The Tommy John Surgery Phenomenon: Current Concepts

Randy Schwartzberg, M.D.

Assistant Professor of Orthopedics - UCF College of Medicine
President - Orlando Orthopaedic Center Foundation

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Who is Tommy John?

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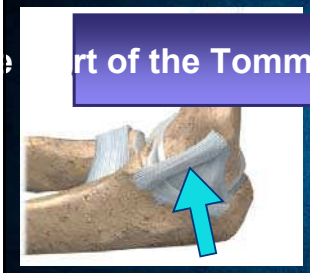
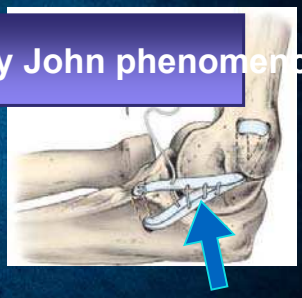
September 25, 1974

rt of the Tommy John phenomen





Tommy John…

A household name

Epidemiology of Medial Ulnar Collateral Ligament Reconstruction

A 10-Year Study in New York State

Justin L. Hodgins,* MD, Mark Vitale,† MD, Raymond R. Arons,* MPH, DrPH, and Christopher S. Ahmad,*‡ MD

2016

- Rate per 100,000 tripled
- Increased rate in 17-20 year olds

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,*† MD, Benedict U. Nwachukwu,† MD, MBA, Sam Rosas,§ BS, William W. Schairer,‡ MD, Frank M. McCormick,§ MD, Bernard R. Bach Jr,† MD, Charles A. Bush-Joseph,† MD, and Anthony A. Romeo,† MD

2016

15-19 year old males…

- 57% of all surgeries
- Increased at rate of 9% per year

Prevalence of Ulnar Collateral Ligament Surgery in Professional Baseball Players

Stan A. Conte,*† PT, DPT, ATC, Glenn S. Fleisig,‡ PhD, Joshua S. Dines,§ MD, Kevin E. Wilk,‖¶ PT, DPT, Kyle T. Aune,‡ MPH, Nancy Patterson-Flynn,† MS, ATC, and Neal ElAttrache,†¶ MD

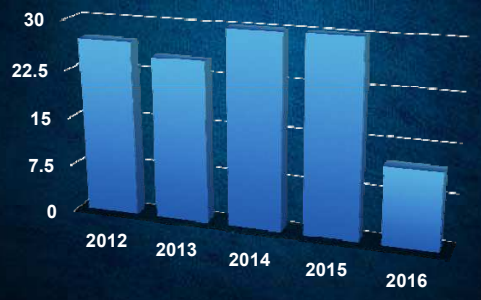
Sports Medicine

2016

Prevalence of UCLR in 5,088 professional players…

10% overall
Pitchers - 16%
Major league pitchers - 25%
Minor league pitchers - 15%

