

Midwest Orthopaedics at RUSH
Chicago Bulls & Chicago White Sox

Pitching Flaws & UCL Injuries

Pitching Flaws and UCL Injuries



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I (and/or my co-authors) have something to disclose.

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Pitching Flaws and UCL Injuries

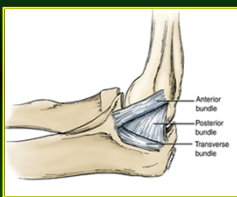
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What is the UCL?

Primary restraint to valgus force at 30°-120°

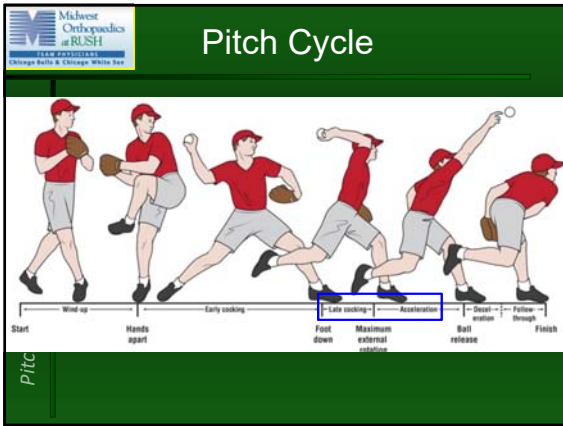
3 Bundles

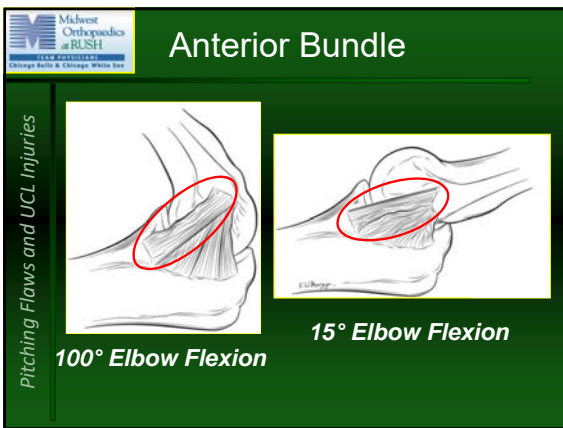
- Anterior Bundle
- Ant/Post Bands
- Posterior Bundle
- Transverse Bundle

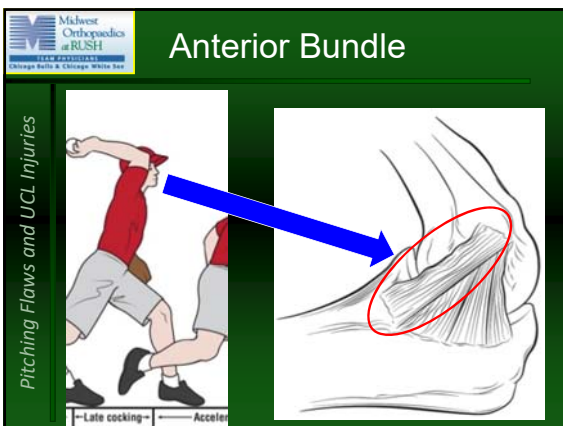


Hypertrophy in MLB Pitchers

Pitching Flaws and UCL Injuries







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Scope of the Problem

Pitching Flaws and UCL Injuries

- Affects athletes of any age engaged in overhand throwing sports.
- Since 2000 there has been a 5-fold increase in shoulder/elbow injuries in youth baseball players.
- Similar increase in the numbers of operative reconstructions required.

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Professional Athlete

Pitching Flaws and UCL Injuries

- -- 1 in 3 MLB Pitchers have required surgery for elbow.
- - Over 200 - 500 Million \$ in cumulative salaries miss time on the DL each year.

