Influence of Pitch Count on Throwing Arm Strength and Range of Motion

Luke Young, Landon Godso, Patrick Schwing, Jessica Talmage, Kevin Giordano DPT, PhD.

LSUHSC – School of Medicine, LSUHSC New Orleans Department of Physical Therapy, Northern University.

Introduction

- Pitching a baseball places considerable mechanical stress on the throwing arm, resulting in dynamic shifts in both range of motion (ROM) and muscular strength.
- Change in a player's strength and Range of Motion of the throwing arm are used as metrics of fatigue in recovery in modern baseball.
- Well-documented post-throwing changes in pitching arm mechanics include increased external rotational range of motion (ROM), decreased internal rotational ROM, and reductions in strength across multiple measures. Specifically, external and internal rotation strength, scaption strength (arm elevation in the scapular plane, approximately 30–45° anterior to the torso), and chuck pinch strength (pinching an object between the thumb and the tips of the index and middle fingers)
- The changes listed above have been extensively documented in long-term, multi-season studies, single-season analyses, and recordings from simulated 60-pitch games, all aimed at predicting injury risk and developing preventative strategies for pitchers. Across youth, collegiate, and professional levels, pitch counts vary widely depending on game context and pitcher role (starter vs. reliever). This variability underscores the importance of examining pitch-to-pitch changes in key performance metrics to guide individualized recovery protocols based on specific pitch counts.

Objectives

- The objective of this study is to determine the rate of change in throwing arm metrics relative to pitch count, with the goal of accurately predicting recovery time and regimen required before a subsequent pitching outing.

Figure 2: Pitch Count and Strength Loss

- This graph displays the predictable and linear strength loss in both External Rotational strength and Chuck Pinch strength. With External Rotational Strength being an indicator of a fatiguing shoulder and Chuck Pinch strength loss indicating fatigue of the muscles that stabilize the elbow.

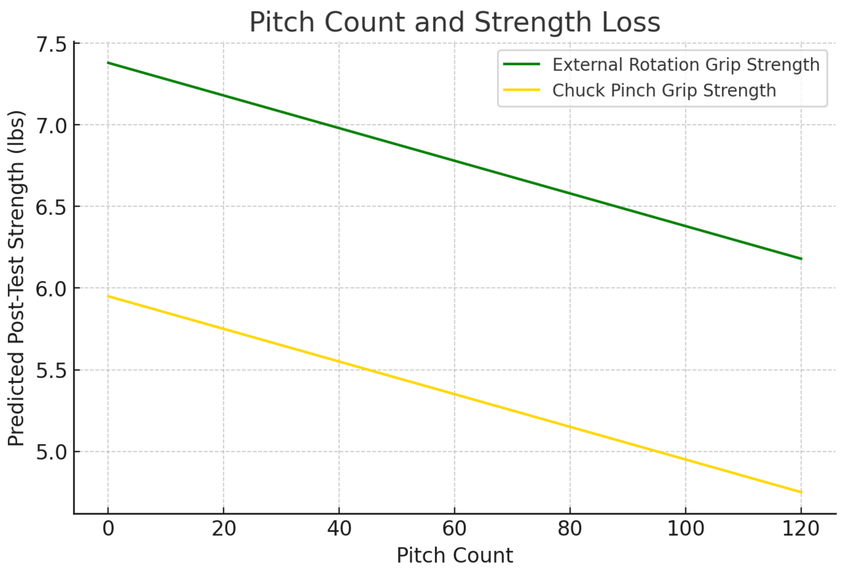
Methods

- 3,587 university level and above pitchers participated in this study, totaling 28,616 live game outings. Using a handheld dynamometer (device used to measure force output) and inclinometer (device used to measure joint angle and ROM) the participants were given instruction to measure internal rotational (IR) range of motion (ROM), external rotational (ER) ROM, IR strength, ER strength, scaption strength, and chuck pinch strength before and after multiple pitching outings. The data collected was then synthesized to find a linear regression with pitch count as the independent variable.

Figure 1

- Images above from left to right indicate how measurements of chuck pinch, Internal Rotational and External Rotational strength were measured using a handheld dynamometer.
- Image to the right displays the dynamometer.

Figure 2



Results

- Neither internal rotational or external rotational ROM were found to change rate that was statistically significant per pitch. With both findings having a $p > 0.05$
- All strength metrics, Internal Rotational, External Rotational, Scaption, and Chuck pinch averaged a statistically significant loss of 0.01 pounds per pitch thrown with $p < 0.001$.

Strength Metric	Average Rate of Change (lbs per pitch)	P value
External Rotational	-0.01	$p < 0.001$
Internal Rotational	-0.01	$p < 0.001$
Scaption	-0.01	$p < 0.001$
Chuck Pinch	-0.01	$p < 0.001$

Conclusion

- These findings show that pitchers experience a predictable, average loss of 0.01 pounds per pitch thrown, which can be extrapolated to one pound of strength for every 100 pitches thrown.
- Comparing an individual pitcher's in-game strength decline to this benchmark may help identify those experiencing disproportionate fatigue, signaling a higher risk of injury and the need for adjusted recovery or workload management.

Future Directions

- Establishing pitch count guidelines was one of the first steps to providing safer guidelines for a pitcher's outing. To build upon these guidelines, data collected in this study and others like it can be used to formulate an algorithm that calculates whether a pitcher's strength metric is in a normal or injury risk state. This would all be based off pitch count as the independent variable.
- The goal is to have data gathered at pre pitching, post pitching, and 24-hours post pitching. The additional metric at 24-hours post pitching will give further insight into how a pitcher is recovering. A pitcher might be within normal ranges of pre and post metrics but recover poorly and be outside of range at 24 hours post. With an established metric at 24-hours post pitching, it can be more accurately assessed whether a pitcher is in an injury risk state or not. This will be the next step in providing useful standards that any athlete can use to reduce preventable injuries.