Number of MLB Players - UCL Reconstruction



Anatomy

Medial Flexor Mass

- FCU
- FDC
- Palmaris Longus
- FCR
- Pronator Teres

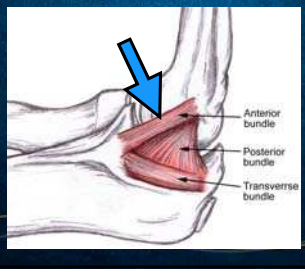
Ulnar Nerve

- Cubital tunnel
- Posterior to medial epicondyle

3

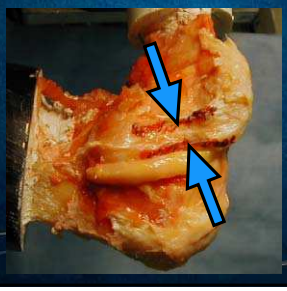
Ulnar Collateral Ligament

- Three bundles
- Anterior bundle
- Major restraint to valgus stress

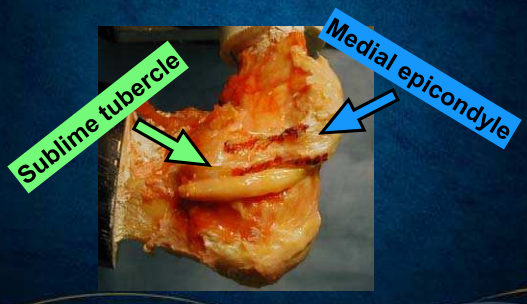


Anterior Bundle

- Average width - 6 mm
- Average thickness - 4-8 mm



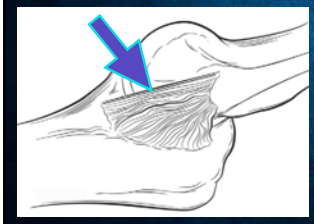
Anterior Bundle Insertions

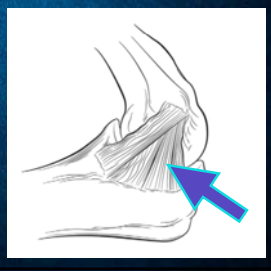


Anterior Bundle

Anterior Band

Posterior Band





UCL Biomechanics

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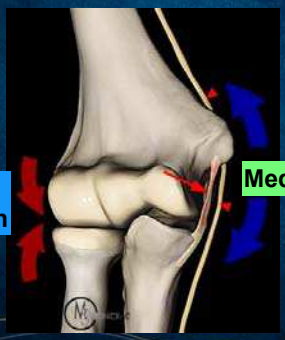
Biomechanical Forces of Throwing

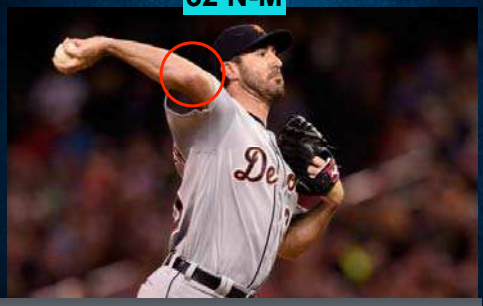
Lateral Compression

Medial Tension



UCL Ultimate Tensile Strength

32 N-M



Varus torque during pitching…

64 N-M

Diagnosis

UCL tears are typically attritional

History

- Gradual onset medial elbow pain
- Only hurts when throwing
- Loss of velocity
- Loss of control

Possible acute painful event

Physical Exam

- FROM
- Mild flexion contractures common
- Possible pain to palpation over UCL
- Valgus stress tests

Valgus Stress Test

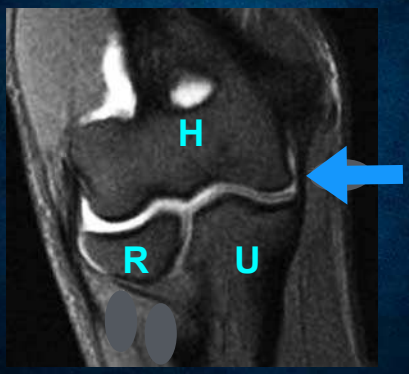
Moving Valgus Stress Test

Milking Maneuver

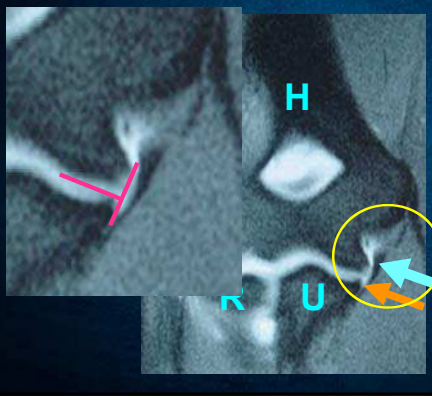
X-rays

Usually normal

MRI



MRI Arthrogram



Treatment

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Partial Thickness Tears

Nonoperative treatment is initial approach.

No one standard recipe

- 6 week shut… …m throwing
- Elbow & shoulder r…
- Core & lower extremities
- Throwing program after 6 weeks

Limited Data…

Nonoperative Treatment of Ulnar Collateral Ligament Injuries in Throwing Athletes*

Arthur C. Rettig,†‡ MD, Colin Sherrill,§ MD, Dale S. Snead,† MD, J. Chris Mendler,‖ MD, and Paul Mieling,† MS, OTR, ATC/L

2001

- 31 throwing athletes
- 42% return to prior level

Operative Treatment

- Failure of rehab for partial tears
- Complete tears

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t are the principles of operative treatm

