



Influence of Pitching Release Location on Ulnar Collateral Ligament Reconstruction Risk Among Major League Baseball Pitchers

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Disclosures

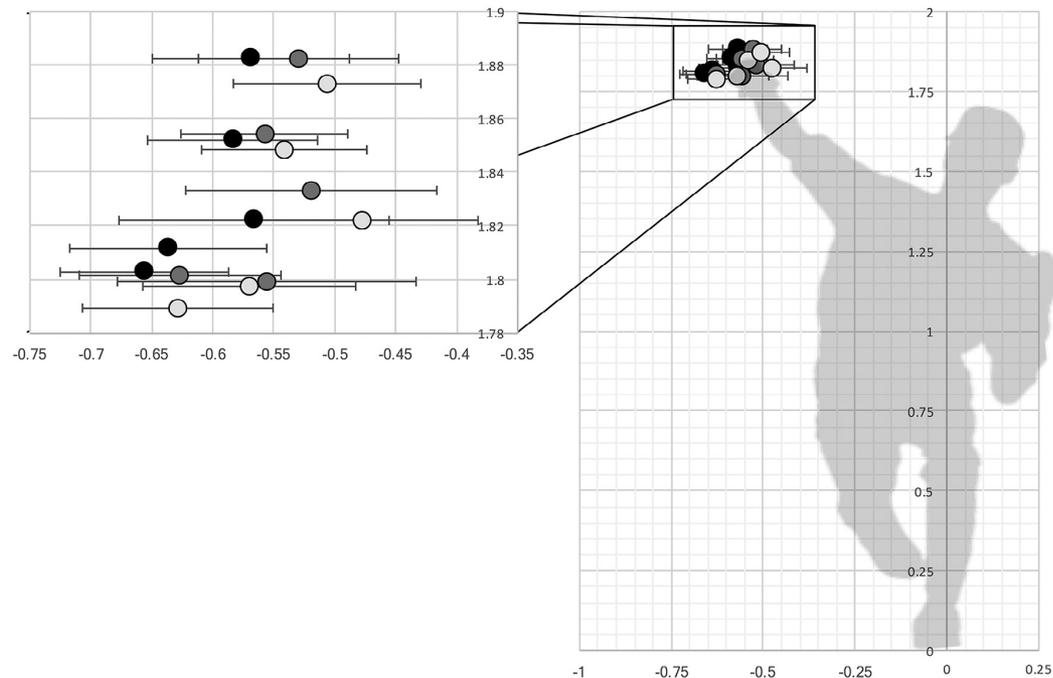
- Up to date on AAOS website
- Matthew D. Saltzman, MD
 - Medacta: Royalties and Consulting
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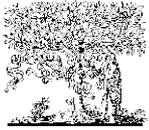
Background

- Up to 25% of MLB pitchers require UCL Reconstruction at some point during their careers [1]
- Return to play 73%-94% [5]
- Several potential risk factors have been identified
 - Overuse [2]
 - Mean pitch velocity[2,3]
 - Fastball percentage [4]
 - Peak fastball velocity[3]
 - Age and height[2]
 - Weight and body mass index[3]

Background

- Pitch-tracking technology presently available in every MLB ballpark
- High-speed cameras track ball trajectory from release to home plate within 1.02 cm of precise location of the ball
- MLB pitcher data is publicly available





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ORIGINAL ARTICLE

Changes in pitching mechanics after ulnar collateral ligament reconstruction in major league baseball pitchers



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- Pitch tracking data (PITCHf/x) for all MLB pitchers who underwent UCLR 2008-2013
- Pitch selection, pitch velocity, pitch accuracy do not significantly change after UCLR
- Pitch release locations are more medial after UCLR for all pitch types except sliders ($p < 0.01$)

