# A BIOMECHANICAL ANALYSIS OF 1-ON-1 OFFENSE'S FEINT MOTION WITH A DRIBBLE IN BASKETBALL

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The purposes of this study were to classify 1-on-1 feint motion with a dribble in basketball by the cluster analysis and to investigate the biomechanical characteristics of the classified one. The subjects were ten male varsity basketball players. The 1-on-1 feint motion with a dribble in basketball were classified into 4 types; Anterior-Posterior (AP) type, Shaking-Left- Right (S-LR) type, Shaking-Anterior-Posterior (S-AP) type, Left-Right (LR) type by the Ward method of the hierarchical cluster analysis with Euclidean distance measure based on the relative COM velocity and relative foot position. The AP and LR types that an offensive player took large step at switching without shaking the COM were likely to be easy to defend, but shaking the COM was an effective technique to get a head of a defensive player.

**KEY WORDS:** motion analysis, kinematics, relative velocity, cluster analysis

**INTRODUCTION:** In basketball, a dribble motion is one of the most frequently-used techniques to carry a ball, and for an offensive player to get a head of a defensive player or to dodge with a various feint motion. Previous biomechanical investigations analysed the dribbling motion only for an individual offensive or defensive player (McClay et al.,1994;Hirata et al., 2011). Although in real games the 1-on-1 feint motion with a dribble varies with situation, defensive players and so on, there seems no scientific information on the feint motion with a dribble against a defensive player enough to design effective teaching and coaching methods. The purposes of this study were to classify 1-on-1 feint motion with a dribble in basketball by the cluster analysis and to investigate the biomechanical characteristics of the classified one.

**METHODS:** The subjects were ten male varsity players that were skillful in handling a ball (height, 1.79±0.06m; weight, 76.1±6.5kg; point-guard) and one male varsity player that was good at defensing (height, 1.74m; weight, 72kg; point-guard). The offensive players were told to get a head of the defensive player with a feint motion at any time. The defensive player was advised to block the course of dribbling rather than cutting a ball. A successful trial was defined as one that each subject was able to move the ball from the right hand to the left hand and change the subject's direction of running after cutting with his right foot.

Three-dimensional coordinates of 47 reflective markers fixed on the offensive and defensive players and 4 markers fixed on the ball were captured with a Vicon T20 system (Vicon Motion System, Ltd.) using 20 cameras operating at 250 Hz. The coordinate data were smoothed with a Butterworth low-pass digital filter with cut-off frequencies ranging from 15.0 to 22.5 Hz which were determined by the residual method by Wells and Winter (1980).The segment angle, relative position of the center of mass (COM), relative COM velocity, motion time, and selected biomechanical variables were obtained.

Figure 1 defines the events used in the present study. The "catch1" was the instant of catching the ball before the switching step, the "B-cd" indicated that the ball was positioned at the rightmost, the "R-off1" was the toeoff before the switching step, and the "R-cd" was the instant of the touchdown of the switching step foot. The "R-off2" was the toeoff after the switching step, the "catch2" was the instant of catching the ball after the switching step, and the "R-on" was the touchdown after the switching step.

The successful trials from all the subjects were classified by the Ward method of the hierarchical cluster analysis with Euclidean distance measure using four elements: X (medial-

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lateral direction) and Y (anterior-posterior direction) components of average relative COM velocity and the foot position of the offensive player relative to that of the defensive one.
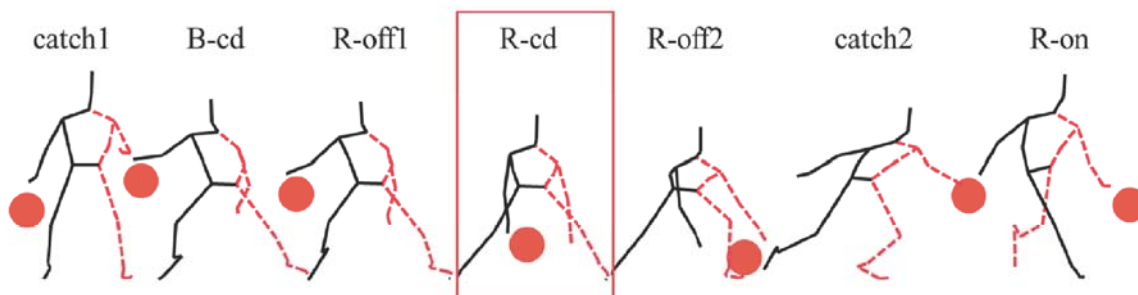