- Anatomic reconstruction
- Replace UCL with tendon graft
- Fix graft securely

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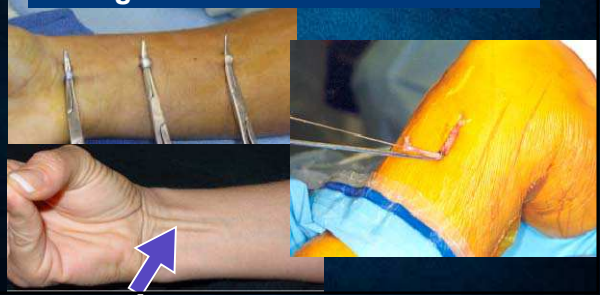
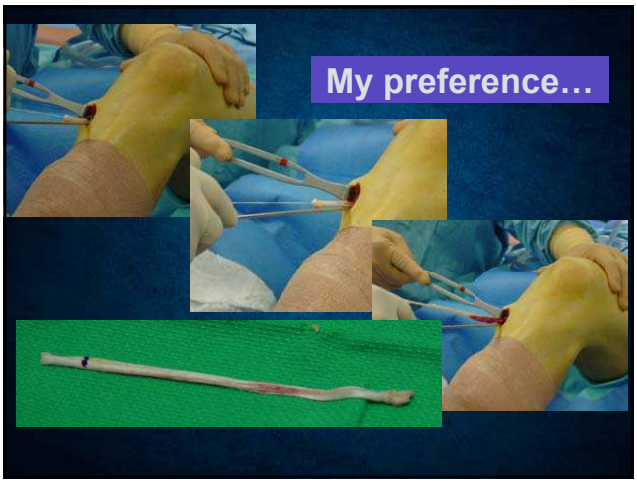
Graft Options

- Palmaris longus tendon autograft
- Gracilis tendon autograft
- Allograft





How has the surgery been done?

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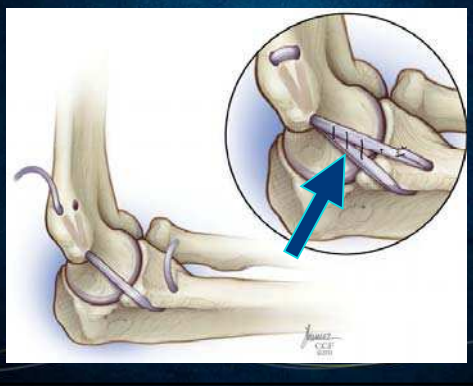
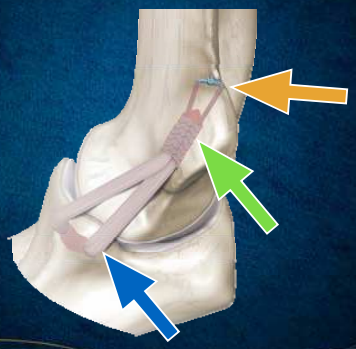
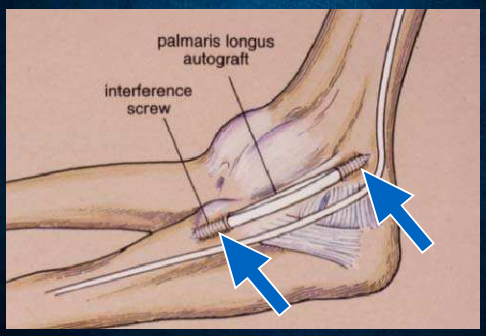
Jobe Technique



Docking Technique



Interference Screws Technique



Most modern technique…

UCL GraftLink

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UCL GraftLink

- Suspension fixation
- Strongest to date
- Excellent tensioning

Postoperative Rehabilitation

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Traditional thoughts…

- Splint at 90 degrees
- Hinged elbow brace
- Block extension

A more modern thought

- Splint for one week < 90
- Hinged elbow brace
- No ROM restrictions

Defining Safe Rehabilitation for Ulnar Collateral Ligament Reconstruction of the Elbow

A Biomechanical Study

Geoffrey A. Bernas,*† MD, Ramon A. Ruberte Thiele,* MS, Karen A. Kinnaman, BS,† Richard E. Hughes,* PhD, Bruce S. Miller,* MD, and James E. Carpenter,*‡ MD

2009

UCL Strain with PROM

Max extension - 50 degrees → < 3%

90 degrees → 7%

- Wrist & elbow exercises
- Shoulder exercises
- Limit shoulder ER until 6 weeks
- Core strengthening
- Leg work

