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Comparison of Glenohumeral and Scapulothoracic Kinematic Parameters During Baseball Pitching Between Fastballs and Curveballs

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Biomechanical analyses of baseball pitching possess limitations in accurately measuring dynamic scapular orientation and distinguishing between glenohumeral (GH) and scapulothoracic (ST) contributions to global shoulder motion. Past studies have compared the effects of fastballs and curveballs at the elbow, trunk, and lower extremities, but GH and ST joint kinematics between pitch types remain unknown. Decreased ST upward rotation, internal rotation, and posterior tilt, and increased GH elevation are linked with reduced subacromial space which may increase the risk for rotator cuff injuries during pitching. GH external rotation and horizontal abduction both impart strain on soft tissues surrounding the joint which can help to improve ball velocity but may also increase injury risk. **PURPOSE:** To examine GH and ST kinematic parameters related to injury risk and performance between pitch types.

METHODS: Trunk and upper extremity segment orientations of 14 collegiate pitchers were measured with motion capture during fastball and curveball pitches. An individualized linear model approach was used to estimate dynamic scapular orientation based on measurable humerothoracic orientation. ST and GH kinematics were calculated throughout each pitch and values at full arm cocking were compared between pitch types using paired t-tests with Bonferroni corrections. **RESULTS:** No significant differences were found between pitch types for any ST or GH variables at full arm cocking. The mean within-subject differences (fastball minus curveball) and variability ($\pm 1SD$) were very small for each parameter: ST upward rotation ($-0.4^{\circ} \pm 1.4^{\circ}$), internal rotation ($1.5^{\circ} \pm 9.1^{\circ}$), and posterior tilt ($-2.1^{\circ} \pm 9.4^{\circ}$), and GH elevation ($-0.9^{\circ} \pm 2.1^{\circ}$), horizontal abduction ($-3.3^{\circ} \pm 7.8^{\circ}$), and external rotation ($2.3^{\circ} \pm 7.2^{\circ}$).

CONCLUSION: The results of this study demonstrate that GH and ST joint orientations at full arm cocking are similar between pitch types which provides evidence suggesting that injury risk at the shoulder may be similar between fastballs and curveballs.