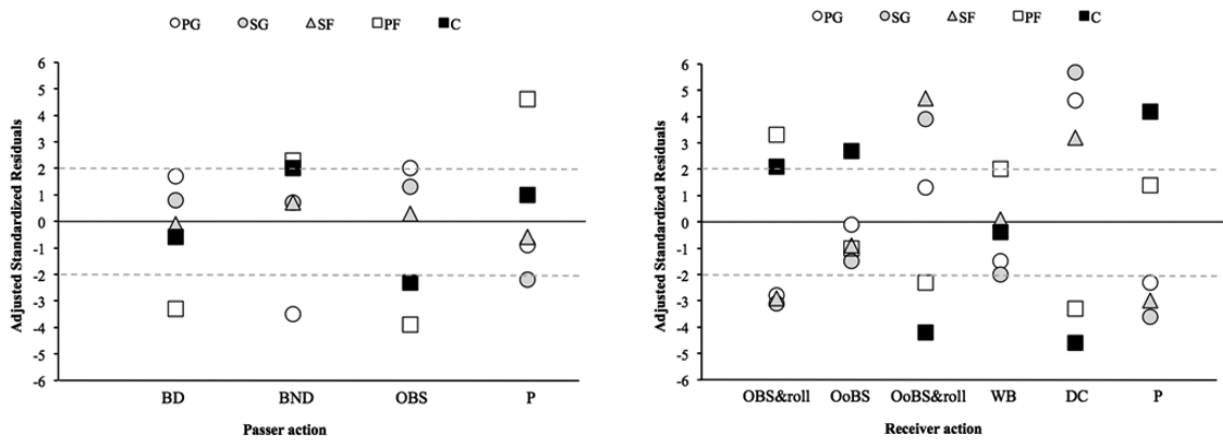


**Figure 1.** Adjusted residual analysis of passer (left panel) and receiver (right panel) actions regarding players' specific position. The dotted lines represent observed frequencies greater than or less than chance, respectively (ASRs<±1.96; *p*<.05).

### Decision tree analysis

CHAID Model 1 describing passing transitions revealed in first term receiver position as main predictor (X2(12)=97.003; p<0.001), classifying four main roots: PG passes, SF/C passes, SG passes, and PF passes. Then, receiver action was set as a second predictor in root 1 (X2(4)=50.001; p<0.001), root 2 (X2(4)=39.180; p<0.001) and root 3 (X2(4)=50.001; p<0.001). Finally, reception zone was detected as a last predictor in root 1 (X2(4)=12.882; p<0.05). Figure 1 displays weighted edges of passing transitions regarding main roots and predictors detected. As depicted, root 1 (PG) classified three main paths: a) PG pass + PF reception + receiver action (OBS&roll, OoBS, WB, P) + reception zone (High post); b) PG pass + C reception + receiver action (OBS&roll, OoBS, WB, P) + reception zone (Low post); c) PG pass + SF reception + receiver action (OoBS&roll, DC). Root 2 (SG) classified two main paths: a) SG pass + SF reception + receiver action (OBS&roll, DC, WB); b) SG pass + C reception + receiver action (OBS&roll, DC, WB). Root 3 (SG) classified four main paths: a) SF/C pass + PF reception + receiver action (OBS&roll, P); b) SF/C pass + C reception + receiver action

(OBS&roll, P); c) SF/C pass + SG reception + receiver action (OoBS, OoBS&roll, WB, DC); d) SF/C pass + PG reception + receiver action (OoBS, OoBS&roll, WB, DC). Root 4 (PF) was not able to discriminate beyond receiver's position.