- Functional rehab progressions for throwing
- Throwing program beginning at 4 months earliest

Interval Throwing Programs

- No one right one
- Many variations
- Common sense progressions
- Soreness rules

GLENN S. FLEISIG, PhD • BECKY BOLT, MS • DAVE FORTENBAUGH, MS
KEVIN E. WILK, DPT • JAMES R. ANDREWS, MD

Biomechanical Comparison of Baseball Pitching and Long-Toss: Implications for Training and Rehabilitation

JOSPT
2011

Greater shoulder & elbow stresses with long toss than shorter distance throws

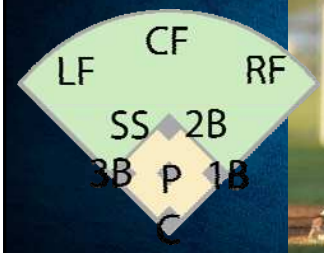
What every player and parent wants to know…

How long to return to play?

It's variable

Individual progressions are different

Position influence…



Timing of surgery relative to seasons

Other important considerations…

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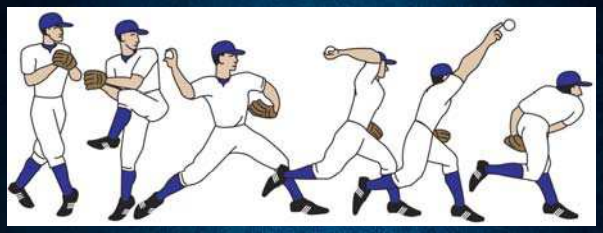
The three hour per week rehab reality…

Pitching Mechanics



Wind-up
Stride
Cocking

Acceleration
Deceleration
Follow through

Why do these UCL injuries occur?

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Mechanics

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The Effect of Pitching Biomechanics on the Upper Extremity in Youth and Adolescent Baseball Pitchers

J. T. Davis,* MD, Orr Limpisvasti,†‡ MD, Derrick Fluhme,§ MD, Kare[illegible]
Lewis A. Yocum,† MD, Neal S. ElAttrache,† MD, and Frank W. Jobe†

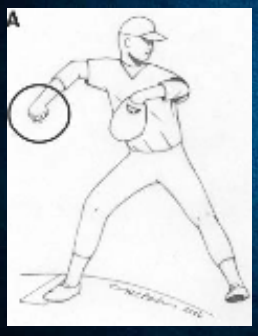
2009

- 169 youth baseball pitchers
- Ages 9-18
- Quantitative motion analysis
- 5 biomechanical pitching parameters

Correct

Incorrect

Correct



Incorrect

Correct

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Correct

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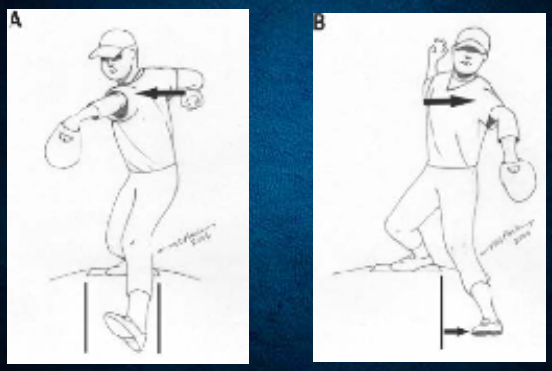

Increased number of incorrect biomechanics parameters

Increased injury risk?

Humeral i… …tation torque

Elbow varus torque

Pitch Type

Curveballs

The Dogma

- Coaches, players & parents
- Da
- To
- Be

s &

☐ TRUE
☐ FALSE

A Biomechanical Comparison of Youth Baseball Pitches

Is the Curveball Potentially Harmful?