Purpose & Methods

- Purpose: Compare pre-injury release point of MLB pitchers who required UCLR to that of pitchers who have never undergone UCLR
- MLB Advanced Metrics Data: both PITCHf/x and Statcast Trackman
- Analyzed data from the 3 years prior to injury
- Pre-injury Year 3 defined as 1 to 365 days prior to surgery (i.e. the year immediately prior to surgery)

Methods

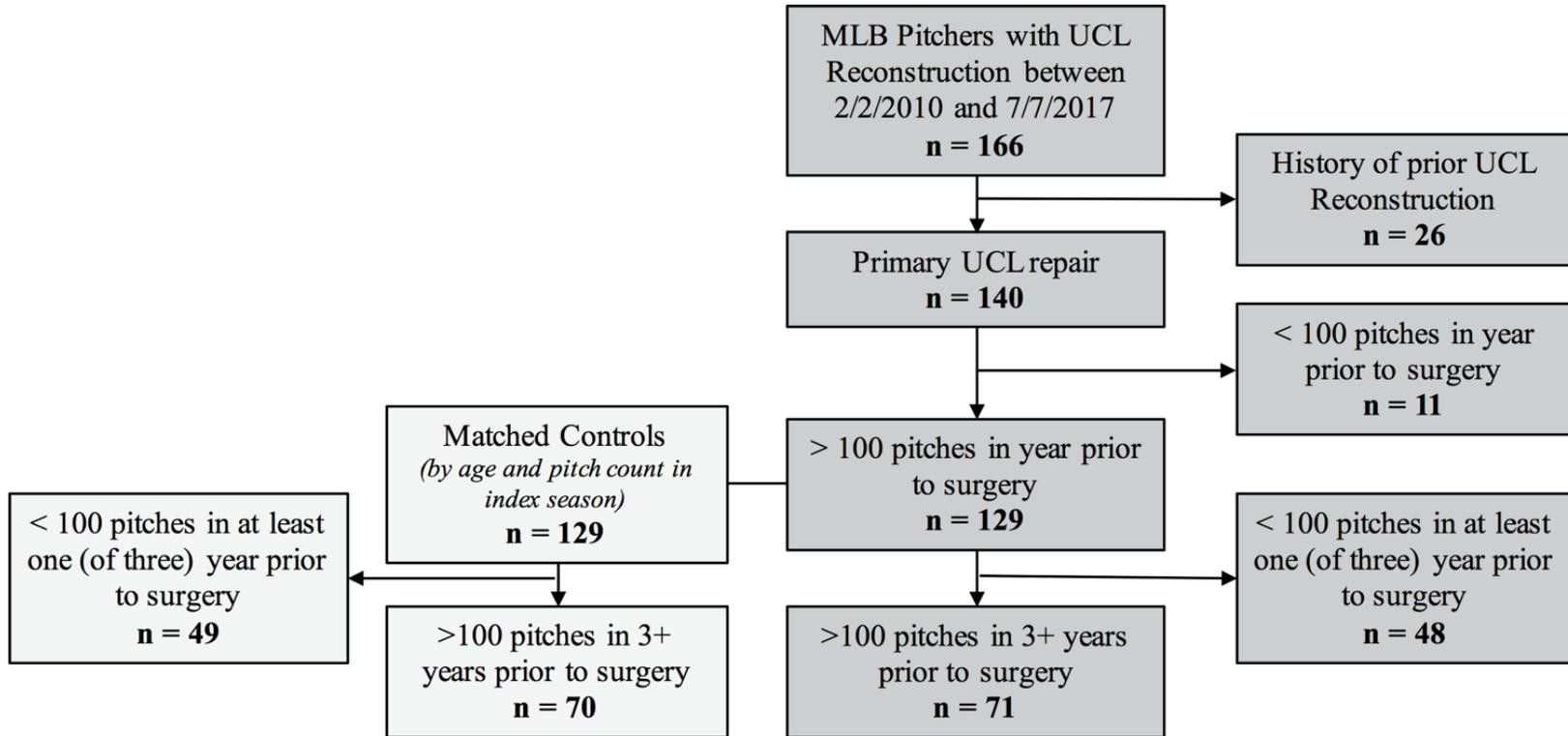


Figure 1. Study flow outlining exclusion criteria and number of pitchers excluded. A significant percentage of pitchers who underwent UCL reconstruction (37%) and control pitchers (38%) were excluded because they did not have complete data for all 3 years prior to surgery. MLB, Major League Baseball; UCL, ulnar collateral ligament.

