CHANGES IN WINDMILL PITCH MECHANICS OVER TIME

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SUMMARY

The number of pitches thrown in 1 week for a softball pitcher is typically in excess of those seen in baseball. Baseball team rotations give their pitching staff's recovery time. Softball teams are not afforded those options for their pitching staffs. The forces create overuse injury. Helping athletes, coaches, and medical staff determine non-optimal mechanics prevents injury. PURPOE: compare changes in throwing technique developing over the course of a pitching session between 2 groups. METHODS: Subjects were 14 pitchers competing in the 2009 Big XII Softball Championships. An area within the pitching circle was calibrated. All pitches were filmed. Five pitches for each subject were evaluated. The digitizing occurred from the set position of the pitch through 5 frames after ball release. The five pitches selected to be digitized were determined by total pitch count on the following basis: *p1*= the 10%, *p2* = the 35%, *p3* = the 60%, *p4* = the 85% and *p5* = the 100% mark of pitches thrown. A 24-point model represents the softball-glove-pitcher system. Digitization began at the set position until 5 frames after ball release. The raw video was converted to a computer-generated stick figure when the digitized film is processed. Linear regression determined the influence each dependent variable. Subjects were then separated into 2 groups based upon pitch count. Group 1 threw more than 40 pitches. Group 2 threw less than 40 pitches. RESULTS: Significance was found with the stride related data($p<.01$), hip-shoulder axis data ($p<.01$) and joint angle data ($p<.01$).

INTRODUCTION

Studies document softball injury rates and trends.(1, 2) A problem specifically identified with softball pitching injuries is a lack of limits on pitch count at any level.(3) The lack of pitch limitation results in softball rosters carrying a minimal number of pitchers and relying on those individuals to fulfill higher pitch counts in comparison to those pitchers on baseball rosters.(4) This could potentially translate to the softball pitcher pitching as many as 1500 to 2000 pitches in one weekend.(5) Suggestions have been made to regulate the frequency and volume of pitching to assist in managing injury in fast-pitch softball, but no current research addresses this issue specifically.(6)

A significant number of time-loss injuries to the upper extremity in elite windmill softball pitchers are documented.(7) The number of outings and pitches thrown in 1 week for a softball pitcher is typically in excess of those seen in baseball pitchers. Baseball team rosters list more pitchers than softball team rosters; developing into starters, middle relievers, or closers. Baseball teams provide rotations to give their pitching staff's recovery time. Softball teams are not afforded those options for their pitchers. As a result, windmill pitch athletes pitch multiple sessions on consecutive days or even multiple outings within a day. The forces have the possibility of creating overuse injury.

Previous studies have examined the one pitch thrown by the athlete or an average of the three highest velocity pitches out of ten thrown. No studies have investigated kinematic and kinetic changes over a session. The purpose of the study was to investigate changes in mechanics that occur through a game. The purpose is to provide an understanding of changes in mechanics that create injury situations. From that, preventative programs can be established targeting the athlete training or player management.

METHODS

Fourteen female windmill pitchers competing in the 2009 Big XII Softball Championships in Oklahoma City, OK comprised the subject pool for this observational study. IRB waived consent due to the public domain nature of the data collection environment.

The researcher set a calibration tool around the pitching circle focusing on the pitching lane. Two digital video cameras (Canon DC 210, Canon USA Inc., Lake Success, NY) occupied positions behind home plate and above the third base dugout. RF sync units (Remote Video Synchronization Unit, Vicon – Colorado, Centennial, CO) attached to each camera provided an impulse to allow video syncing during analysis. All pitches thrown by the athletes during the game were filmed.

Five pitches for each subject were evaluated. The five pitches selected to be digitized were determined by the total pitch count for the individual athlete on the following basis: *p1*= the 10% mark, *p2* = the 35% mark, *p3* = the 60% mark, *p4* = the 85% mark, and *p5* = the 100% mark of total pitches thrown by the athlete. The digitizing occurred from the set position of the pitch through 5-6 frames after release of the ball. A 24-point model of the pitcher represents the softball-glove-pitcher system. 5 events occurring during the pitching motion were selected for comparison. The positions of the throwing arm at 3 o'clock, 6 o'clock, 9 o'clock, 12 o'clock and release were used. These were selected based upon previous research and coaching literature. Digitization began when the athlete was at set position and continued until 5 frames after the release of the ball. The raw video was converted to a computer-generated stick figure when the digitized film is processed. Athletes were separated into 2 groups based upon pitch count for analysis. Grouping was based upon average number of pitches. The average pitch count among all athletes was 41 pitches thrown during the contest. Group 1 threw more than 41 pitches. Group 2 threw less than 41 pitches. Linear regressions determined the influence of the number of pitches thrown on each dependent variable. Dependent variables of importance were based upon previous literature. The independent variable was ball velocity at release.

RESULTS AND DISCUSSION

An analysis investigated the influence of stride factors on release velocity. The results of the regression indicated the predictors explained 55.2% of the variance (R^2=.305, F(1,5)=7.26, p<.01). Stride length (p = .008) was longer and stride angle (p=.011) was wider for athletes in Group1 when compared to athletes in Group 2. A second regression compared the relationship between hip and shoulder around the z-axis factors on release velocity. The results of the regression explained 52.6% of the variance (R^2=.277, F(1,3)=7.28, p<.01). Ball velocity at 12 o'clock (p.=.019) and shoulder angle in the z-plane (p=.023) were significant in their relationship to final release velocity. The third regression compared joint angles around the y-axis to the influence on release velocity. The results of the regression indicated the predictors explained 77.6% of the variance (R^2=.601, F(1,25)=2.113, p<.021). As this is an observational study, the researchers were trying to find focus aspects for future research. A final analysis was run focusing on the differences between the two groups at ball release related to previous significant factors. The focus was on stride leg and throwing arm and their influence on ball release velocity. The results of the regression indicated the predictors explained 72.4% of the variance (R^2=.524, F(1,15)=3.303, p<.01). Shoulder angle at of the throwing arm (p=.005), hip angle of the stride leg (p=.037), and ankle angle of the stride leg (p=0.024) were significant between the groups.

CONCLUSIONS

As pitch counts go above 45 pitched, windmill athletes lengthen and widen their strides in order to maintain velocity production. A longer and wider stride at release provides a lower release velocity due to a decrease in momentum. An interesting component related to stride is the impact of stride leg hip flexion/extension angle and stride leg ankle plantar/flexion angle. The optimization of stride length needs juggle with the optimization of joint angles. A larger angle of the stride ankle and of the stride hip at the 12 o'clock position is a not an optimal contributor to high release velocities.

A larger shoulder-shoulder angle around the z-axis at release is not good for optimal velocity. However, a greater shoulder flexion angle at the 12 o'clock position indicates a contribution to higher release velocity. The velocity of the ball at the 12 o'clock position impacts the overall release velocity.

Overall release velocity is not an indicator of decreased performance as athletes modify technique to non-optimal styles to maintain velocity. Protocols to address muscle strength of the upper extremity at 12 o'clock would be helpful. Limiting appearances or lower pitch counts help to preserve athlete health.

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