Shouchen Dun,* MS, Jeremy Loftice,* CSCS, Glenn S. Fleisig,*† PhD, David Kingsley,† and James R. Andrews,* MD

2008

- Youth baseball pitchers (11-14 y.o.)
- Elbow varus torque
- Humeral internal rotation torque

Fastball > Curveball

A Biomechanical Comparison of the Fastball and Curveball in Adolescent Baseball Pitchers

Carl W. Nissen,*† MD, Melany Westwell,‡ MS, PT, Sylvie Ounpuu,‡ MSc, Mousam Patel,‡ MS, Matthew Solomito,‡ BSBE, and Janet Tate,§ PhD

2009

- High school pitchers
- Elbow varus torque
- Humeral internal rotation torque

Fastball > Curveball

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

Glenn S. Fleisig,* PhD, David S. Kingsley, Jeremy W. Loftice, Kenneth P. Dinnen, MS, Rajiv Ranganathan, Shouchen Dun, MS, Rafael F. Escamilla, PhD, and James

2006

- 21 college baseball pitchers
- Elbow proximal force

Fastball > Curveball > Change-up

Effect of Pitch Type, Pitch Count, and Pitching Mechanics on Risk of Elbow and Shoulder Pain in Youth Baseball Pitchers

Stephen Lyman,* PhD, Glenn S. Fleisig,*† PhD, James R. Andrews,* MD, and E. David Osinski,‡ MA

2002

Effects of curveballs in youth players

↑ Risk of shoulder pain

No increase risk of elbow pain

Risk of Serious Injury for Young Baseball Pitchers

A 10-Year Prospective Study

Glenn S. Fleisig,*† PhD, James R. Andrews,* MD, Gary R. Cutter,‡ PhD, Adam Weber,*‖ BS, Jeremy Loftice,* BS, Chris McMichael,*‖ MPH, Nina Hassell,* MPH, and Stephen Lyman,§ PhD

2011

Curveballs before age 13

Slight increased risk of injury

Not significant (p=0.41)

Ulnar Collateral Ligament Reconstruction in High School Baseball Players

Clinical Results and Injury Risk Factors

Damon H. Petty, MD, James R. Andrews, MD, Glenn S. Fleisig,* PhD, and E. Lyle Cain, MD

2004

- 27 former HS baseball pitchers
- S/P UCL reconstruction
- 67% threw curveballs before age 14

The Curveball as a Risk Factor for Injury: A Systematic Review

W. Jeffrey Grantham, MD,† Jaicharan J. Iyengar, MD,† Ian R. Byram, MD,‡ and Christopher S. Ahmad, MD*†

2015

ological studies do not demonstrate an increa

Pitch Quantity

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Believed to be the greatest issue…

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Risk Factors for Shoulder and Elbow Injuries in Adolescent Baseball Pitchers

Samuel J. Olsen II, MD, Glenn S. Fleisig,* PhD, Shouchen Dun, MS, Jeremy Loftice, and James R. Andrews, MD

2009

Injured pitchers reported more…

- Months per year
- Innings per game
- Pitches per game

Averaging > 80 pitches per game…

3.8x increased risk of surgery

Risk of Serious Injury for Young Baseball Pitchers

A 10-Year Prospective Study

Glenn S. Fleisig,*† PhD, James R. Andrews,* MD, Gary R. Cutter,‡ PhD, Adam Weber,*† BS, Jeremy Loftice,* BS, Chris McMichael,*† MPH, Nina Hassell,* MPH, and Stephen Lyman,§ PhD

2011

Pitchers > 100 innings per year - 3.5x more likely to be injured

Pitching Practices and Self-Reported Injuries Among Youth Baseball Pitchers

A Descriptive Study

Johna K. Register-Mihalik, PhD, ATC; Sakiko Oyama, MS, ATC; Stephen W. Marshall, PhD; and Frederick O. Mueller, PhD

2012

Athletic Training & Sports Health Care

Associations with shoulder/elbow injuries

- Pitching in travel ball
- Pitching in showcases
- Playing in multiple leagues
- Pitching with shoulder/elbow pain

Evidence Based Injury Prevention Conclusions

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position statement

National Athletic Trainers' Association Position Statement: Prevention of Pediatric Overuse Injuries

Tamara C. Valovich McLeod, PhD, ATC*; Laura C. Decoster, ATC†; Keith J. Loud, MDCM, MSc‡; Lyle J. Micheli, MD§; J. Terry Parker, PhD, ATC‖; Michelle A. Sandrey, PhD, ATC¶; Christopher White, MS, ATC#

- Overuse is principle risk factor
- Poor pitching mechanics contribute
- Research does not support throwing curveballs as a risk factor

Curveball Thoughts

Curveball Literature Confounded

- Pitching amounts
- Better pitchers
- More opportunities to pitch
- No clinical studies control for pitch type

Are curveballs safe?