CHAID Model 2 describing receiving transitions revealed in first term receiver position as main predictor (X2(12)=101.095; p<0.001), classifying four roots: C receptions (root 1), SF receptions (root 2), PF receptions (root 3), and PG/SG receptions (root 4). Then, following variables were set as second predictors: receiver action in root 1 (X2(4)=21.368; p<.01), passer action in root 2 (X2(4)=15.042; p<.05), and passing zone in root 3 (X2(4)=14.371; p<.05). Finally, defensive help in root 1 (X2(4)=16.405; p<.05) and effectiveness in root 3 (X2(4)=10.635; p<.05) were detected as last predictors. Figure 2 displays weighted edges of passing transitions regarding main roots and predictors detected. As depicted, root 1 (C) classified one main path: a) receiver action (OBS&roll, OoBS) + SG pass + C reception. Root 2 (SF) classified two main paths: a) PG pass + passer action (OBS, BD) + SF reception; b) PF pass + passer action (BND, P) + SF reception. Root 3 (PF) classified one main path: PG pass + receiver action (OBS&roll, WB) + PF reception.
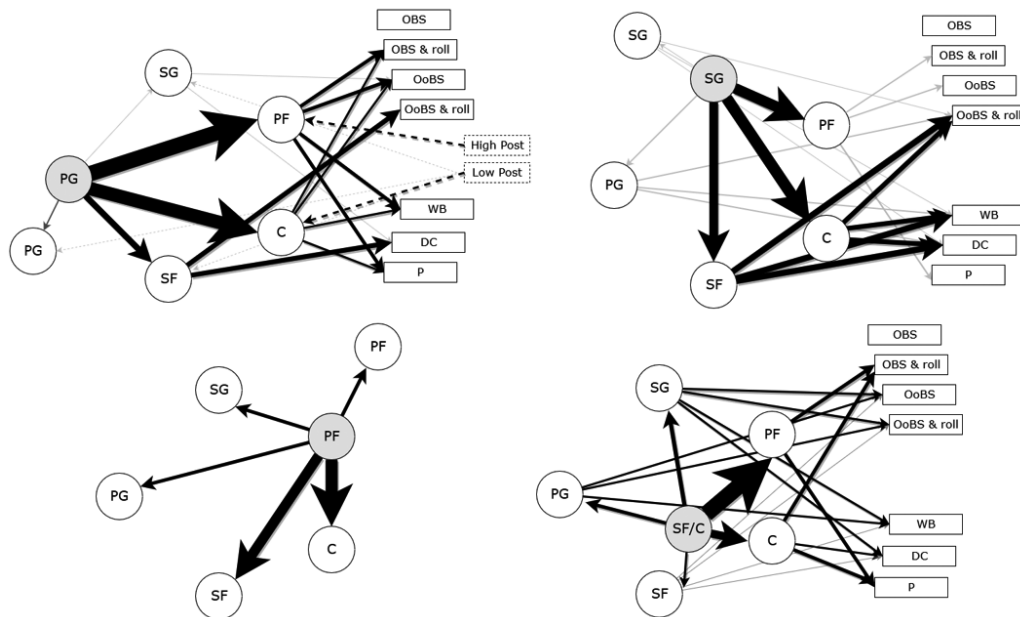
**Figure 1.** Weighted graph of ball pass transitions according to specific players' position: PG passes (root 1), SF/C passes (root 2), SG passes (root 3), and PF passes (root 4). Predictors are displayed in circles (specific players' position) and rectangles (players' action). Edges width is proportional to probability of transition between roots. Dotted lines indicate a third root division. Second-path edges colours represent increments over 10% (black) and below 10% (grey).
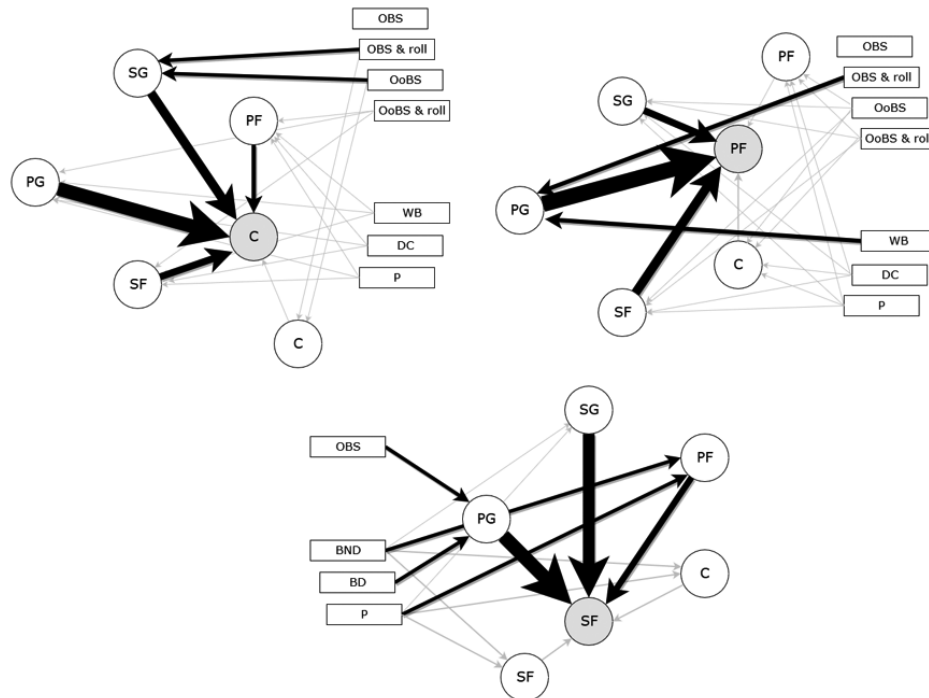


