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Elbow Injuries in Throwers: Risk Factors, Prevention and Treatment

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Stress of Throwing



Throwing places incredibly high stresses on shoulder and elbow joints

Elbow reaches 2200 degrees per second of angular velocity degrees/sec¹

Shoulder reaches 7000-9000 degrees per second of angular velocity¹

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1. Scroey, et al. Sports Health, 2010.

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Disclosures

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- Committee member for AOSSM, AANA, and ORS

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Throwing Cycle

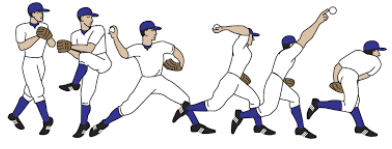
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<https://doi.org/10.1007/s12178-022-00744-9>

SPORTS INJURIES AND REHABILITATION: GETTING ATHLETES BACK TO PLAY (R. GALLO, SECTION EDITOR)

Throwing Injury Prevention Strategies with a Whole Kinetic Chain-Focused Approach

Michael Mayes¹ · Madeline Salekly² · Drew A. Lansdown¹

- Coordination of complex motions to transfer energy
- Requires strength and stability through:
 - Lower extremities
 - Core
 - Spine
 - Shoulder
 - Elbow



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Outline

- Review the stress of throwing and epidemiology of elbow injuries
- History and exam for evaluating patients with elbow injuries
- Presentation and treatment options for:
 - Ulnar collateral ligament injuries
 - Capitellar osteochondritis dissecans
 - Ulnar neuritis
 - Posteromedial impingement
- Cases

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Epidemiology of Injured Throwers

Epidemiology of Shoulder and Elbow Injuries Among United States High School Baseball Players

School Years 2005-2006 Through 2014-2015

Michael G. Saper^{1,2}, D.D., M.D., Lauren A. Parnianpour¹, M.D., Wei Liu¹, Ph.D., B. David Comstock¹, Philip J. Bevilacqua¹, David J. Lussier¹, and Robert W. Anderson¹, M.D.
B. David Comstock, Philip J. Bevilacqua, David J. Lussier, and Robert W. Anderson, M.D. are supported by the National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

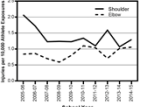


Figure 1. Overall shoulder and elbow injury rates in United States high school baseball players from 2005-2006 through 2014-2015. Shoulder: Prevalence = 0.001, Incidence = 0.001, Elbow: Prevalence = 0.001, Incidence = 0.001

Diagnosis	Shoulder, n (%)	Elbow, n (%)
Muscle strain	10 (10.0)	1 (1.1)
Tendinitis	46 (18.2)	27 (18.2)
Ligament sprain	2 (0.4)	49 (18.2)
Osteoarthritis	13 (5.4)	22 (13.3)
Tendon strain	20 (8.2)	13 (8.2)
Other	58 (6.7)	8 (5.4)
Unknown	20 (8.2)	0 (0.0)
Subtotal	123 (18.2)	123 (18.2)
Fracture	3 (1.2)	3 (1.2)
Dislocation	2 (0.8)	4 (2.7)
Other	2 (0.8)	0 (0.0)
Unknown	0 (0.0)	2 (1.4)
Subtotal	5 (0.8)	7 (4.6)
Hyperextension	1 (0.4)	1 (0.7)
Stress fracture	0 (0.0)	1 (0.7)
Apophysitis	0 (0.0)	1 (0.7)
Loosening	0 (0.0)	1 (0.7)

An Epidemiological Comparison of Elbow Injuries Among United States High School Baseball and Softball Players, 2005-2006 Through 2014-2015

Andrew J. Cook¹, M.D., Matthew J. Parnianpour¹, M.D., Robert W. Anderson¹, M.D., and Robert W. Anderson¹, M.D.
Andrew J. Cook, M.D., Matthew J. Parnianpour, M.D., Robert W. Anderson, M.D., and Robert W. Anderson, M.D. are supported by the National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

