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## The Relationship Between Shoulder Range of Motion and Arm Stress in College Pitchers: A MOTUS Baseball Study

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# **The Relationship Between Shoulder Range of Motion and Arm Stress in College Pitchers:**

## **A MOTUS Baseball Study**

### **Abstract**

#### *Predictors of Elbow Torque Among College Baseball Pitchers*

**Purpose:** To investigate the relationship of shoulder range of motion (ROM) conditions, such as glenohumeral internal rotation deficiency (GIRD) and external rotation gain (ERG), to torque across the medial elbow in college pitchers.

**Methods:** Pitchers were recruited from three local college baseball teams. Exclusion criteria included injury or restricted activity due to pain. They were evaluated within two weeks before their first game of the season. Pitchers completed an intake survey at the time of shoulder ROM and upper extremity length measurements. Pitchers were fitted with a MOTUS sensor baseball sleeve (Motus Global, Massapequa, NY). The sensor placed at the medial elbow reported elbow torque, arm speed, arm slot, and shoulder rotation for each pitch, while a radar gun measured peak ball velocity. After adequate warmup, pitchers threw 5 fastballs in a standardized manner off the mound at game-speed effort. The primary outcome was to evaluate the relationship between shoulder ROM and medial elbow torque. Additional outcomes evaluated pitcher characteristics, demographics, and outcome scores in the context of shoulder ROM. Outcomes were assessed via a multivariable model, which controlled for possible covariates.

**Results:** Twenty-eight pitchers were included in the preseason analysis with an average (SD) age of 20.1 (1.3) years and playing experience of 15.3 (1.8) years, 2.5 (1.2) of those years at

collegiate level. The dominant shoulder demonstrated decreased internal rotation ( $54.5 \pm 10.6$  vs  $65.8 \pm 9.1$ ) and increased external rotation (ER,  $94.1 \pm 10.4$  vs  $88.4 \pm 9.2$ ) relative to the non-dominant side ( $p < 0.001$ ), while total rotational range of motion (TRROM) was significantly decreased in the dominant arm ( $148.6 \pm 12.4$  vs  $154.1 \pm 10.6$ ,  $p < 0.001$ ). The average GIRD was 11.3 (9.87) and average ERG was 4.4 (8.87). External rotation was found to be a predictor of arm stress, with an increase in 0.35 Nm of elbow torque for every degree increase in ER (beta =  $0.35 \pm 0.06$ ,  $p = 0.003$ ); there was moderate correlation between ER and arm stress ( $r = .45$ ,  $P < .001$ ). Pitchers demonstrated significantly greater arm stress with the following shoulder ROM measurements: GIRD  $< 20$  as compared to greater than 20 degrees ( $46.6 \pm 0.5$  versus  $43.5 \pm 1.1$ ,  $P = .011$ ), ERG  $> 5$  as compared to  $< 5$  degrees ( $47.4 \pm 0.7$  versus  $45.1 \pm 0.6$ ,  $P = .014$ ), and loss of total rotational ROM  $< 5$  as compared to  $> 5$  degrees ( $46.6 \pm 0.5$  versus  $43.6 \pm 1.1$ ,  $P = .013$ ).

**Conclusions:** College pitchers with external rotation gain produced greater medial elbow torque during the pitching movement. These findings indicate that pitchers with increased external rotation of their throwing arm may experience greater elbow stress while pitching, placing their medial elbow at risk of injury.

**Level of Evidence:** Level II prospective observational study

**Key Words:** UCL, Ulnar Collateral Ligament, Pitching, Tommy John, Laxity, Pain, Elbow, Injury