

## DELIVERIES TO HOME PLATE AND FIRST BASE MADE BY LEFT-HANDED BASEBALL PITCHERS

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The purpose of this study was to analyze differences between the delivery to home plate and first base of left-handed baseball pitchers and, subsequently, quantify the pick-off move. Seven healthy participants were used in the study, and all were current or former collegiate pitchers. Deliveries to both targets were captured in three dimensions, and selected kinematics were used for comparison. Results showed that of the selected kinematics, only upper torso rotation (UTR) displayed both statistically significant differences as well as differences that could be detected in game situations. Other measurements showed differences in their means, but were not disparate enough to be considered reliable for use in game strategy. High-level left-handed pitchers maximize their natural advantage.

**KEY WORDS:** baseball, pitching, pick-off move, kinematics.

**INTRODUCTION:** The pick-off is an essential skill for any baseball pitcher. After a runner reaches first base, he is allowed to lead-off first base towards second base as far as he wants. In an attempt to shorten the lead-off and potentially have the base runner tagged out, pitchers can choose to throw to first base. This delivery of the ball to first base instead of being pitched to home plate is called a pick-off. The importance of the pick-off is magnified for left-handers because they face first base and can make their move later and more deceptive (Mazzoni, 1995; Stallings, 1997). From the set position, the left-handed pitcher (LHP) can kick his lead leg up and even begin to bring it down without revealing in which direction he intends to throw. For right-handed pitchers, as soon as his lead leg kicks up, he must deliver the ball to home plate. LHPs are encouraged to maximize this advantage to its fullest extent. Most coaches have similar philosophies when it comes to teaching the left-handed pick-off move. For example, Fairfield University coach Wayne Mazzoni (1995) reminds his LHPs of three important keys to a successful pick-off move: (a) maintaining equal lower body movements when coming either to home plate or first base; (b) keeping the same rhythm about his motion; (c) and not pointing his lead leg or toe toward first during a pickoff unless it is also a part of his motion to home plate. He adds that no noticeable shoulder or torso rotation should be detected by the runner or opposing coach in a pick-off attempt. There exists an exorbitant amount of research on the biomechanics of the pitching motion (Barrentine et al., 1998; Braatz & Gogia, 1987; Dillman et al., 1993; Elliot et al., 1985; Elliot et al., 1988; Escamilla et al., 1998; Feltner & Dapena, 1986; Pappas, Zawacki, & Sullivan, 1985; Werner, Fleisig, Dillman, & Andrews, 1993; Stodden et al., 2001). However, no known studies have undertaken the biomechanical comparison of the pitcher's pick-off move, nor have they focused on LHPs. Even though LHPs possess a distinct advantage when it comes to pick-off moves, having identical deliveries to home plate and first base is extremely challenging. Therefore, the purpose of this study was to determine the kinematic differences between deliveries to home plate to deliveries to first base in left-handed highly experienced baseball players. Specifically, the amount of upper torso rotation (UTR), maximum lead leg lift, deflection of the lower lead leg as it approaches maximum lift, and ankle plantar flexion (PF) were compared between the two deliveries. These variables were selected because they reflect the elements of deception that a pitcher attempts to employ when performing an effective pick-off move. It was hypothesized that UTR would be greater in performing the delivery to first base, that lead leg lift and PF would remain fairly constant, and that lower leg swing would be more negative (lower) during the delivery to home plate.

**METHODS:** Seven (N=7) healthy LHPs were recruited for this study. Six currently played for a NCAA Division II university in south Florida, and the other was a former minor league pitcher. All had extensive high school and college pitching experience, and were free of orthopedic injuries. Four 60 Hz JVC cameras were placed in the corners of the Barry University Biomechanics Laboratory facing the center where the participant performed the deliveries

trials. Prior to collection, a 2 x 2 x 2 m control object containing 21 balls with known coordinates was videotaped for calibration purposes. All testing occurred on the same day within an 8 hr time period, and the cameras remained stationary. After reading and signing the informed consent form, participants were given time to familiarize themselves with the laboratory setting and were instructed as to the virtual locations of the mound, home plate, and first base. Participants then performed a warm-up session consisting of 10 min of stretching and 5-10 "dry" repetitions of both deliveries. Reflective markers were then placed bilaterally on the shoulders, the hips, the knees, the ankles, and the shoes directly over the fifth metatarsals. To create the most game-like atmosphere, pitchers wore their baseball mitt, and threw a ball constructed of athletic tape with the same size and mass as a real baseball. This replacement ball was used for the safety of both the pitcher and the laboratory. Participants were first instructed to throw to home plate then move to the set position and deliver the mock ball with game-like intensity towards home plate. After 20-30 seconds of rest, the pitcher repeated the trial, delivering the ball toward home plate. This process was repeated for throws to first base, with the pitcher using his self-selected most deceptive pick-off move. A total of three clean trials for each delivery were recorded. One trial from each condition was randomly selected for analysis. The Peak Motion Measurement System (Motus ver 7.2.3, Englewood, CO) was used to digitize the video records of each participant from the 10th frame before the initial leg lift through the 10th frame after the leg touched down. 3D coordinates were obtained using the Direct Linear Transformation Method (Abdel-Aziz & Karara, 1971). The transformed coordinates were smoothed using a Butterworth filter (10 Hz cut-off frequency). Since the Z-axis was defined as the direction of home plate, the Y-axis as vertical, and the X direction as the cross product of Z and Y, or the direction of first base, the kinematic data were measured in reference to these axes and the associated planes. UTR was measured as the angle between the Z-axis and the segment adjoining the left and right shoulders and projected onto the XZ plane. The deflection, or swing, of the right leg was defined as the angle between the Y axis and the segment connecting the right knee and ankle and projected onto the YZ plane. Lift of the right leg was the angle created between the Y-axis and the segment connecting the right hip and right knee segment and was projected onto the XY plane. PF of the right ankle was the angle between the Y-axis and the segment connecting the ankle and toe and projected on the XY plane. Dependent t-tests ( $\alpha = .05$ ) comparing these angles were used to reduce the data.