Sport/Injury	Baseball, n (%)	Softball, n (%)	Ratio (95% CI)
Pitching	10 (10.0)	7 (8.7)	1.15 (0.45-2.95)
Throwing and pitching	46 (18.2)	22 (20.0)	0.91 (0.45-1.85)
Other	20 (8.2)	13 (8.2)	1.00 (0.45-1.15)
Subtotal	76 (18.2)	42 (20.0)	0.91 (0.45-1.15)
Fracture	3 (1.2)	3 (1.2)	1.00 (0.45-1.15)
Dislocation	2 (0.8)	4 (2.7)	0.29 (0.05-1.76)
Other	2 (0.8)	0 (0.0)	0.00 (0.00-0.00)
Subtotal	7 (4.6)	7 (4.6)	1.00 (0.45-1.15)
Hyperextension	1 (0.4)	1 (0.7)	0.57 (0.05-1.15)
Stress fracture	0 (0.0)	1 (0.7)	0.00 (0.00-0.00)
Apophysitis	0 (0.0)	1 (0.7)	0.00 (0.00-0.00)
Loosening	0 (0.0)	1 (0.7)	0.00 (0.00-0.00)

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Risk Factors for Elbow and Shoulder Injuries in Adolescent Baseball Players

A Systematic Review

Ryan Borucki,^{1,2} DO, Christopher Horvath,¹ MD, Rajar Joshi,¹ BS, Matthew Strick,¹ MD, Vernon Chiribhaskar,¹ PhD, and Arman Ohanian,¹ MD. Investigators performed at Penn State Health Milton S. Eisenhower Medical Center, Hershey, Pennsylvania, USA.



TABLE 2
Risk Factors According to the Major League Baseball and USA Baseball Pitch Smart Guidelines¹⁶

- Pitching while fatigued
- Throwing too many innings over the course of the year
- Not taking enough time off from baseball every year
- Throwing too many pitches and not getting enough rest
- Pitching on consecutive days
- Excessive throwing when not pitching
- Playing for multiple teams at the same time
- Pitching with injuries to other body regions
- Not following proper strength and conditioning routines
- Not following safe practices while at showcases
- Throwing curveballs and sliders at a young age
- Radar gun use

¹⁶Reprinted from Major League Baseball Pitch Smart.

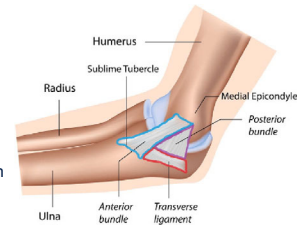
- Reviewed 22 studies on risk factors for injuries
- Identified 6 clear risk factors for injury:
 - Age
 - Height
 - Pitching for multiple teams
 - Pitch velocity
 - Arm fatigue
 - Pitches per game

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Ulnar Collateral Ligament

- Three bands:
 - Anterior oblique
 - Posterior oblique
 - Transverse
- Anterior oblique is:
 - Most isometric through range of motion
 - Strongest stabilizer to valgus stress
- Posterior oblique is tight in flexion



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Key Points in History

SPECIFIC INJURY?

- Was there a pop?
- Where was it felt?
- How long has there been pain?

TIMING

- Specific phase in throwing cycle
- Every throw? Just some? After?

VOLUME

- How often do you throw?
- Number of seasons/year
- Number of teams
- Positions played

ABILITY

- Velocity? Any change?
- Control?
- Current level and plans for future play?

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Ulnar Collateral Ligament Injuries

- Increasing in incidence, especially amongst youth throwers
- Can present as:
 - Acute injury – felt a pop on specific throw
 - Chronic accumulation of microtrauma
- Commonly present with complaints of:
 - Medial elbow pain
 - Loss of accuracy
 - Loss of velocity

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Examining the Thrower's Elbow

Palpation

- UCL
- Flexor-pronator mass
- Ulnar nerve
- Radiocapitellar joint
- Olecranon
- Triceps tendon
- Biceps tendon

