Oklahoma State University | Department of Athletic Training

Hip Range of Motion on Upper Extremity Pitching Kinematics: A Critically Appraised Topic

OKLAHOMA STATE UNIVERSITY
CENTER FOR HEALTH SCIENCES

Brionna Belcher MAT-II Student, Kira Wicker MAT-II Student, Matthew O'Brien, PhD, LAT, ATC, PES, CES

INTRODUCTION

Many factors can affect upper extremity kinematics during the pitching motion. Changes in these kinematics can lead to increased risk of injury to the upper extremity. Risk factors for injury in baseball pitchers include deficits in shoulder range of motion (ROM), weakness of the rotator cuff, and increased torque due to compensation.[1] It has been hypothesized that hip ROM can be a reason for these compensations in the upper extremity. Previous research has shown there is a significant relationship between hip extension and shoulder rotation in baseball pitchers.[2]

OBJECTIVES

The purpose of this Critically Appraised Topic is to review literature that studies the full relationship between hip ROM and upper extremity kinematics during the pitching motion.

METHODS

Sources Used for Search:

- Medline
- PubMed
- Science Direct
- Google Scholar

Search Terms Used:

- Hip range of motion
- Hip rotation
- Shoulder kinematics
- Upper extremity kinematics
- Elbow kinematics

Inclusion Criteria:

- Male pitching athletes
- Articles that studied hip range of motion on upper extremity kinematics
- Published within the past 10 years
- Article is available in English
- Level of Evidence 3 or higher

Exclusion Criteria:

- Non-athletes
- Non-pitching athletes
- Articles published over 10 years ago
- Article was not available in English

RESULTS

Study Authors	Laudner et al. (2014)	Albiero et al. (2022)	Zeppieri et al. (2021)
Methods/Participants:	34 NCAA Division I baseball pitchers participated. One testing session was completed. Hip rotation was measured by two examiners with a Pro 3600 Digital Inclinometer. This was measured bilaterally in a prone position before throwing began. Participants then went through a preferred warm-up routine. Markers were placed on bony landmarks Five trials were completed with a target 18.4 meters away. Data from the three fastest pitches were averaged. Data was collected using a Motion Analysis System. Speed was recorded using a Stalker Sport radar gun.	A total of 21 adolescent male baseball pitchers were included. Participants were healthy with no previous throwing-arm injury. - Mean age = 16.1 ± 0.8 Participants completed a 20-minute dynamic warm-up, then AROM hip measurements were completed by the same physical therapist on lead and back hips. Raptor-E cameras were used to complete the biomechanical analysis. Reflective markers were placed on anatomical landmarks bilaterally. Each participant threw 10 fastball pitches and the 3 fastest trials were analyzed further.	A total of 7 Division I college baseball pitchers participated in this study Hip internal rotation (IR) and external rotation (ER) were calculated using an inclinometer. Biomechanical Analysis was done using a Motion Capture System. 15 markers were placed bilaterally on the participants on anatomical landmarks Each participant completed 10 fast ball pitches after warming-up. Data was collected on the three fastest and most accurate pitches.
Outcomes Measured:	**Primary outcomes**: Hip ROM on shoulder ER torque **Secondary Outcomes**: Shoulder horizontal adduction motion Total arc motion	**Primary outcomes:** Hip AROM on shoulder and elbow torque **Secondary Outcomes:** Stride length Torso-rotation angle	**Primary outcomes:** Lead and trail hip IR and ER Total hip arc Elbow flexion angle Lead and train hip IR and ER Maximum shoulder ER Maximum shoulder horizontal adduction angular velocity **Secondary outcomes:** Onset of maximum trunk angular velocity
Results:	Moderate negative correlation between hip rotation and shoulder ER torque (0.56 ±0.003). Negative correlation between lead hip ER and shoulder adduction ROM (r = −0.36, P = 0.04). Significant relationship also seen between trail hip ER and shoulder adduction ROM ($r = -0.35$, $P = 0.04$)	There were negative correlations between stride length and back-hip extension, torso-rotation angle and back-hip ER, back hip abduction and back-hip ER, and Lead-hip abduction angle and back-hip abduction. There was a significant correlation between normalized elbow-varus torque and lead-hip abduction. (r = 0.464; P = .03) No significant correlation was found on hip AROM and shoulder IR torque.	Trail hip ER has a significant correlation with trunk angular velocity (r = .650, P = .009) Lead hip total rotation had a significant correlation with max. shoulder ER (r = .695, p = .005). Lead hip IR was also correlated with elbow flexion (r = .952, p = .001).
Evidence Quality Score	CEBM: Level 3 PEDro: 6/10	CEBM: Level 3 PEDro: 7/10	CEBM: Level 3 PEDro: 6/10
Support for the Answer	Yes	Yes	Yes

CONCLUSION

A total of 6 studies met the inclusion and exclusion, but 3 were included in this paper due to the limitations of the other studies.[3,4,5] All the studies that were included in this CAT found a significant correlation between hip range of motion and upper extremity kinetics/kinematics. Two studies found significant relationships between lead-hip rotation and shoulder ER torque.[3,5] One study did not report any significant findings on hip rotation and shoulder rotation, but they found a significant relationship between hip abduction and elbow varus torque.[4] Based on the data collected, it can be concluded that hip range of motion influences upper extremity kinematics.

REFERENCES

1. Tyler, T. F., Mullaney, M. J., Mirabella, M. R., Nicholas, S. J., & McHugh, M. P. (2014). Risk Factors for Shoulder and Elbow Injuries in High School Baseball Pitchers. The American J of Sport Med. https://doi.org/10.1177/0363546514535070
2. Steve Scher, Kyle Anderson, Nick Weber, Jeff Bajorek, Kevin Rand, Michael J. Bey; Associations Among Hip and Shoulder Range of Motion and Shoulder Injury in Professional Baseball Players. J Athl Train 1 March 2010; 45 (2): 191–197. doi: https://doi.org/10.4085/1062-6050-45.2.191
3. Laudner, K., Wong, R., Onuki, T., Lynall, R., & Meister, K. (2015). The relationship between clinically measured hip rotational motion and shoulder biomechanics during the pitching motion. J of Science and Medicine in Sport, 18(5), 581-584. https://doi.org/10.1016/j.jsams.2014.07.011
4. Albiero ML, Kokott W, Dziuk C, Cross JA. Hip Flexibility and Pitching Biomechanics in Adolescent Baseball Pitchers. J Athl Train. 2022;57(7):704-710. doi:10.4085/1062-6050-0103.21
5. Zeppieri G Jr, Bruner ML, Michelini JP, Farmer KW. The Relationship Between Hip Range of Motion and Pitching Kinematics Related to Increased Elbow Valgus Loads in Collegiate Baseball Pitchers: A Pilot Study. Int J Sports Phys Ther. 2021;16(2):468-476. Published 2021 Apr 1. doi:10.26603/001c.21319