

Ulnar Collateral Ligament Tear in Elite Baseball Pitchers: Do High School Showcase Exposures Predict Injury?

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INTRODUCTION:

Ulnar collateral ligament reconstruction (UCL-R) surgeries have increased significantly in amateur and professional baseball pitchers. While high school (HS) showcase participation has been considered an injury risk factor, limited data corroborating this association exists. Despite concern that showcase participation in amateur athletes may lead to higher risk of future injury, there is a scarcity of UCL injury-specific research on elite amateur pitchers using reliably recorded pitch velocity and other performance data rather than self-reported metrics. The objectives of this study were to examine the age at which elite high school pitchers began to achieve high fastball velocity, specifically greater than 90, 92, and 95 mph ($\geq 90/92/95$ mph), as well as to examine the relationship between showcase participation and future need for UCL-R during their professional career. We hypothesize that pitchers achieving fastball velocities $\geq 90/92/95$ mph at younger ages are more likely to undergo UCL-R earlier in their professional careers compared to pitchers not achieving these velocity thresholds. Additionally, we hypothesize that pitchers participating in high showcase volumes are more likely to undergo UCL-R compared to pitchers participating in fewer showcases.

METHODS:

Demographic, HS showcase performance, and injury data from pitchers selected in the first 5 rounds of the Major League Baseball (MLB) Draft (2011-2020) were gathered from publicly available databases. Demographic data collected for each pitcher included date of birth, height/weight/body mass index at time of MLB Draft, position (left- vs. right-handed pitcher), MLB Draft year, MLB Draft round and overall pick, high school state/country, college (if attended), whether pitcher entered professional baseball directly after HS, U.S. region, MLB organization which drafted pitcher. Performance data were collected for each pitcher exclusively from PG (www.perfectgame.org) and PBR (www.prepbaserballreport.com) events participated in during their HS careers prior to MLB draft. Performance metrics included: peak fastball velocity at HS showcases, age at which a pitcher achieved $\geq 90/92/95$ mph at a HS showcase, age at which slider was first thrown in a HS showcase, peak slider velocity in a HS showcase. UCL injury data included: age at UCL-R, specific amateur or professional level when injured, and recovery time (in months).

Continuous and categorical variables for pitchers undergoing UCL-R and those not undergoing UCL-R were compared, and multivariable analysis was performed using logistic regression. Standard deviations of ± 1 SD were used to define "early" versus "late" UCL-R subgroups after normal distribution was confirmed (Shapiro-Wilk test, $p = 0.183$). Trends in time were evaluated using linear regression. The significance of trends over time was evaluated using linear regression. Data analysis was performed using SPSS Version 27 (IBM Corp). A two-tailed $P < 0.05$ was used for determining statistical significance.

RESULTS:

There were 845 pitchers selected in the first five rounds of the MLB Draft in the 10-year period selected for this study (2011-20). Overall, 659 of 845 pitchers (78.0%) had retrievable showcase performance data. Of 845 pitchers, 229 (27.1%) underwent UCL-R. Peak fastball velocity recorded at showcases was the strongest predictor of UCL-R (adjusted odds ratio 1.19, 95% CI 1.02, 1.39; $p = 0.03$). Peak fastball velocity in high school (HS) was significantly higher among pitchers who underwent UCL-R compared the no UCL-R group (91.57 vs. 90.71 mph, 95% CI -1.43, -0.29; $p < 0.01$). Pitchers who achieved a peak fastball velocity of ≥ 90 mph in HS were more likely to undergo UCL-R compared to those who did not ($p = 0.03$). Similarly, pitchers who achieved a peak fastball velocity of ≥ 92 mph in HS were more likely to undergo UCL-R compared to pitchers who did not ($p < 0.01$).

Age at which pitchers participated in their first HS showcase was significantly younger for the "early" versus the "late" UCL-R group (15.53 vs. 16.51 years, 95% CI -1.53, -0.41; $p < 0.01$). Elite pitchers with "early" UCL-R participated in more showcases compared to the "late" UCL-R group (5.38 vs. 2.89, 95% CI 0.48, 4.50; $p = 0.02$). Upon multivariable analysis, peak fastball velocity in HS and a peak fastball velocity of ≥ 95 mph in HS were primary independent predictors of undergoing UCL-R. The likelihood of undergoing UCL-R increased 19% for every unit (mph) increase in peak fastball velocity at HS showcases (aOR 1.19, 95% CI 1.02, 1.39; $p = 0.03$).

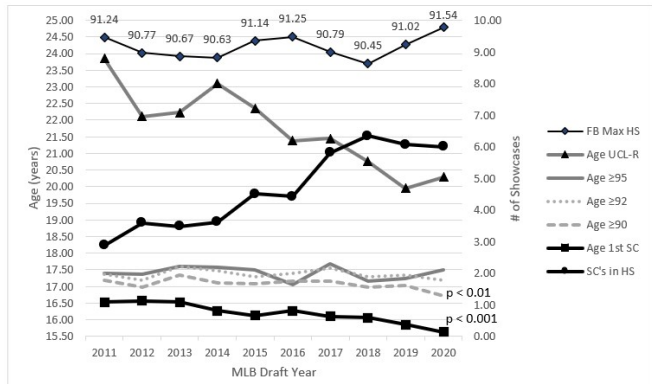
Between 2011-2022, significant trends were identified among pitchers chosen in the first five rounds of the MLB Draft (**Figure 1**). Mean age at which a pitcher underwent UCL-R decreased steadily over the decade by over 3.5 years (23.85 vs. 20.29 years, $p < 0.001$). Mean age at which a pitcher attended his first HS showcase steadily declined as well over the ten-year period (16.53 vs. 15.63 years, $p < 0.001$). Mean number of HS showcases a pitcher attended more than doubled

during the decade (2.88 vs. 6.00 total showcases, $p < 0.001$). Additionally, mean age at which a pitcher achieved ≥ 90 mph fastball in a HS showcase also declined (17.19 vs. 16.71 years, $p < 0.01$).

DISCUSSION AND CONCLUSION:

Peak fastball velocity recorded at HS showcase events is the strongest predictor of UCL-R in elite pitchers. Achieving fastball velocity thresholds of ≥ 90 mph and ≥ 92 mph at HS showcase events significantly increased the likelihood of UCL-R in elite pitchers. Younger age at first HS showcase, and younger age achieving ≥ 90 mph in a HS showcase significantly increased the likelihood of early UCL-R compared to late UCL-R in this cohort. Overall, our study findings provide statistically significant results which support a formal recommendation to limit showcase participation in adolescent and HS pitchers to age 16 years and older.

Figure 1. Trends in MLB Draft Pitchers, 1st Five Rounds, 2011-2020^a



^aMLB, Major League Baseball; FB Max HS, peak fastball velocity in high school showcase; UCL-R, ulnar collateral ligament reconstruction; Age $\geq 90/\geq 92/\geq 95$, age achieving fastball velocity in high school showcase; SC, showcase; HS, high school. Data points on FB Max HS plot indicate velocity, in miles per hour.