Range of Motion

- Flexion and extension
- Pronation/supination

Ulnar Nerve

- Tinel's at cubital tunnel
- Stability of ulnar nerve



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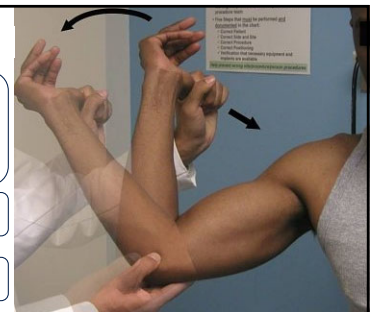
Examining the UCL

Ulnar Collateral Ligament

- Varus/valgus stress in full extension
- Moving valgus stress test
- Milking maneuver

Evaluate for both instability and/or pain

Consider stress fluoroscopy or ultrasound for quantitative evaluation

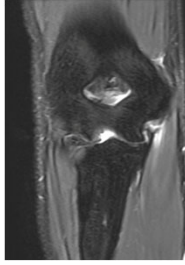


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Imaging for UCL Injuries

- XR may show calcification along UCL or other bony changes
- MRI often obtained to visualize UCL
- Consider arthrogram, especially for more chronic injury pattern
- Ultrasound can be good tool as well



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Ulnar Collateral Ligament Repair With Collagen-Dipped FiberTape Augmentation in Overhead-Throwing Athletes



Jeffrey R. Dugas,¹ MD, Christopher A. Looney,^{1,2} MD, Brian Capogno,³ MD, Brian L. Walters,¹ MD, Christopher M. Jones,¹ MD, Marcus A. Rothemann,⁴ MD, Glenn S. Fleisig,¹ PhD, Kyle T. Aune,¹ MPH, Morika Dragocz,¹ MPH, Kevin E. Wik,¹ DPT, Benton A. Emborn,¹ MD, and E. Lyle Cain Jr.,¹ MD
Investigation performed at the American Sports Medicine Institute, Birmingham, Alabama, USA

- 111 overhead athletes treated with repair with high-strength suture augmentation
- 92% return to play rate at 6.7 months
- Shortened time to return to play compared to traditional reconstruction
- Included partial and complete tears as well as proximal and distal injuries

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TABLE 1
Patient Characteristics^a

Age at surgery, mean ± SD, y	18.3 ± 3.7
Sex	
Male	107 (96)
Female	4 (4)
Laterality	
Right	90 (81)
Left	21 (19)
Sport	
Baseball pitcher	90 (81)
Baseball nonpitcher	12 (11)
Football	4 (4)
Soccer	1 (1)
Level	
High school	74 (67)
College	31 (28)
Professional	4 (4)
Location	
Proximal	11 (10)
Distal	100 (90)

^aData reported as n (%), unless otherwise indicated.

TABLE 2
Subgroup Analysis of Functional Scores and Time to Return to Play^a

Location of tear ^b	n	KJOC Score		Time to Return to Play, wk ^c	
		Mean	P Value	Mean	P Value
Proximal	11	85.1	0.002	29.5	0.002
Distal	100	88.8	0.002	28.1	0.002
Severity of tear ^d					
Partial	40	86.3	0.002	29.3	0.002
Complete	60	88.1	0.002	27.7	0.002
Ulnar nerve transection ^e					
No	90	88.1	0.002	27.7	0.002
Yes	10	85.1	0.002	29.5	0.002
Position					
Baseball pitcher	90	88.8	0.002	28.1	0.002
Baseball nonpitcher	12	85.1	0.002	29.5	0.002
KJOC score					
1 year	90	88.1	0.002	27.7	0.002
2 years	90	88.1	0.002	27.7	0.002

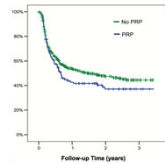
spitals

Nonoperative Treatment of Elbow Ulnar Collateral Ligament Injuries With and Without Platelet-Rich Plasma in Professional Baseball Players



