Modifiable Factors that Affect Elbow Torque: Analysis of 81,999 Throws from Professional Baseball Players

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INTRODUCTION

Likely due to the high level of strain exerted across the elbow during the throwing motion, elbow injuries are on the rise in baseball. In order to identify at risk athletes and guide post-injury return to throw programs, a better understanding of the variables that influence elbow torque is desired.

PURPOSE

The purpose of the current study was to analyze the on-field activity of professional baseball pitchers and determine the mechanical factors (arm speed, arm slot, and arm rotation) that have the greatest within-athlete association with elbow varus torque. We hypothesized that arm slot would have minimal impact on elbow varus torque; however, torque would likely increase as arm speed and arm rotation increase. It is our hope that these data will allow identification of modifiable factors that impact elbow torque during throwing and serve as a foundation for the development of evidence based, individualized return to throw programs for the future.

METHODS

A total of 81 professional pitchers performed 81,999 throws while wearing a motusBASEBALL™ sensor and sleeve (Motus Global, Massapequa, NY, USA). These throws represented a combination of throw types, such as warm-up/catch, structured long-toss, bullpen throwing from a mound, and live game activity. Variables recorded for each throw included arm slot, arm speed, arm rotation, and elbow varus torque. Linear mixed-effects models and likelihood ratio tests were utilized to estimate the relationship between elbow varus torque and arm slot, arm speed, and arm rotation within individual pitchers.

RESULTS

All three metrics were significantly associated with elbow torque:

- Arm Slot: χ² = 428, p<0.01
- Arm Speed: χ² = 57,683, p<0.01
- Arm Rotation (max external rotation): χ² = 1,392, p<0.01

Elbow Torque increased by 1 Nm for every...

- 13˚ decrease in Arm Slot
- 116˚/s increase in Arm Speed
- 8˚ increase in Arm Rotation

CONCLUSIONS

- The motusBASEBALL™ sensor appears to be a valid and reliable tool for measuring arm mechanics during the overhead throwing motion.
- In this study, elbow varus torque was significantly associated with potentially modifiable factors such as arm speed, arm rotation, and arm slot.
- Elbow varus torque increased significantly as pitchers increased arm rotation during the arm cocking phase and rotational velocity of the arm during the arm acceleration phase of throwing.
- Within individual athletes, a 1-Nm increase in elbow varus torque was associated with a 13˚ decrease in arm slot, a 116˚/s increase in arm speed, and an 8˚ increase in arm rotation.
- Arm flexibility, arm speed, and elbow varus torque (and likely injury risk) are inter-related and should be considered collectively when treating pitchers.