

CHARACTERISTIC GROUND-REACTION FORCE IN BEGINNER BASEBALL PITCHING

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INTRODUCTION

The role of the lower limbs in baseball pitching is a controversial issue among players, coaches, and trainers. House (1983) maintained that the pitcher should not drive toward target, but rather initiate a “control fall”; Ryan and Torre (1977) emphasized the need to drive toward target with maximal effort (MacWilliams et al., 1998). Several researches reported that the peak push-off vertical forces are slightly more than one time of body weight (BW) (Elliott et al., 1988; MacWilliams et al., 1998). These forces, however, were of sufficient magnitude to conclude that while a pitcher may not drive toward target with maximal effort (Elliott et al., 1988). Elliott et al. (1988) also reported that the pitchers with faster ball velocity recorded more force on push-off foot at lead foot contact, and the ability to drive the body over a stabilized front leg was a characteristic of the fast pitchers. Review of previous study, they were mainly focused on elite pitchers. But there maybe some difference between beginner and elite pitchers. These differences are important cues for training beginners to be elite. The purpose of this study was to explore the differences of ground force between elite and beginner pitchers.

METHODS

An elite baseball pitcher of national team (age: 20-years-old, height: 178cm; weight: 93.7 kg) and 4 beginners of amateur team (age: 19.75 ± 0.96 -years-old, height: 177.0 ± 4.7 cm; weight: 72.9 ± 9.5 kg) participated in this study. An AMTI OR6-6 force platform was used to record ground reaction force (GRF) (1000 Hz). All pitchers were asked to perform 10 pitches to a net. The first 5 trials and the last 5 trials were used to record lead foot force and push-off foot force respectively. The elite pitcher can pitch over 145 km/hr in competition, and the beginner only can pitch nearly 90 km/hr. The force and the time scale were normalized with the subject's body weight and the duration from lead foot contact ground to ball release. All data time presented in figure 1 was nearly 0.6 second for elite and 0.7 second for beginner.

RESULTS AND DISCUSSION

The ball speed in elite was 35.9 m/s (129.3 km/hr), and in beginners was 23.5 m/s (84.5 km/hr). The results showed that the medial-lateral (ML) force were very small (0.11BW - 0.19 BW). The peak anterior-posterior (AP) and vertical force on lead foot of elite (AP force is 0.7BW, vertical force is 1.7BW) were larger than beginners (AP force is 0.4BW, vertical force is 1.1BW), but the timings of peak force were almost same. And vertical force for elite was also larger than the study of Macwilliams et al. This result indicated that the force of lead foot was important in pitching. The times to peak AP and vertical forces on push-off foot was different between elite and beginner (0.1 normalized time before

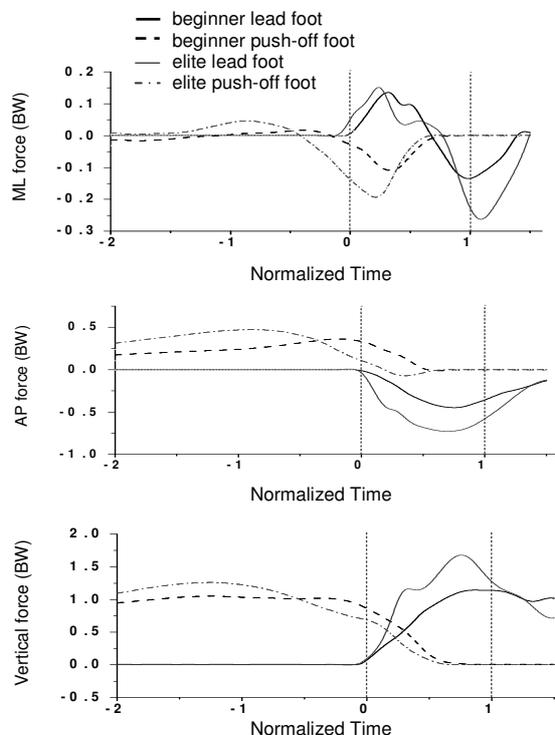


Figure 1: Mean force for beginner and elite pitchers. The instant of $t = 0$ and $t = 1$ meant the instant of foot contact and ball release respectively.

landing for beginners, 0.7 normalized time before landing for elite, and 0.7 normal time before landing for beginners, 1.2 normal time before landing for elite in vertical force), but the force value were similar. According this timing on push-off foot, it might have an important role in pitching. At the instant of foot contact, the AP and vertical force magnitude on push-off foot for elite was smaller than beginner. This result was different from the study of Elliott et al. Therefore, the real mechanism for this instant needs the further study.

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