**Figure 2.** Weighted graph of ball reception transitions according to specific players' position: C receptions (root 1), SF receptions (root 2), PF receptions (root 3), and PG/SG receptions (root 4). Predictors are displayed in circles (specific players' position) and rectangles (players' action). Edges width is proportional to probability of transition between roots. Second-path edges colours represent increments over 10% (black) and below 10% (grey).

## Discussion

Current study sought to identify players' relationships according to their specific position when using inside pass in NBA playoffs teams. As expected, outside players were likely to pass the ball while inside players received it. However, we detected well-defined pass and reception transition patterns especially when including interactions between outside-inside players. Concretely, seven pairs of players were positively associated: PG-PF, SG-SF, SF-PF, PF-SF, PF-SG, PF-PG, and C-PG. This concurs with Fewell et al. (2012), who found risks on moving the ball frequently to a specific player position as it allows the opposition to adjust their defence accordingly. Indeed, players' actions around the outside are required to force defensive displacement and generate optimal passing conditions near the basket, enhancing scoring options by reducing opposition degree and helps occurrence (Courel-Ibáñez, et al., 2016; Sautu, Garay, & Hernández-Mendo, 2009). Our findings support this premise, as the lack of previous passer's actions (i.e., ball not dribbled and positional standing) was negative associated with specialist passing positions like PG and SG. Furthermore, we observed that particular actions previous the reception have been used differently according to the players' specific position. On the one hand, on ball screen and roll is the commonest way for PF and C to get the ball in the inside, whilst dive cuts are proper to outside players like PG, SG and SF. This seems logical given that ball screen effectiveness relies on how the ball hander perceives defender actions - requiring a dribbling and passing skills - and how well the screener sets the screen to free the player with the ball – requiring enough strength and body size to stand against the physical contact (Gómez, et al., 2015; Hollins, 2003). Besides, NBA outside players are lately becoming more athletic, increasing jump, speed and power skills that allow them to grab the ball in higher heights (enhancing alley-oops options) and also dunking the ball from farther distances from the basket (Mateus, Gonçalves, Abade, Liu, Torres-Ronda, Leite, & Sampaio, 2015). On the other hand, out of ball screens and roll are practically only made by SG and SF. This is quite interesting since this specific movement involves two supporting players without the ball, which indicate the importance of overlapping collective interactions away from the ball (weak side) to create free space in favour of the receiver (Courel-Ibáñez, et al., 2016; Lamas, Santana, Heiner, & Ugrinowitsch, 2015). For instance, as depicted in Figure 3, first inside pass option comes from a pick and roll between PG and C in the strong side. Meanwhile in the weak side, an out of ball screen between SF and PF is trying to avoid defensive helps against C, as well as providing a second inside pass option from the PF roll. As a last chance, SG cuts toward the basket to receive as approaching to the rim (both from PG or C), but also helps on SF potential open pass by