- Youth may lack development for proper mechanics
- Throwing early may be counterproductive
- More pitch types may increase pitch/practice quantity

General Recommendations

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Avoid…

- Pitching with signs of fatigue
- Throwing for 3 months per year
- Pitching > 100 innings per year
- Playing on multiple teams at same time
- Playing pitcher and catcher

Advise…

- Learn proper mechanics early
- Stop pitching with shoulder/elbow pain
- Get evaluated for such pain
- Follow pitch limit recommendations

Pitch Count Limits

Ages	Daily	Weekly
9-10	50	75
11-12	75	100
13-14	75	125
15-16	95	N/A

Ages	Season	Year
9-10	1,000	2,000
11-12	1,000	3,000
13-14	1,000	3,000

Pitch Count Rest Days Ages 7-14

# of Pitches	Rest Days
1-20	0
21-35	1
36-50	2
51-65	3
66+	4

*2014 Little League Baseball

Pitch Count Rest Days Ages 15-18

# of Pitches	Rest Days
1-30	0
31-45	1
46-60	2
61-75	3
76+	4

*2014 Little League Baseball

Some Latest Thoughts

Effects of Weather

versus

Comparison of Shoulder Range of Motion, Strength, and Playing Time in Uninjured High School Baseball Pitchers Who Reside in Warm- and Cold-Weather Climates

Kevin M. Kaplan,* MD, Neal S. ElAttrache,* MD, Frank W. Jobe,* MD, Bernard F. Morrey,† M
Kenton R. Kaufman,‡ PE, PhD, and Wendy J. Hurd,‡§ PT, PhD, SCS

2011

Warm Weather Pit

- More m
- ider ER/IR
- ratios

rm weather pitchers may be more subject to inj

Does Geographic Location Matter on the Prevalence of Ulnar Collateral Ligament Reconstruction in Collegiate Baseball Pitchers?

Jason L. Zaremski,*† MD, CAQSM, MaryBeth Horodyski,† EdD, ATC, LAT, FNATA,
Robert M. Donlan,‡ DO, CAQSM, Sonya Tang Brisbane,† BS, MPH, and Kevin W. Farmer,† MD

2015

isk of UCLR in pitchers from southern states
er risk of UCLR in SEC vs Big 10 pitchers (R

Pace of Pitching

Major League Baseball pace-of-play rules and their influence on predicted muscle fatigue during simulated baseball games

Michael W. L. Sonne and Peter J. Keir

2016

J of Sports Sciences

- Effects of time between pitches
- Comparisons
  - Proposed Rule 8.04 (12 sec)
  - 2014 AFL pitch clock (20 sec)
  - 2014 MLB self-selected times
- 2014 FanGraphs web site
- Mathematical model

lbow muscle fatigue with lesser time betwee

ECRB & flexor mass

UCL Morphology with Ultrasound

Factors Related to Increased Ulnar Collateral Ligament Thickness on Stress Sonography of the Elbow in Asym… Youth and Adolesc…

2016

UCL thickness increases with age & pitch volume in youth pitchers.

…rphologic change of the ulnar collateral …school baseball

Journal of Shoulder and Elbow Surgery

Tsuyoshi Tajika, MD, PhD…
Tsuyoshi Ichinose, MD, PhD†, Daisuke Shimoya…
Hitoshi Shitara, MD, PhD*, Takanori Kitagawa, MD*, Kenichi Sa…
Takashi Osawa, MD, PhD†, Kenji Takagishi, MD, PhD†

Greater UCL thickness in high school pitchers with h/o elbow symptoms.

Stress Sonography of the Ulnar Collateral Ligament of the Elbow in Professional Baseball Pitchers

A 10-Year Study

Sports Medicine

2014

- Thicker UCLs in dominant elbow
- More hypoechoic areas & calcifications
- Increase valgus laxity to stress over time

Pitch Velocity & UCL Tears

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Fastball Pitch Velocity Helps Predict Ulnar Collateral Ligament Reconstruction in Major League Baseball…

2016

Higher peak pitch velocity in UCLR pitchers 93.3 vs 92.1 mph

…Before Ulnar Collateral …ior League …Controls

John Prodromo,*† MD, Nimit Patel,† MD, Neil Kumar…
Loni Philip Tabb,‡ PhD, and James Tom,† MD

