PEAK VERTICAL GROUND REACTION FORCES ARE DIFFERENT DURING STRETCH VS. WIND-UP PITCHING IN COLLEGIATE BASEBALL PLAYERS

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INTRODUCTION

There are two mechanical patterns that baseball pitchers use to deliver the ball, commonly referred to as the stretch and the wind-up. Most biomechanical studies have investigated upper extremity kinematics and are typically focused on the wind-up pattern. Dun et al. is the only study to date that has examined differences between the stretch and wind-up. They found a small but significant difference in pitched ball velocity (0.2 m/s faster from the wind-up than from the stretch). Interestingly, in the upper extremity kinematic and kinetic variables investigated, the authors found no differences [1] between patterns. However, this study reported neither external ground reaction force data nor any lower extremity kinetics values.

Many studies have shown correlations between biomechanical variables and performance measures. However, few pitching studies have been conducted that have accounted for GRFs during the movement. A recent study investigated lower-extremity GRFs in baseball collegiate pitchers, and found strong correlations between GRF data and kinematic and kinetic variables [3]. However, this study failed to report any correlations of GRFs on performance measures.

The variance in ball velocity during pitching might be explained more so by differences in ground reaction forces than in upper body kinematics, since anecdotal evidence suggests that pitch velocity originates in the lower body. No studies have investigated the differences in GRFs between stretch and wind-up motions, therefore the purposes of this study were to compare the differences in ground reaction forces during stretch and wind-up pitching and to examine any relationships between ground reaction forces with pitched ball velocity in the two pitching patterns.

METHODS

Sixteen Division I collegiate pitchers were examined in this study (BM: 91.96 kg ± 8.36kg). All pitchers were on the active roster and had an approximate ¾ overhead delivery. Each participant provided university approved informed consent before testing. Each subject was fitted for standard bilateral full-body biomechanical motion capture and a familiarization period was allowed for the athlete to warm-up on the simulated mound. The mound consisted of two imbedded AMTI force plates; a small drive (rear) leg plate that was oriented parallel to the floor and a larger landing platform that was oriented at roughly a 10 degree angle to the floor, similar to the angle on a standard pitching mound. Data were collected with a 9 camera Qualisys motion capture system. Pitchers were instructed to throw four-seam fastballs at a target on a suspended net from their natural stretch/wind-up positions. Each pitcher threw 10 pitches from each starting position and starting position was randomized to minimize any fatigue effect between each trial. Ball velocity was recording using a radar gun.

Figure 1: Data collection area with mound setup. Subject demonstrates typical starting positions for the stretch (left) and wind-up (right) pitching patterns.
Data were reduced and compared using Student’s t-test to determine any significant (p<.05) differences between ball velocity and ground reaction forces between the two conditions. Regression analyses were conducted to determine if any significant relationships between variables existed.

RESULTS AND DISCUSSION

There was a small but statistically significant difference in pitched ball velocity between wind-up (36.81 mps ± 1.48) and stretch (36.48 mps ± 1.55). This difference is not practically significant as it is probably too small to have an impact on performance (less than 1 mph different). These values were slower than expected and could have been a result of the placement of the radar gun.

A significant difference in peak vertical GRF was observed between the groups (Wind-up: 1764.5 N ± 324.3 vs. Stretch: 1620.1 N ± 264.4) as shown in Figure 2. These data were similar to previously reported values [3, 4].

A moderate positive correlation (r=0.66) was found between mean ball velocity and mean landing vertical GRF. This was similar to many of the correlations among upper extremity kinematics and ball velocity found in other studies [2, 3].

CONCLUSIONS

Overall, peak ground reaction forces were greater in the landing leg during wind-up pitching vs. stretch pitching. Moderate correlations between ball velocity and vertical GRFs identify the importance of the interaction between the pitcher and the mound in generating high ball velocities. Further investigation into these external loads and their effects on other performance variables during baseball pitching is warranted.

REFERENCES


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