KINEMATIC AND KINETIC COMPARISON OF DIFFERENT VELOCITY BASEBALL PITCHERS

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INTRODUCTION

Pitching faster ball is one of the most important ability for baseball pitchers. Although there are many investigations of baseball pitching motions focused on pitching kinematics, only a few comparative investigations of pitching kinetics between groups of different pitching ball velocity have been reported. The purpose of this study was to compare the pitching kinematics and kinetics between two levels of pitchers.

METHODS

Twenty-two healthy baseball players (19 pitchers and 3 fielders, 18 right-handed and 4 left-handed) volunteered to participate in this study as subjects. After warming up, the subjects threw fastballs from regular pitcher's mound toward a catcher with maximal effort until they were fully satisfied (5~10 balls). Pitching motions were videotaped with two high-speed VCR cameras (250fps). The trial of the fastest pitch for each subject was selected for analysis and was digitized manually from windup to the follow-through. The coordinates of 26-body segment endpoints were reconstructed with a DLT method to construct 15-body segments model, and were smoothed using a butterworth digital filter. The range of the cut-off frequency was 5Hz (left toe) -12Hz (right hand).

The subjects with pitch velocity greater than the mean velocity (34.4m/s, n=22) were assigned to the high velocity group (HG, 35.7±1.0m/s, n=10), while the subjects with a pitch velocity lower than the mean velocity were assigned to the low velocity group (LG, 33.2±1.1m/s, n=12).

In this study, we focused on the kinetics of acceleration phase; from stride foot contact (SFC) to ball release (REL). Kinematic and kinetic parameters of upper extremity (shoulder, elbow, and wrist of throwing arm) were calculated, and then normalized according to the time of acceleration phase and averaged for each group. Student's t-test was used to assess significant differences between HG and LG at all normalized times ($p<0.05$).

RESULTS AND DISCUSSION

The velocities of ball of the two groups had the significant difference ($p<0.001$). Required time of this phase for each group was approximately same (0.09±0.01ms of HG and 0.10±0.02ms of LG). Figure shows the shoulder internal rotation angular velocity (top), shoulder internal rotation torque (middle), and elbow extension angle (bottom) for HG and LG during the acceleration phase.

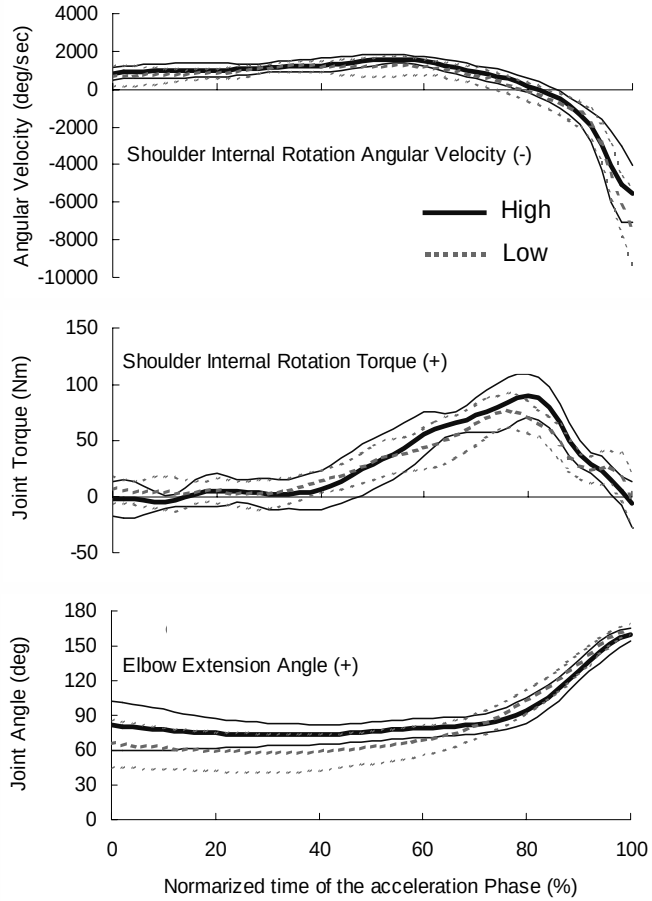

Figure 1: Shoulder internal rotation angular velocity (top), shoulder internal rotation torque (middle), and elbow extension angle (bottom) for HG and LG during the acceleration phase. Circle indicates the time when the significant differences were showed between two groups.

Though HG exerted the significant larger joint torque of shoulder internal rotation than LG from 80% to 89% of this phase, there were no significant differences in shoulder internal rotation angle between two groups. HG kept their elbow angle approximately 90 degrees during the phase of external rotation of shoulder. Therefore, HG had needed to exert the larger shoulder internal rotation torque to decelerate the external rotation of shoulder and to accelerate the internal rotation due to the larger internal moment of upper extremity. Many investigations suggested that peak internal rotation torque of shoulder was important to increase the ball velocity, but it may be more important to make a posture of shoulder or elbow that the torque or angular velocity works more effectively.