**Figure 1. The event definition of the feint motion with a dribble.**

**RESULTS AND DISCUSSION:** Figure 2 shows the result of the hierarchical cluster analysis by two elements: X component of the average relative COM velocity and Y component of the relative foot position. Figure 3 shows the distribution of successful trials on the two elements. Figures 2 and 3 indicated that the feint motions of ten players were divided into four types. The first type was Anterior-Posterior (AP, subjects E, H and J) type that the players took a large forward step after a small shaking of the COM. The second one was Shaking-Left-Right (S-LR, subjects G and I) type that the players took a small step at the time of switching after a large shaking in left and right direction of the COM before switching. The third one was Shaking-Anterior-Posterior (S-AP, subjects A, B and D) type that the players took a small step at the time of switching after a large shaking in anterior and posterior direction of the COM. The fourth one was Left-Right (LR, subjects C and F) type that the players took a large step in left and right direction at the time of switching after a small shaking of the COM.
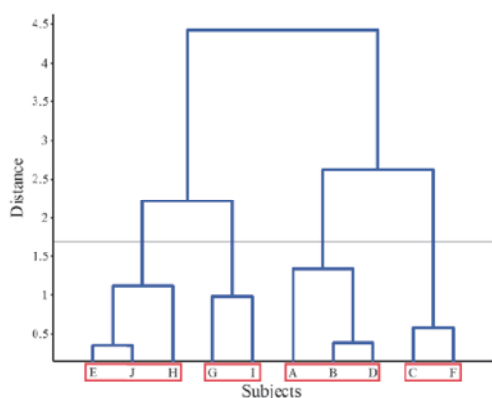


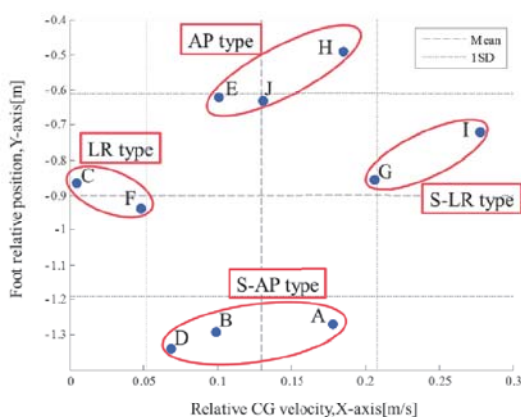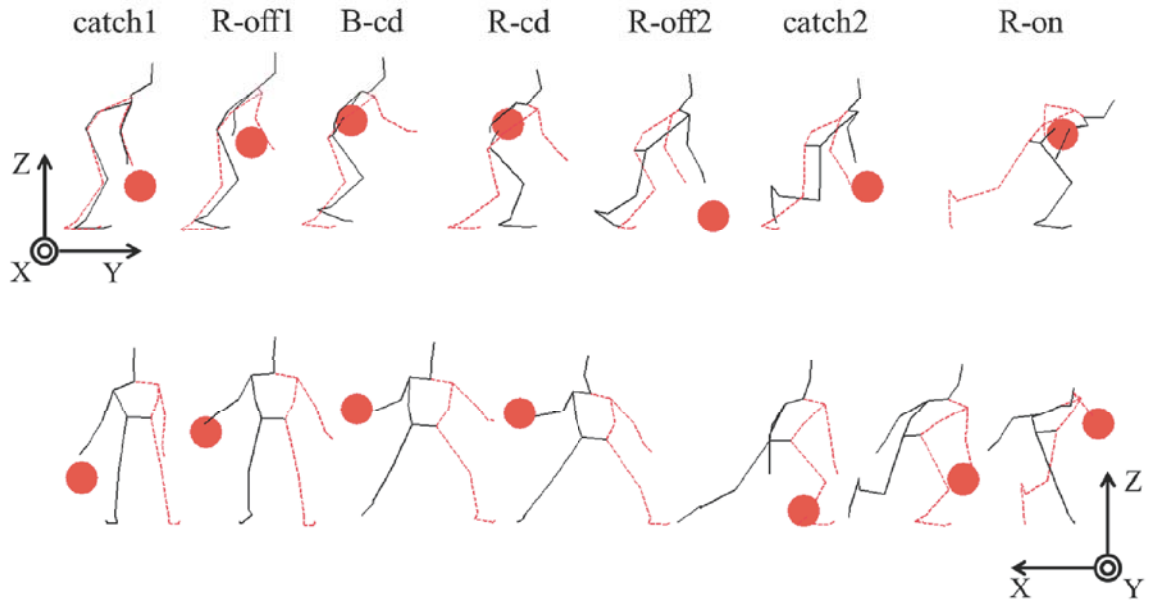**Figure 2 Results of the cluster analysis with two elements.**