moving his opponent at the inside. These sequences of movements have been widely used in the Utah Jazz team headed by John Stockton (NBA's all-time leader in assist) and Karl Malone (NBA's 2nd all-time leading scorer) (Howell, 2011).
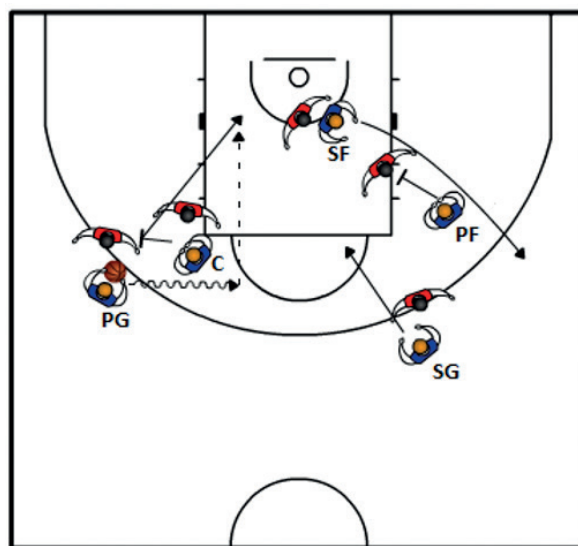


**Figure 3.** A common outside-inside players' interaction during an inside pass. Strong side (left): On ball screen and rolling between PG and C. Weak side (right): At the same time, out of ball screen of PF in favor SF while SG cuts toward the basket. Continuous arrows indicate player movement without the ball, dotted arrows indicate a pass, and a T indicates a screen.

We were especially interested in discovering ball transition patterns to describe how players collectively behave during inside pass situations. This approach is spreading widely in basketball research since allow to represent basic structure of players' interactions in the match, which help in better understanding of game dynamics during the competition (Fewell et al., 2012; Lamas et al., 2015). In the current study, we were able to detect and describe a series of common game strategies used to make the ball reach the inside according to passer and receiver specific positions and the action perform. As mentioned above, the highest used connections involved PG and SG passes with PF, SF, and C receptions. These data corroborate those reported by Fewell et al., (2012), who observed that NBA teams' ball movement is controlled mainly by the PG and secondary by the SG, while PF functioned as the primary shot-taker and C usually had the highest success/failure ratio. Besides, the superior physical condition of NBA players, linked with their extraordinary skills chiefly in post-game positions, promote the use of the inside game as an efficient tactic to easily score even against the latent high defensive pressures (Erčulj & Štrumbelj, 2015; Mavridis, et

al., 2009). Nevertheless, we detected differences in the way these players interact when aimed at getting the ball reaches the paint. For instance, PF receiving odds increased when PG had the ball and mainly after screening and rolling to the high post. Conversely, C receiving options came mostly from the SG and after rolling to the low post.

It is worth noting at this point the role of inside players as passers and not only as receivers. We noticed important increments on PF reception chances when C or SF had the ball but also the vast majority of PF passes were received by C or SF. Certainly, inside players' role require passing skills to initiate the offence after a defensive rebound, to stimulate fastbreak options by an outlet pass, or to redistribute the ball to the outside after an offensive rebound (Cárdenas et al., 2015; Fewell, at al., 2012). However, during the offense, inside players should be also involved in the development of collective dynamics focused in taking advantage of the high- and low-post positions (Figure 4), such as the triangle offence (Jackson & Winter, 2009), or the best-known John Wooden's