UCL and Control Cohort

TABLE 1
UCL and Control Cohort Demographics^a

Variable	UCL (n = 71)	Control (n = 70)	P
Age, y	29.65 ± 3.92 [23.44-48.04]	29.17 ± 3.54 [23.89-42.63]	.402
Pitches, index season	1267 ± 880 [103-3341]	1489 ± 941 [135-3576]	.163
Height, cm	190.5 ± 4.8 [178-201]	189.0 ± 5.4 [178-201]	.188
Weight, kg	100.2 ± 7.8 [84-123]	97.5 ± 9.5 [79-125]	.152
Body mass index	27.59 ± 2.08 [23.73-33.75]	27.31 ± 2.38 [21.96-36.96]	.478
Left:right-handed	19:53 (26.4)	21:49 (30.0)	.635 ^b
Position			.420 ^b
Starter	30 (42.3)	29 (41.4)	
Relief	34 (47.9)	28 (40.0)	
Combination	7 (9.9)	12 (17.1)	
Draft position ^c	204 ± 235 [1-922]	262 ± 297 [5-1290]	.154

^aValues are presented as mean ± SD [range] or n (%). UCL, ulnar collateral ligament.

^bChi-square goodness-of-fit test for proportion of left- and right-handers.

^cFifty-three of 71 pitchers in the UCL group and 53 of 70 pitchers in the control group were drafted in the Rule 4 Amateur Draft.

Results

- Both UCLR and control cohorts threw similar rates of fastballs and had similar mean pitch velocity and fastball velocity
- Control pitchers had decreased mean pitch and mean fastball velocity over time ($p = .005$)
- UCLR group had no change in mean pitch and mean fastball velocity over time ($p = 0.12$)

TABLE 3
Pitch Velocity^a

	Preinjury Year			<i>P</i> ^b
	1	2	3	
Mean pitch velocity, mph				
UCL cohort	89.04 ± 3.23	88.99 ± 3.12	88.74 ± 3.22	.064
Control cohort	89.00 ± 2.64	88.84 ± 2.50	88.56 ± 2.57	.005
<i>P</i> value ^c	.928	.760	.711	
Fastball velocity, mph ^d				
UCL cohort	92.13 ± 2.79	92.04 ± 2.80	91.89 ± 2.94	.153
Control cohort	91.87 ± 2.33	91.71 ± 2.40	91.49 ± 2.45	.012
<i>P</i> value ^c	.559	.457	.392	

^aBold indicates statistically significant within-group difference. UCL, ulnar collateral ligament.