**Figure 3 Distribution of successful feint motions.**

Figure 4 shows stick pictures of the feint motion of AP (subject H) and S-AP (subject D) types in Y-Z plane and X-Z plane. A solid line indicates the right side of the body, a broken line is the left side, and a large circle is a ball. The AP type was the large ball movement, the high position of the ball at B-cd and the right foot moving forward, and the widen stance at R-cd. The players of S-AP type took the wide stance from the time of catch1, dribbled in the low position, moved the ball at a small strake at B-cd, and then stepped the left foot forward at R-cd.

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## AP type  Subj.H

catch1    R-off1    B-cd    R-cd    R-off2    catch2    R-on

## S-AP type Subj.D

catch1    B-cd    R-off1    R-cd    R-off2    catch2    R-on
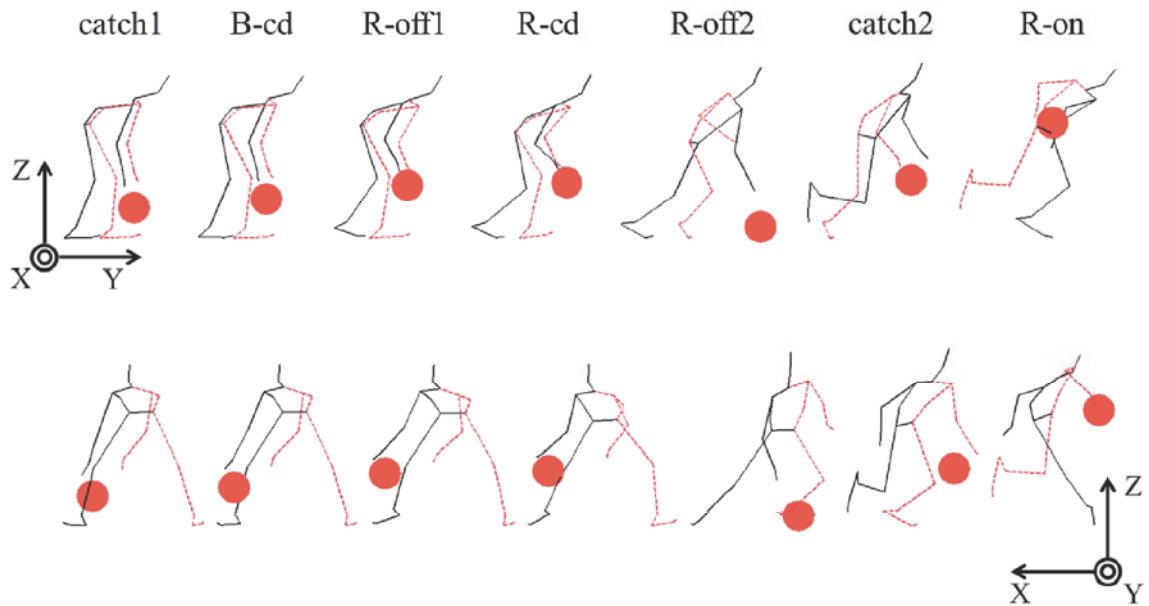
**Figure 4. Stick pictures of the feint motion of AP (subject H) and S-AP (subject D) types in Y-Z plane and X-Z plane.**