Tommy John Surgeries in MLB Pitchers by Year

Year of Surgery	Number of UCL Reconstructions
1980	0
1985	0
1990	0
1995	0
1996	10
1997	0
1998	0
1999	0
2000	15
2001	15
2002	15
2003	15
2004	15
2005	10
2006	15
2007	15
2008	15
2009	15
2010	15
2011	15
2012	15
2013	15
2014	15
2015	35

Trends in Medial Ulnar Collateral Ligament Reconstruction in the United States: A Retrospective Review of a Large Private-Payer Database From 2007 to 2011
 Brandon J. Erickson, Benedek U. Nwachukwu, Sam Rossas, William W. Schairer, Frank M. McCormick, Bernard R. Bach, Jr, Charles A. Bush-Joseph and Anthony A. Romeo
Am J Sports Med 2015 43: 1770
 DOI: 10.1177/0363546515580304

Pitching Flaws and UCL Injuries

PearlDiver Database Study

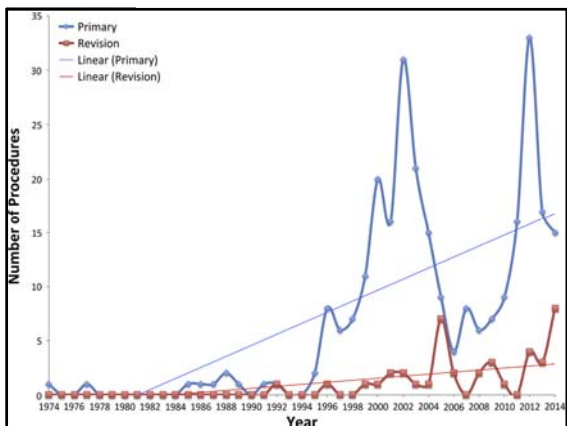
2007 – 2011

790 patients underwent UCLR
 695 males, 95 females

Avg annual incidence:
 3.96 per 100,000 for the overall population
 22 per 100,000 for patients aged 15 to 19 years.

Overall average annual growth was 4.2%.

Incidence of UCLR in the 15- to 19-year-old group increased at an average rate of 9.12% per year ($P = .009$)



Rate of Return to Pitching and Performance After Tommy John Surgery in Major League Baseball Pitchers
 Brandon J. Erickson, Anil K. Gupta, Joshua D. Harris, Charles Bush-Joseph, Bernard R. Bach, Geoffrey D. Abrams, Angielyn M. San Juan, Brian J. Cole and Anthony A. Romeo
Am J Sports Med 2014 42: 536 originally published online December 18, 2013
 DOI: 10.1177/0363546513510890

Pitching Flaws and UCL Injuries

- Created a database of all UCLR in MLB players from 1974 until 2013
- 179 MLB Pitchers underwent UCLR
- 83% RTS in MLB
- 97.2% RTS in MLB minors

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 Brandon J. Erickson, Anil K. Gupta, Joshua D. Harris, Charles Bush-Joseph, Bernard R. Bach, Geoffrey D. Abrams, Angielyn M. San Juan, Brian J. Cole and Anthony A. Romeo
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 DOI: 10.1177/0363546513510890

Tommy John Surgeries in MLB Pitchers by Year

1 in 3 MLB Players will undergo UCL reconstruction at a cost of \$200-\$500 million in lost salary with time on DL.

Outcomes in revision Tommy John surgery in Major League Baseball pitchers
Joseph N. Liu, MD^{1,2*}, Grant H. Garcia, MD³, Stan Conte, PT, DPT, ATC⁴, Neal ElAttrache, MD⁵, David W. Altchek, MD⁶, Joshua S. Dines, MD⁷

Pitching Flaws and UCL Injuries

235 MLB pitchers underwent UCLR
31 pitchers (13.2%) underwent revision UCLR
37% underwent revision within 3 years of index UCLR
26 revisions had more than 2 years of follow-up

17 pitchers (65.4%) returned to pitch at least 1 MLB game
11 (42.3%) returned to pitch 10 or more games

Average length of recovery: 20.76 months for players who RTS in MLB

MLB pitchers undergoing revision surgery had a statistically shorter career after revision surgery, pitched fewer innings, and had fewer total pitches per season compared to controls


 **UCL Epidemic**

UCL Injuries

Can We Identify Players at Risk for UCL Injury?

Can we apply Modifications to reduce

Are Pitching Mechanics Modifiable by the time athletes reach an elite level or have they been self-selected?