UCLA offence (Wooden & Nater, 2006). These kind of strategies and their multiples variations results in great benefits serving as an alternative to avoid defensive adjustment and force defensive imbalances, emerging a large variety of optimal shooting conditions. Nonetheless, inside players should be technically and tactically trained accordingly to their new role - far beyond just rebounding, screening and blocking -, in which tactical intelligence, creativity, pattern detection, passing-receiving skills and decision making abilities play a crucial role (Alarcón, Cárdenas, Miranda, Ureña, & Piñar, 2010; Perales, Cárdenas, Piñar, Sánchez, & Courel, 2011; Memmert, 2013). Indeed, it is becoming easier to find inside players passing specialist in the NBA, called by the press as "point centers"; for instance in the latest season (2015-2016), centers like Pau Gasol (4.1 assists per game) or Marc Gasol (3.8 assists per game), and point forwards Draymond Green (7.8 assists per game) or Blake Griffin (4.9 assists per game) reached numbers close to guard positions.
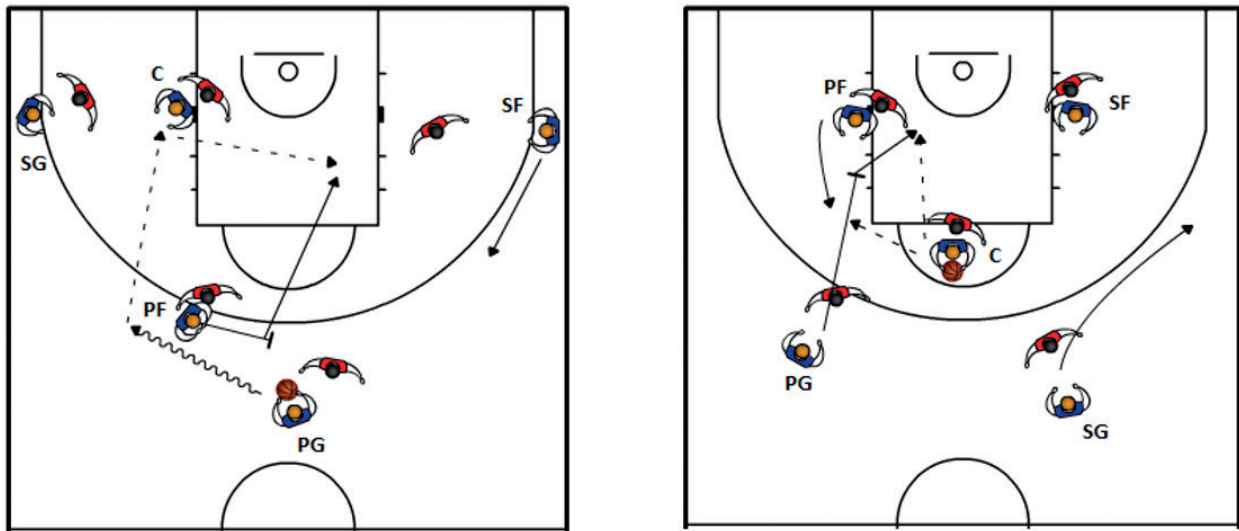


**Figure 4.** Post players passing combinations during an inside pass. Left graph: pick and roll between PG and PF and triangle with C assisting. Right graph: C in the high-post handling the ball, PG set a down screen for PF while SG cuts to the wing. Continuous arrows indicate player movement without the ball, dotted arrows indicate a pass, and a T indicates a screen.

Finally, the lack of detecting ball transitions that result in more effectiveness (i.e., larger points scored or fouls received) might be explained given the greater benefits that inside pass situations provided per se to the offence (Courel-Ibáñez, et al., 2013; 2016). Hence, current players' combinations should be considered as useful ways to enhance inside pass options, consequently increasing team's odd of succeeding. There is however an open challenge for performance analysis researches of assessing the quality of actions to the whole possession (Cervone, D'Amour, Bornn, & Goldsberry, 2014),

raising the spectre of methods conduced, offensive and defensive behaviours measured and, more importantly, feed the debate on defining what would be considered as a good or a not-so-good decision according to each specific game situation. Current investigation could be limited however by the lack of defensive factors assessment, so we were unable to express how the offensive action is influenced by the defensive reaction (Lamas et al., 2015). Another potential limitation could be the study of short-time period events like just before or right after the pass, missing important information on

how these situations have emerged (Suárez-Cadenas, Courel-Ibañez, Cárdenas, & Perales, *in press*).