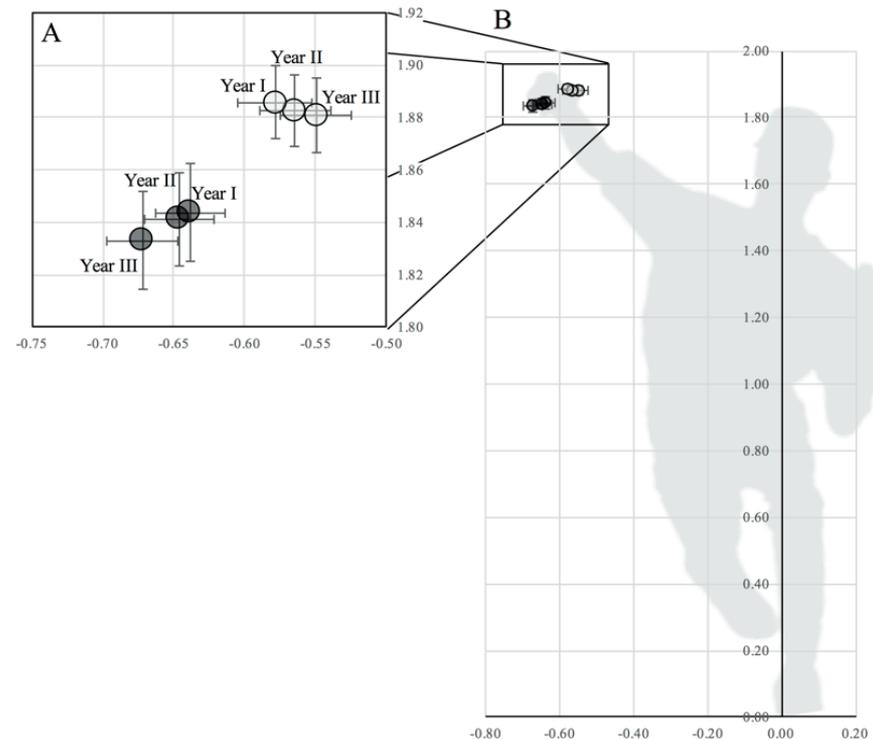
^bWithin-cohort *P* values were calculated with 1-way analysis of variance with correlated samples.

^cNonpaired 2-tailed *t* tests were calculated between cohorts, with *P* = .0167 used for significance.

^dFastball velocity accessed via fangraphs.com.

Results

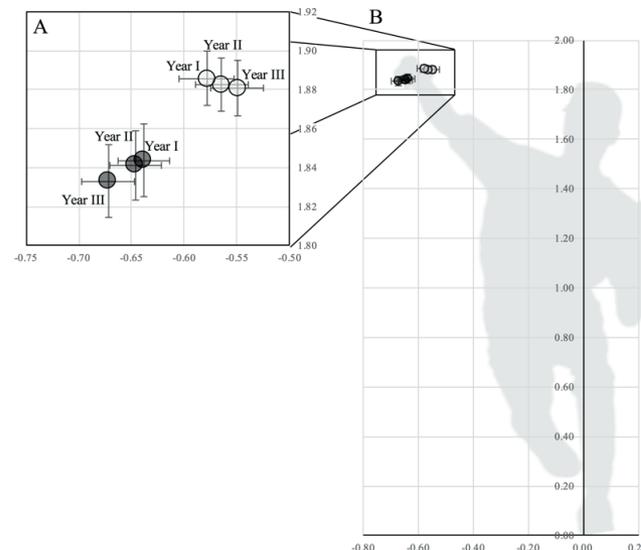
- Mean pitch release point more LATERAL in UCLR group ($p < 0.05$)
 - 8.1 cm (pre-injury Year 2)
 - 12.2 cm (pre-injury Year 3)
- Vertical release location in pre-injury year 3 was 4.8 cm lower in the UCLR than control group ($p = 0.045$)
- Mean release location in UCLR group was 3.4 cm more LATERAL in pre-injury Year 3 than in Pre-injury Year 1 ($p = 0.036$)
- No time-based changes in control group



UCLR group = Dark Gray
Control group = Light Gray

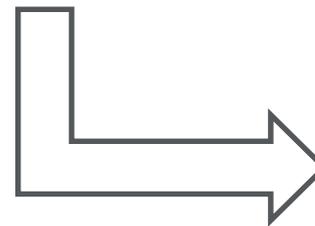
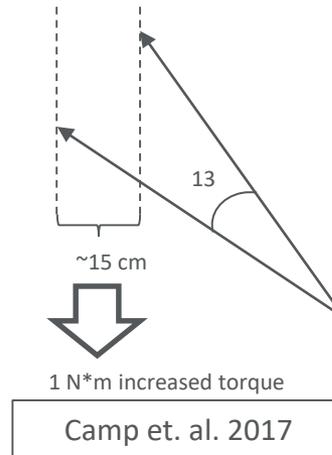
Regression Model and Prediction Rule