**RESULTS:** Data were available for six of the seven pitchers for UTR, for which they displayed a significant difference ( $p < .01$ ) in motions, turning  $60.68 \pm 20.350$  when throwing to first base and  $20.04 \pm 13.980$  when throwing to home plate. All seven pitchers had data for the maximum leg lift, and they had measures of  $74.82 \pm 11.370$  when throwing to first and  $73.78 \pm 12.810$  when throwing home. These differences were not significant ( $p = .705$ ). In fact, a significant correlation ( $p = .02$ ), was found between the leg lifts. Six of the seven pitchers had data for the lower leg swing, in which no significant differences ( $p = .537$ ) existed, with means of  $-6.87 \pm 4.820$  when throwing to first base and  $-11.35 \pm 17.160$  when throwing to home plate. No significant differences were found when the participants were divided into two groups: those whose lower leg swung more on throws to first base ( $n=2$ ) and those whose lower leg swung more on throws to home plate ( $n=4$ ). For the ankle angle, the participants were grouped into two categories: those who exhibited PF on the throw to first base vs. home plate, and those who produced dorsiflexion (DF) on the throw to first base vs. home plate. In the PF ( $n=3$ ), no significant difference was found ( $p = .18$ ), with means of  $117.99 \pm 17.150$  for first base and  $105.04 \pm 24.620$  for home plate. A significant difference ( $p = .01$ ) was found in the DF group ( $n=4$ ), with means of  $121.99 \pm 10.360$  for first base and  $127.24 \pm 9.350$  for home plate. Figure 1 summarizes these results. Figures 2 and 3 represent the UTR from the initial position until maximum rotation.

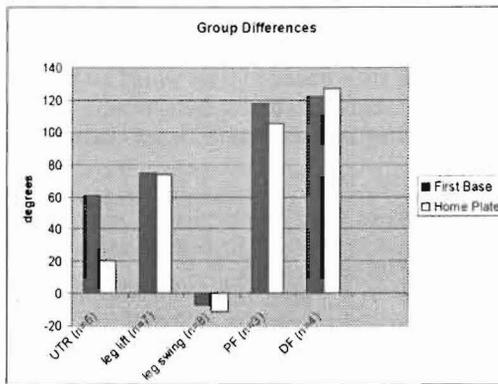


Figure 1: ROM between First Base and Home Plate Deliveries.

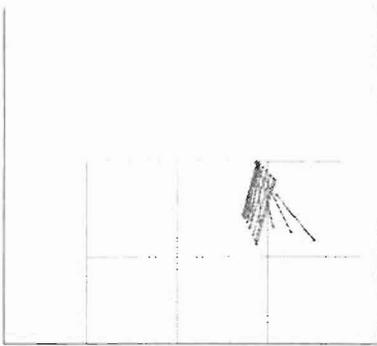


Figure 2: UTR of First Base Delivery.

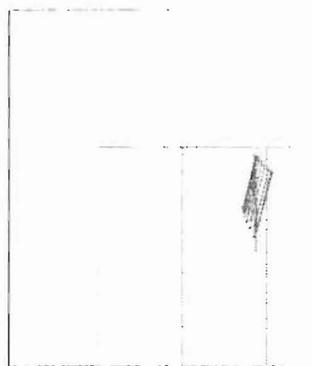


Figure 3: UTR of Home Plate Delivery.

**DISCUSSION AND CONCLUSIONS:** The pick-off move is a complex delivery involving balance, timing, and, most of all, consistency of a perceived identicalness to the delivery to home plate. In the context of this study, differences in most of the variables were found, but as to the application and exploitation of these differences by baseball players, this may not be possible. Changes in UTR were expected to be the most noticeable, since all players are taught to throw the ball by first pointing their lead shoulder towards their intended target before throwing. First base is at a 90 degree angle from home plate, so one might expect the difference between the two to be approximately 90 degrees, but pitchers attempt to mask this physical limitation as best they can, and in this study, pitchers were able to reduce the difference by more than half, with a difference of approximately 40 degrees. As a baserunner, one should be able to see a difference of this magnitude, but unfortunately, the UTR may occur after the baserunner has already made a decision to move towards second base or retreat to first base. A survey of the mindset of the baserunner and pitcher during the pick-off situation may provide insight as to whether the actions on the field accurately reflect the thoughts and expectations of the players.

As for the other dependent variables, while there are some differences between the two deliveries, it is probable that changes of only a few degrees could not be detected at a distance of approximately 60 ft., especially when occurring as moving objects in a motion that spans less than two seconds. Furthermore, even if statistically significant differences are found, they may not mean as much for measurements of pick-off moves because of the added dimension of actually being able to see these differences on the field of play. It can be concluded that this particular group of left-handed pitchers collectively did a very good job of maximizing their deception advantage, making it a very difficult task for baserunners to determine in which

direction the pitcher would intend to throw. It is possible that this is a unique group and other samples or populations may exhibit different characteristics, however the mechanics of the pick-off throw seem to suggest that differences in UTR would be the only useful and detectable variable for a baserunner. It is possible that other measurements such as head movement and trunk lean may be different. However, these variables were not measured in this study.

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