## Practical Applications.

It is importance notice that nearby 20% of total match ball possessions from this sample (score difference below 10 points) included an inside pass, which represents a large potential scoring options with a greater effective rate, even in tight competition situations. Players' configurations described may serve as a useful guide for coaches and staffs when training the inside game. It is recommended developing dynamics interactions in the strong side (pick and roll, pass and cut) linked with simultaneous supporting actions from players in the weak side (out of ball screen, dive cut) to increase scoring options when using inside pass. Furthermore, our findings point out that collaboration between the perimeter and post players is an essential key to success in NBA basketball, highlighting the concept of "point centers" as inside players with greater on ball skills (dribbling and passing), but also capable to score from far distances. These findings may have implications in basketball training and competition process, contributing in a better understanding of collective strategies which leads to an accurate designing of practices task focused on increasing inside game options and players' decision-making according to specific competition constraints.

## References

1.  Agresti, A. (2002). *Categorical Data Analysis (2nd Ed.).* New York, US: Wiley.
2.  Alarcón, F., Cárdenas, D., Miranda, M. T., Ureña, O., & Piñar, M. I. (2010). La influencia de un modelo constructivista para la enseñanza de la táctica en baloncesto sobre la eficacia del juego durante la competición. *Retos: nuevas tendencias en educación física, deporte y recreación, 17*, 15-20.
3.  Altman, D. G. (1991). *Practical Statistics for Medical Research.* London: Chapman & Hall.
4.  Anguera, M. T., Blanco, A., Hernández-Mendo, A., & Losada, J. L., (2011). Diseños observacionales: ajuste y aplicación en psicología del deporte. *Cuadernos de psicología del deporte, 11*(2), 63-76.
5.  Cárdenas, D., Conde, J., & Courel-Ibáñez, J. (2013). El uso del Match Analysis para la mejora del rendimiento físico en los deportes de equipo. *Cultura, Ciencia y Deporte*, (23), 147-154.
6.  Cárdenas, D., Ortega, E., M., Llorca, J., Courel, J, Sánchez-Delgado, & Piñar, M., (2015). Motor Characteristics of fast break in high level basketball. *Kinesiology*, 47(2), 3-10.
7.  Cervone, D., D'Amour, A., Bornn, L., & Goldsberry, K. (2014). *Predicting points and valuing decisions in real time with NBA optical tracking data.* In: MIT Sloan Sports Analytics Conference; p. 1–9.
8.  Courel-Ibáñez, J., Suárez-Cadenas, E., Ortega, E., Piñar, M., & Cárdenas, D. (2013). Is the inside pass a performance indicator? Observational analysis of elite basketball teams. *Revista de Psicología del Deporte, 22*(1), 191-194.
9.  Courel-Ibáñez, J., McRobert, A.P, Ortega, E., & Cárdenas, D. (2016). Inside pass predicts ball possession effectiveness in NBA basketball. International Journal of Performance Analysis in Sport, 16, 711-725.
10. Duarte, R., Araújo, D., Correia, V., & Davids, K. (2012). Sports Teams as Superorganisms. *Sports Medicine, 42*(8), 633-642.
11. Erčulj, F., & Štrumbelj, E. (2015). Basketball Shot Types and Shot Success in Different Levels of Competitive Basketball. *PloS one, 10*(6), e0128885. doi: 10.1371/journal.pone.0128885.
12. Fewell, J. H., Armbruster, D., Ingraham, J., Petersen, A., & Waters, J. S. (2012). Basketball teams as strategic networks. *PloS one, 7*(11), e47445.
13. Field, A. (2009). *Discovering statistics using SPSS.* London: Sage publications.
14. Fritz, C. O., Morris, P. E. and Richler, J. J. (2012) Effect size estimates: Current use, calculations, and interpretation. *Journal of Experimental Psychology: General*, 141(1), 2-18. doi: 10.1037/a0024338.