- Of 11 variables used in binary logistic regression model, only more lateral horizontal release location was identified as significant risk factor ($p = .048$) with odds ratio of 0.51
- Odds risk of UCLR is 4.9% for every 10-cm increase in lateral release location

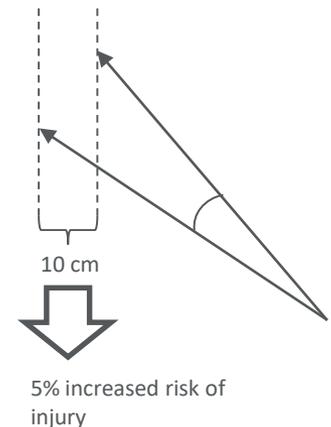


Correlation with literature

- 1-N-m increase in elbow varus torque was associated with a 13° decrease in arm slot, and 8° increase in arm rotation (Camp, AJSM 2017)



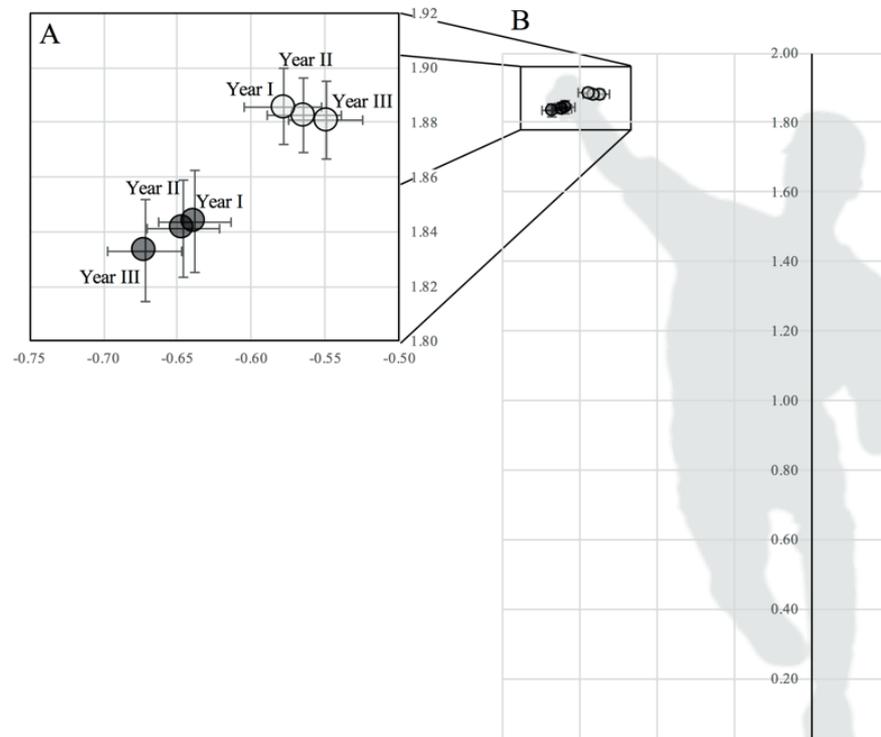
Roughly 5% increased odds of UCL reconstruction for every 10 cm of increased lateral release location (P = .048)



Portney et. al. 2019

Limitations

- Data gathered from internet sources
- Pitch tracking estimates only release location of ball and does not measure joint angles at shoulder or elbow



Conclusions

- Lateral release location and progressive lateralization of release point were significant risk factors for eventual need for UCLR
- Arm slot deserves more attention as it alters valgus and varus torque on elbow
- PITCHf/x and Trackman are powerful technology that allow for accurate monitoring of potential risk factors for UCLR
- This information could potentially be used to better identify pitchers at risk for UCL injury

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Thank you

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