A Comparative and Matched Cohort Analysis
Ashish Chaudhuri,¹ MD, MBA, Peter McQueen,¹ MD, Peter R. Chalmers,¹ MD, Michael G. Ciccone,¹ MD, Christopher L. Camp,¹ MD, John Drangas, BA, Hitesh G. Potter,¹ MD, Stephen A. Faddy,¹ MD, Brandon J. Erickson,¹ MD, Henry R. Horvath,¹ MD, Daniel Keels,¹ MD, and Jan Trnka,¹ MD
Investigation performed at Division of Sports Medicine, Department of Orthopaedic Surgery, Scripps Clinic, La Jolla, California, USA

- 544 professional baseball players with non-operative treatment of UCL injuries
- 133 received PRP injections
- 411 did not have PRP injections
- Overall return to play rate of 54%
- 50% survivorship of native UCL at 1 year, 43% at 3 years



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Return-to-Play and Competitive Outcomes After Ulnar Collateral Ligament Reconstruction Among Baseball Players



A Systematic Review

Stephen J. Thomas,^{1,2} PhD, ATC, Ryan W. Paul,³ BS, Adam B. Rosen,¹ PhD, ATC, Sam J. Wilkins,¹ MD, Joseph Schmitt,¹ BS, John D. Kelly IV,^{1,2} MD, and Ryan L. Cristin,^{1,2} PhD, CSCS
Investigation performed at Temple University, Philadelphia, Pennsylvania, USA

- Return to play among elite level throwers is approximately 12 months
- Return to prior level of performance can be 15+ months
- Return to play rates:
 - 80-97% in MLB pitchers
 - 59-89% for other positions

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Nonoperative Treatment of Elbow Ulnar Collateral Ligament Injuries With and Without Platelet-Rich Plasma in Professional Baseball Players



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Investigation performed at Division of Sports Medicine, Department of Orthopaedic Surgery, Scripps Clinic, La Jolla, California, USA

- Most injuries were proximal (65%) and most were grade 2 (49%)
- Grade 3 injuries and distal injuries had highest rates of failure of non-operative treatment
- Players treated to PRP had slower return to play – likely driven by protocol
- Inconsistent PRP preparation, rehab, other limitations

MLB physicians:
80% response rate
48% used leukocyte-poor PRP
40% used leukocyte-rich PRP
12% do not use PRP

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Clinical Sports Medicine Update

The Outcome of Elbow Ulnar Collateral Ligament Reconstruction in Overhead Athletes

A Systematic Review

Mark A. Vitek, MD, MPH, and Christopher S. Ahmad,¹ MD
From the Center for Shoulder, Elbow, and Sports Medicine, Department of Orthopaedic Surgery, Columbia University, New York, New York

- 8 Level 3 studies
- Overall, 83% excellent result
- RTP ranges from 10-26 months
- 10% complication rate

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Author (Year)	Level of Evidence	Study Design	Number of Patients (n)	Mean Age (y)	Mean Follow-up (y)	Return to Play (%)	Return to Prior Level (%)	Complication (%)	Notes
Chen et al (2017)	III	Retrospective Cohort	100	22.0	1.0	90	80	0	Baseball pitchers
Chen et al (2018)	III	Retrospective Cohort	100	22.0	1.0	90	80	0	Baseball pitchers
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The Effect of Ulnar Collateral Ligament Reconstruction on Pitch Velocity in Major League Baseball Pitchers

Drew A. Lansdown,* MD, and Brian T. Feeley,*† MD
Investigation performed at the University of California, San Francisco, California, USA



- Identified 129 MLB pitchers who underwent UCL reconstruction
- Utilized StatCast data and isolated fastballs specifically

TABLE 2
Pitch Velocity Before and After Ulnar Collateral Ligament Reconstruction

Pitch Type ^a	Presurgery Velocity ^b	Postoperative Velocity ^b	P Value ^c
Fastball (n = 80)	91.3 (2.61)	90.6 (2.55)	.0034
Curveball (n = 50)	76.9 (4.14)	76.3 (3.10)	.29
Changeup (n = 72)	82.3 (2.62)	82.5 (2.76)	.50
Slider (n = 70)	82.9 (2.49)	82.7 (2.54)	.68

