HEAD MOTION DURING BASEBALL PITCHING

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INTRODUCTION

Coaching literature has suggested that limiting head movement is a key to pitching accuracy (Winkin et al., 2001). The movement of the head during pitching has not been well documented (Dun et al., 2006), and no studies have linked head movement to the ability to throw strikes. The purpose of this study was to quantify the movement of the head during pitching and determine if a relationship exists between head movement and pitch accuracy.

METHODS

Current collegiate and professional pitchers (N=43) volunteered to participate in this study. Subjects were 22 ± 3 years old, with an average height and mass of 191 ± 6 cm and 94 ± 10 kg, respectively. All subjects were healthy enough to pitch competitively. Each subject completed an informed consent form prior to testing.

An eight-camera Eagle 4 motion capture system (Motion Analysis Corp., Santa Rosa, CA) tracked reflective markers that had been placed on anatomical landmarks of the subject's body (Barrentine et. al.,1998; Dillman et. al., 2002). The subject was also fitted with a hat that contained four markers (front, top, rear, and lateral offset) to track the head movement specifically for this study. After completing a normal warm-up routine, a preliminary static trial was collected to define a neutral position for the head. Then, the subject pitched 10 fastballs from an indoor pitching mound with maximal effort towards a strike zone target located 18.4 m away from the rubber. A researcher logged each pitch's location.

Local, orthogonal coordinate frames were created in order to calculate movement in reference to the global frame (see Figure 1). Global x-axis rotation was called lateral head tilt with positive rotation towards the throwing shoulder. Global y-axis rotation was called forward head tilt with positive rotation looking upwards. Global z-axis rotation was called head rotation with positive rotation towards the non-throwing shoulder.

Figure 1. Global and local coordinate frames for the head and trunk.

For each pitch, the head's orientation among the three axes with respect to the global frame was recorded at four discrete events of the pitch sequence: foot contact (FC), maximum external rotation of the shoulder (MER), ball release (BR), and maximum internal rotation of the shoulder (MIR). Two separate data analyses were performed based on available data. In the first analysis, subjects were classified into accuracy groups by the number of strikes thrown out of 10: very accurate (9 or 10), somewhat accurate (7 or 8), or not accurate (6 or less). Using five randomly selected pitches per subject, MANOVAs were used to compare the subjects' head orientation by accuracy group at each of the events and over the range of events. In the second analysis, MANOVAs were used to compare the head's orientation within each pitcher at each of the events for three balls versus three strikes. For all tests, $\alpha = .05$.

RESULTS

The head's range of motion from FC to MIR was 33° ± 2° of lateral head tilt, 15° ± 2° of forward head tilt, and 37° ± 2° of head rotation. Analyzing pitchers by accuracy group, significant differences were seen only in lateral head tilt at FC, forward head tilt at FC and MIR, and head rotation in the FC-to-MIR range of motion (Table 1). Analyzing within pitcher, no significant differences were found in head orientation at any event.

Variable	Very Accurate	Somewhat Accurate	Not Accurate
FC – Lat. Tilt (deg)	8(2)[*]	12(2)[+]	1(2)[*+]
FC – For. Tilt (deg)	20(2)[*+]	13(2)[*]	14(2)[+]
MIR – For. Tilt (deg)	32(3)	24(3)[*]	34(2)[*]
Range – Rotation (deg)	32(3)[*]	44(3)[*]	36(3)

Table 1. Means (SDs) by accuracy group for significantly different variables. [*+] Post-hoc differences between groups.

DISCUSSION

While the head motion was further quantified by having a larger sample than previous research (Dun et.al., 2006), it was surprising that, contrary to the coaching literature that preaches maintaining a steady head to improve control (Winkin et al., 2001), few differences were seen between the most accurate and the least accurate pitchers and within individual pitchers. Moreover, no practical differences or logical trends were seen; the magnitude of the differences was at most 8° to 10°, and there was no discernible progression from the most accurate to the least accurate pitchers. Two limitations to this study may have led to this result and should be the focus of future research. First, pitch location could have been better differentiated (e.g. inside balls, strikes, and outside balls) in order to determine a relationship between head movement and accuracy. Second, since pitching is an open-loop action, it may be that by the time of FC the mind and body have already determined the location to which they want the ball to be delivered. In this case, the motions recorded in this study are more probably a consequence of the other, more rapidly moving body parts and an anticipation of viewing the result of the pitch. Perhaps an analysis of head motion in the earlier phases in the delivery may correlate more strongly with accuracy.

REFERENCES

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