15. Gabín, B., Camerino, O., Anguera, M.T., & Castañer, M. (2012), Lince: multiplatform sport analysis software. *Procedia Computer Science Technology, 46*, 4692 – 4694.
16. Glazier, P. S. (2010), Game, set and match? Substantive issues and future directions in performance analysis, *Sports Medicine, 40*, 625-634.
17. Gómez, M. Á., Battaglia, O., Lorenzo, A., Lorenzo, J., Jiménez, S., & Sampaio, J. (2015). Effectiveness during ball screens in elite basketball games. *Journal of Sports Sciences*, 33(17), 1844-1852.
18. Gréhaigne, J-F., & Godbuout, P. (2013). Collective variables for analysing performance in team sports. In T. McGarry, P. O'Donoghue & J. Sampaio (Eds.), *Routledge Handbook of Sports Performance Analysis* (pp. 101-114). London, UK: Routledge.
19. Guppillotte, A. (2008). The inside-outside game. *FIBA Assist Magazine, 34*, 8–11.
20. Hollins, L. (2003). The screens and various options. *FIBA Assist Magazine, 5*, 6–13.
21. Howell, B. (2011). *Utah Jazz.* Minnestona, USA: ABDO.
22. Jackson P, Winter T (2009) *Triangle Offense.* In: Gandolfi G, editor. NBA coaches playbook. Champaign, US: Human Kinetics p. 89–11
23. Lamas, L., Junior, D., Santana, F., Rostaiser, E., Negretti, L., & Ugrinowitsch, C. (2011). Space creation dynamics in basketball offence: validation and evaluation of elite teams. *International Journal of Performance Analysis in Sport, 11*(1), 71-84.
24. Lamas, L., Santana, F., Heiner, M., Ugrinowitsch, C., & Fellingham, G. (2015). Modeling the Offensive-Defensive Interaction and Resulting Outcomes in Basketball. *PloS one, 10*(12), e0144435.
25. Maslovat, D., & Franks, I. (2008). *The need for feedback.* In M. Hughes & I. Franks (Eds.), The essentials of performance analysis: an introduction (pp. 1-7). London, UK: Routledge.
26. Mateus, N., Gonçalves, B., Abade, E., Liu, H., Torres-Ronda, L., Leite, N., & Sampaio, J. (2015). Game-to-game variability of technical and physical performance in NBA players. *International Journal of Performance Analysis in Sport, 15*(3), 764-776.
27. Mavridis, G., Tsamourtzis, E., Karipidis, A., & Laios, A., (2009). The inside game in World Basketball. Comparison between European and NBA teams. *International Journal of Performance Analysis in Sport, 9*(2), 157-164.
28. McGarry, T. (2009). Applied and theoretical perspectives of performance analysis in sport: Scientific issues and challenges. *International Journal of Performance Analysis in Sport, 9*(1), 128-140.
29. Memmert, D. (2013). *Tactical creativity.* In P. O'Donoghue & J. Sampaio (Eds.), Routledge handbook of sports performance analysis (pp. 297-308). London, UK.: Routledge.
30. Norusis, M. (2004). *SPSS 13.0 Guide to Data Analysis.* Upper Saddle-River, N.J.: Prentice Hall, Inc.
31. Perales, J. C., Cárdenas, D., Piñar, M. I., Sánchez, G., & Courel, J.

(2011). El efecto diferencial de la instrucción incidental e intencional en el aprendizaje de las condiciones para la decisión de tiro en baloncesto. *Revista de Psicología del Deporte, 20*(2), 729-745.

32. Randolph, J. J. (2005). *Free-Marginal Multirater Kappa (multirater K [free]): An Alternative to Fleiss' Fixed-Marginal Multirater Kappa.* Online Submission.

33. Sampaio, J., McGarry, T., Calleja-González, J., Sáiz, S. J., i del Alcázar, X. S., & Balciunas, M. (2015). Exploring game performance in the national basketball association using player tracking data. *PloS one, 10*(7), e0132894.

34. Sautu, L. M., Garay, J. O., & Hernández, A. (2009). Observación y análisis de las interacciones indirectas en el baloncesto ACB. *Cuadernos de Psicología del Deporte, 9*, 69.

35. Suárez-Cadenas, E., Courel-Ibañez, J., Cárdenas, D. & Perales, J. C. (*In press*). Towards a decision quality model for shot selection in basketball: An exploratory study. *The Spanish Journal of Psychology.*

36. Wooden, J., & Nater, S. (2006). *John Wooden's UCLA offense.* Champaign, US: Human Kinetics.