 **Risk Factors**

Pitching Flaws and UCL Injuries

Risk factors for UCL injuries in pitchers

- Potential Modifiable Factors
 - Shoulder Motion
 - Mechanics (?)
 - Other Injuries
 - Pitch Type
 - Number of Pitches
- Non-Modifiable Factors
 - Height
 - Weight (?)
 - Velocity

Pitching Flaws and UCL Injuries

Pitch Type

Differences among fastball, curveball, and change-up pitching biomechanics across various levels of baseball

Glenn S. Fleisig, Walter A. Laughlin, Kyle T. Aune, E. Lyle Cain, Jeffrey R. Dugas and James R. Andrews
 American Sports Medicine Institute, Birmingham, AL, USA

Level	Fastball	Curveball	Change-up
Youth	37	33.9	31.6
High school	62.6	58.3	55.8
College	69.2	63.9	60.8
Minor league	83.1	75.5	73.6
Major league	105.8	101.6	93.9

No Difference in Elbow Varus Torque between Curveball and Fastball at any level

Difference in torque noted between Fastball and Change Up (Velocity)

UCL Injuries

Biomechanical Performance of Baseball Pitchers With a History of Ulnar Collateral Ligament Reconstruction

Glenn S. Fleisig,^{1*} PhD, Charles E. Laddin,¹ PhD, Walter A. Laughlin,¹ MS, Michael G. Cicotti,³ MD, Bert R. Mandelbaum,³ MD, Kyle T. Aune,¹ MPH, Rafael F. Escamilla,⁴ PhD, PT, Toran D. MacLeod,⁵ PhD, PT, and James R. Andrews,^{1*} MD
 *Investigator performed at the American Sports Medicine Institute, Birmingham, Alabama, USA

No Difference in Kinematics between Normal Group and Players after UCL

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ROM and UCL

Current Data:

Total Arc of Motion Deficits and Flexion Deficits Associated with Increased Risk of UCL Tear

Horizontal Adduction Deficits (Posterior Capsular Tightness) Associated with increased risk of injury (UCL tear)

Decreased Torsion in the ND arm may predispose risk for UCL Tear: Volume of Throwing....

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Pitching Flaws and UCL Injuries

Pitching Motion and Influence of Fatigue

The Impact of Fatigue on Baseball Pitching Mechanics in Adolescent Male Pitchers

Brandon J. Erickson, M.D., Terrance Sgori, B.S., Peter N. Chalmers, M.D., Patrick Vignona, B.S., Matthew Lesniak, B.S., Charles A. Bush-Joseph, M.D., Nikhil N. Verma, M.D., and Anthony A. Romeo, M.D.

Pre-testing
• Demographic Data
• Range of motion testing

Warm-up
• Usual warm-up (stretching, jogging, drills, short toss, long toss)
• 10 pitches from home plate building towards 100% velocity

• 28 m

Pitching Flaws and UCL Injuries

Pitch Number	Blue Bar (Mean Score)	Green Bar (Mean Score)
15	~0.5	~0.2
30	~1.0	~0.5
45	~1.5	~0.8
60	~2.3	~1.0
75	~3.0	~1.5
90	~3.5	~1.8

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A

B

fatigue

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- No U
- Hip t incre

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Does Workload Influence Injury Risk in Starting Pitchers?

Pitching Flaws and UCL Injuries

- Publicly available database
 - All MLB starting pitchers with ≥5 starts in seasons 2010-2015
 - Excluded players:
 - Previous surgery
 - Injury in a current year due to trauma or medical reason
 - If began season on DL due to injury from previous year
 - 2010-2015 data collected on...
 - Annual pitching stats (# starts, innings, pitches, pitches/gm)
 - Annual DL information
- Multiple logistic regression
 - Are pitching stats a risk factor for injury?

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161 MLB starting pitchers included...

Pitching Flaws and UCL Injuries

- Upper extremity responsible for most DL occurrences and DL days

	Overall	UE	LE	Axial
Injury Year: 2011				
Number (Days)	34 (4040)	34 (3005)	7 (337)	13 (898)
Average	80.8 ± 107.7	93.9 ± 126.7	56.2 ± 42.7	58.2 ± 48.6
Injury Year: 2012				
Number (Days)	44 (3460)	29 (2793)	7 (405)	8 (262)
Average	91.1 ± 120.0	121.4 ± 138.8	97.8 ± 91.6	52.8 ± 20.1
Injury Year: 2013				
Number (Days)	40 (1902)	28 (1255)	7 (211)	5 (436)
Average	54.3 ± 47.2	54.6 ± 43.8	30.1 ± 18.1	87.2 ± 74.3
Injury Year: 2014				
Number (Days)	29 (2105)	16 (1359)	10 (617)	3 (28)
Average	75.2 ± 96.0	90.6 ± 122.7	61.7 ± 56.6	43.0 ± 19.1
Injury Year: 2015				
Number (Days)	22 (1318)	14 (1019)	6 (237)	2 (62)
Average	59.9 ± 49.0	72.8 ± 54.7	39.5 ± 31.5	31.0 ± 8.5

UE: Upper extremity
LE: Lower extremity

The Impact of Fatigue on Baseball Pitching Mechanics in Adolescent Male Pitchers
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Pitching Flaws and UCL Injuries

- The majority of velocity is generated from the pitcher's core and legs
- As the core and legs fatigue, the pitcher opens up more during their delivery
- The pitcher then places more stress across the shoulder and elbow, specifically the UCL, to generate force for the pitch
- Hence, trunk weakness may be a factor in UCL tears, and strengthening the core may prevent UCL injuries

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161 MLB starting pitchers included...