Higher mean pitch velocities for all pitches in UCLR pitchers 92.1 vs 91.3 mph for fastballs

Major League Baseball pitch velocity and pitch type associated with risk of ulnar collateral ligament injury

Robert A. Keller, MD*, Nathan E. Marshall, MD, John-Michael Guest, Kelechi R. Okoroha, MD, Edward K. Jung, MD, Vasilios Moutzouros, M

2016

erences in fastball pitch velocities for UCLR p

Return to Pitching after UCLR

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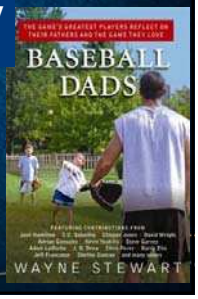
Tommy John Surgery Myths

- Everyone returns to play
- Increase in pitch velocity
- More durable elbow



Nonoperative Treatment of Ulnar Collateral Ligament Injuries in Throwing Athletes*

Arthur C. Rettig,†‡ MD, Colin Sherrill,§ MD, Dale S. Snead,† MD, J. Chris Mendler,‖ M
Paul Mieling,† MS, OTR

Sports Medicine

2014

- 30/38 pitchers returned after UCLR
- Decrease fastball velocity

Rate of Return to Pitching and Performance After Tommy John Surgery in Major League Baseball Pitchers

Brandon J. Erickson,* MD, Anil K. Gupta,* MD, MBA, Joshua D. Harris,* MD, Charles Bush-Joseph,* MD, Bernard R. Bach,* MD, Geoffrey D. Abrams,* M Angielyn M. San Juan,* BS, Brian J. Cole,* MD, MBA, and Anthony A. Rom

2014

83%

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Major weaknesses of these studies..

RTP is compared to year leading up to surgery. Competitiveness in RTP is not evaluated with advanced metrics.

Performance, Return to Competition, and Reinjury After Tommy John Surgery in Major League Baseball Pitchers

A Review of 147 Cases

Eric C. Makhni,* MD, Randall W. Lee,* BS, Zachary S. Morrow,* BS, Anthony Prakash Gorroochurn,† PhD, and Christopher S. Ahmad,*‡ MD

2016

- Evaluated metrics up to 3 years prior and 3 years after UCLR
- Numerous metrics evaluated

Pitchers RTP at mean 16.8 months post-op
67% returned to same level post-op
57% returned to disabled list

Comparing 3 years pre-op to post-op…
Decline in 10 of 12 metrics

Comparing 1 year pre-op to post-op…
Decline in 3 of 12 metrics

Performance and Injury Characteristics of Pitchers Entering the Major League Baseball Draft After Ulnar Collateral Ligament Reconstruction

Lucas Wymore,*† MD, Paul Chin,‡ MD, PhD, Christopher Geary,§ MD, Gregor
Daniel Keefe,¶ MD, Heinz Hoenecke,¶ MD, and Jan Fronek,¶ MD

2016

d no difference in professional advancement

Pitching Performance and Longevity After Revision Ulnar Collateral Ligament Reconstruction in Major League Baseball Pitchers

Nathan E. Marshall,*† MD, Robert A. Keller,† MD, Jonathan R. Lynch
Michael J. Bey,†‡ PhD, and Vasilios Moutzouros,† MD

2015

rate of return to MLB (65%) and shorter caree

Summary

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John has attained sports medicine fam

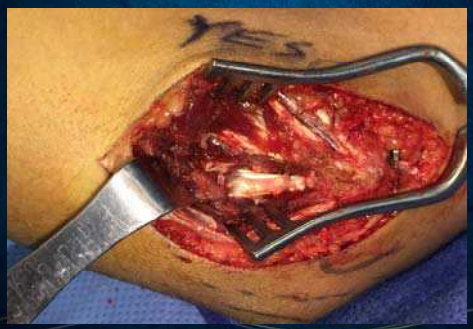
ses during pitching exceed UCL ultima

Diagnosis is best made by careful history & quality MRI arthrogram.

th prevention should be a research fo

- Volume
- Mechanics

umerous accepted surgical techniques



re-injury performance is not as high as

Rehab attention to detail is critical.

- Whole body
- Prevention emphasis
- Supervised ITP

ıore advances in the Tommy John S

Thank You