

# Kinetic Comparison among the Fastball, Curveball, Change-up, and Slider in Collegiate Baseball Pitchers

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## Abstract

## Background

Controversy exists about whether breaking pitches are more stressful than are fastballs. Previous biomechanical studies compared kinematics but not kinetics.

## Hypothesis

Elbow and shoulder forces and torques are statistically different among the fastball, curveball, change-up, and slider.

## Study Design

Descriptive laboratory study.

## Methods

Twenty-one healthy collegiate pitchers were studied with a high-speed automated digitizing system. All subjects threw fastballs ( $n = 21$ ), most threw curveballs ( $n = 20$ ) and change-ups ( $n = 19$ ), and a few threw sliders ( $n = 6$ ). Wrist, elbow, and shoulder kinetics were calculated using inverse dynamics. Nine kinetic and 26 kinematic parameters were compared among the different pitch types using repeated-measures analysis of variance.

## Results

At the shoulder, internal rotation torque, horizontal adduction torque, abduction torque, and proximal force were significantly less in the change-up than in the other 3 pitches. Shoulder horizontal adduction torque was greater in the fastball than in the curveball and slider. Shoulder proximal force was greater in the slider than in the curveball. Elbow proximal force was less in the change-up than in the other 3 pitches. Elbow varus torque was greater in the fastball and curveball than in the changeup. Elbow flexion torque was greater in the curveball than in the change-up. The curveball and change-up demonstrated kinematic differences from the fastball, consistent with previous studies.

## Conclusion

There were significant kinematic differences between the fastball and curveball but few kinetic differences. The change-up had lower joint kinetics, lower angular velocities, and different body positions than the other 3 pitch types had. Results for the slider were inconclusive because of small sample size.

## Clinical Relevance

Because the resultant joint loads were similar between the fastball and curveball, this study did not indicate that either pitch was more stressful or potentially dangerous for a collegiate pitcher. The low kinetics in the change-up implies that it is the safest.

## Keywords

[elbow](#), [shoulder](#), [wrist](#), [force](#), [torque](#), [kinematics](#), [pitching](#), [biomechanics](#)

## on Risk of Elbow and Shoulder Pain in Youth Baseball Pitchers From – The American Journal of Sports Medicine

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## Abstract

## Background

Joint pain is thought to be an early sign of injury to a pitcher.

## Objective

To evaluate the association between pitch counts, pitch types, and pitching mechanics and shoulder and elbow pain in young pitchers.

## Study Design

Prospective cohort study.

## Methods

Four hundred and seventy-six young (ages 9 to 14 years) baseball pitchers were followed for one season. Data were collected from pre- and postseason questionnaires, injury and performance interviews after each game, pitch count logs, and video analysis of pitching mechanics. Generalized estimating equations and logistic regression analysis were used.

## Results

Half of the subjects experienced elbow or shoulder pain during the season. The curveball was associated with a 52% increased risk of shoulder pain and the slider was associated with an 86% increased risk of elbow pain. There was a significant association between the number of pitches thrown in a game and during the season and the rate of elbow pain and shoulder pain.

## Conclusions

Pitchers in this age group should be cautioned about throwing breaking pitches (curveballs and sliders) because of the increased risk of elbow and shoulder pain. Limitations on pitches thrown in a game and in a season can also reduce the risk of pain. Further evaluation of pain and pitching mechanics is necessary.