Figure 5 shows the changes in the lean angle of the left shank for the defensive player from R-off1 to R-cd (time zero). The decreasing lean angle of the left shank for the defensive player against the AP type player indicated that the player prepared to step backward in response to the offensive player. The forward leaning of the defensive player against the S-AP type player

indicated that the defensive player intended to step forward in response to the offensive player who was moving backward. Since the defensive player leaned the shank back and forth to respond the offensive player's feint motion, it may be helpful for the offensive player to watch the shank movement of the defensive player for the prediction of the defensive player's movement direction.

As shown in Figure 6, only one failed trial (□B) located near the S-AP type, while other failed trials were seen around the AP type and LR type. This may indicate that the types with a large step at switching without shaking were likely to be easy to defend, but shaking the COM was an effective technique to get a head of a defensive player. This is because the defensive player tended to predict the movement of the offensive player from a large step and the body movement, as demonstrated by the AP and LR types.
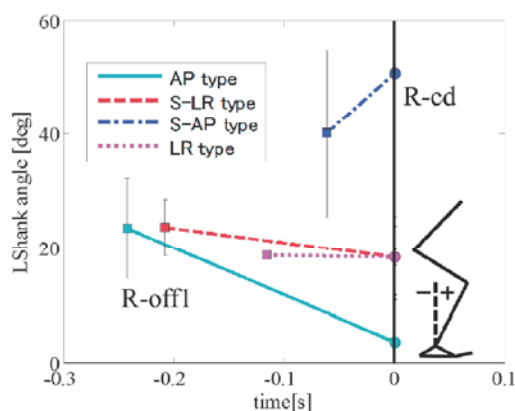


**Figure 5 Changes in the lean angle of the left shank for the defensive player.**
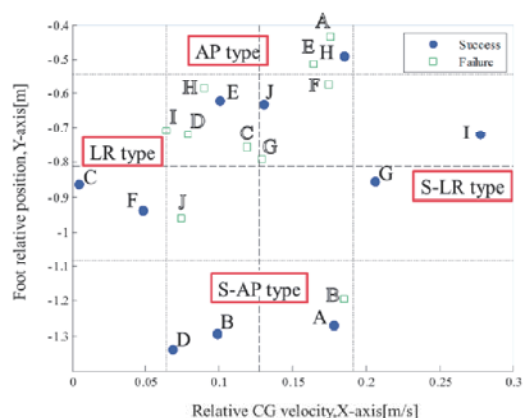
**Figure 6 Distribution for the successful and failed trials of the classified feint motions.**

**CONCLUSION:** The 1-on-1 feint motions with a dribble in basketball were classified into 4 types (Anterior-Posterior type, AP type; Shaking-Left-Right type, S-LR type; Shaking-Anterior-Posterior type, S-AP type; Left-Right type, LR type) by the cluster analysis based on the relative COM velocity and relative foot position.

The AP and LR types that an offensive player took large step at switching without shaking the COM were likely to be easy to defend, but shaking the COM was an effective technique to get a head of a defensive player. It may be helpful for the offensive player to watch the shank movement of the defensive player for the prediction of the defensive player's movement direction.

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