Pitching Flaws and UCL Injuries

- Upper extremity responsible for most DL occurrences and DL days
- No significant association between preceding years of cumulative stats with pitcher placement on DL for any musculoskeletal reason evaluating:
 - Starts
 - Pitch count
 - Innings
 - Pitches per start
- Only exception: total innings pitched from 2010-2011 being significantly associated with DL placement in 2012 (No DL, 310.5±97.5 innings; DL, 344.7±85.9 innings)

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Non-Modifiable Factors

UCL Injuries

Physics Problem:
UCL is operating at or near its failure load.

Kinetics of Baseball Pitching with Implications About Injury Mechanisms

Glenn S. Fleisig,* PhD, James R. Andrews, MD, Charles J. Dillman, PhD, and Rafael F. Escamilla, MS, CSCS

From the American Sports Medicine Institute, Birmingham, Alabama
more, the number of UCL tears has gone up.

Is Tommy John Surgery Performed More Frequently in Major League Baseball Pitchers From Warm Weather Areas?
Brandon J. Erickson, Joshua D. Harris, Matthew Tetreault, Charles Bush-Joseph, Mark Cohen and Anthony A. Romeo
Orthopaedic Journal of Sports Medicine 2014 2:
DOI: 10.1177/2325967114553916

Pitching Flaws and UCL Injuries

247 MLB Pitchers Underwent UCLR as of June 1, 2014

State/country where MLB pitcher played Baseball was used to determine warm vs. cold

Cold states were outside the 33rd parallel;
warm states were within it

Summary

Little Data to suggest that modifiable factors are associated with UCL tear (Shoulder ROM)

Further work needed to determine if injury prevention programs may help

No usable guidelines regarding innings limits

Physics will likely give us the answer:
Size, Velocity, Volume

A Review Paper

Predicting and Preventing Injury in Major League Baseball

Whiteside DJ, Martini DN, Lepley AS, Zernicke RF, Goulet GC. *Am J Sports Med* 2016;44:2202-2212. doi:10.1177/0898010116666666

Abstract

Major League Baseball (MLB) pitchers are at high risk for injury, particularly ulnar collateral ligament (UCL) reconstruction. The purpose of this review is to discuss the epidemiology, risk factors, and prevention of UCL injury in MLB pitchers. The review discusses the epidemiology of UCL injury in MLB pitchers, including the incidence and risk factors. It also discusses the prevention of UCL injury, including the use of pitching mechanics, workload management, and injury prevention programs. The review concludes that UCL injury is a significant problem for MLB pitchers and that further research is needed to better understand the risk factors and prevention of this injury.

Predictors of Ulnar Collateral Ligament Reconstruction in Major League Baseball Pitchers

David Whiteside, Douglas N. Martini, Adam S. Lepley, Ronald F. Zernicke and Grant C. Goulet
Am J Sports Med 2016 44: 2202 originally published online May 6, 2016

Factors associated with a smaller likelihood of UCLR:


1. Increase in mean days between consecutive games
2. Number of unique pitch types thrown

An increase in mean pitch speed or mean pitches per game was associated with significantly higher odds of UCL reconstruction surgery

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Revision UCLR

Pitching Flaws and UCL Injuries



Trends in Revision Elbow Ulnar Collateral Ligament Reconstruction in Professional Baseball Pitchers

Alexander T. Wilson, BS,* Tyler S. Pidgoun, MD,* Nathan T. Morrell, MD,* Manuel F. DeSilva, MD

Analyzed professional Pitchers who had revision UCLR 1974-2014

- 271 underwent primary UCLR
- 40 (15%) had at least one revision UCLR
- 3 had a second revision UCLR

Avg time from primary UCLR to revision: 5.2 +/- 3.2 years

Avg career length:
After primary UCLR: 4.9 +/- 4.3 years
After revision UCLR: 2.5 +/- 2.4 years

No risk factors for revision UCLR were identified

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Thank You

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