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Osteochondritis Dissecans of the Capitellum

Chang L. Baker III,*† MD, Anthony A. Romeo,[‡] MD, From The Hughston Clinic, Columbus, Georgia
Department of Orthopaedic Surgery, Rush US



TABLE 1
Results of Nonoperative Treatment

Study/Length of Follow-up	Elbows With Radiographic Findings at Presentation	Radiographic Evidence of Healing at Follow-up, %	Return to Sport, %	Pain/Symptoms at Follow-up, %
Mazzoni et al ¹ /24 months	84 radiolucency	81	75	Unknown
	17 nondisplaced fragments	53	53	Unknown
	20 flattening/lucency	88	88	Unknown
	4 fragmentation, no sclerosis	50	50	Unknown
	9 fragmentation with sclerosis/loose bodies	11	22	Unknown
Takahara et al ² /5.2 years	17 loose/non-displaced fragments	55	Unknown	53
	7 displaced fragments	0	Unknown	53

- Better non-operative outcomes with open capitellar physis, near-normal motion, radiographic findings of subchondral flattening or radiolucency
- Non-operative treatment includes rest from repetitive activities, stretching then strengthening, monitoring x-rays for healing

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Ulnar Collateral Ligament Injury Treatment

- Trial of non-operative management for most
- Surgical management:
 - Can consider UCL repair if:
 - Partial injury
 - Proximally-based injury
 - Younger thrower
 - Potentially shorter duration of ongoing throwing career
- Gold standard = UCL reconstruction

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Osteochondritis Dissecans of the Capitellum

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From The Hughston Clinic, Columbus, Georgia, and [‡]Division of Sports Medicine, Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois



- Surgical treatment:
 - Fragment excision
 - Drilling of lesion
 - Fragment fixation
 - Osteochondral transplant

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Osteochondritis Dissecans of the Capitellum

- Adolescent overhead throwers and gymnasts
- Likely secondary to repetitive microtrauma
- Valgus stress during throwing leads to compression and shear at the radiocapitellar joint
- Complaints:
 - Lateral elbow pain
 - Stiffness and swelling
 - Catching/locking



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Ulnar Neuritis

- Ulnar nerve travels through cubital tunnel at the posteromedial elbow
- Nerve may be compressed at multiple sites from triceps intermuscular septum to entry of FCU muscle
- Ulnar nerve symptoms are often secondary to medial elbow instability
- Complaints of:
 - Dull aching pain in forearm
 - Numbness/tingling into the hand

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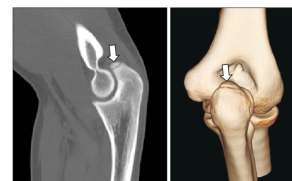
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Physical Exam for Ulnar Nerve

- Palpation of nerve
- Tinel's sign along entire course of the nerve
- Check nerve stability with range of motion of the elbow
 - Ulnar nerve may sublux with flexion
- Sensory exam through SF/RF
- Distal motor exam

Exam for Valgus Extension Overload

- Tenderness over the posteromedial olecranon
- Pain with forced extension
- Can develop flexion contracture due to pain
- Imaging may show osteophytes at posteromedial olecranon fossa



Ulnar Neuritis Treatment

- Non-operative treatment starts with relative rest
 - Avoid throwing
 - Night splint
- Surgical treatment
 - In situ decompression
 - Subcutaneous transposition
 - Submuscular transposition
- Return to play after transposition at ~12 weeks

Treatment for Valgus Extension Overload

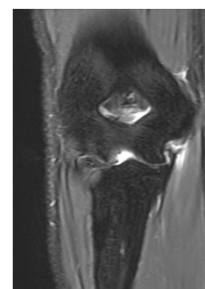
- Non-surgical management:
 - Stop throwing
 - NSAIDs
 - Injections if needed
- Surgical treatment:
 - Removal of osteophytes
 - Need to ensure normal olecranon is not resected - can lead to increased stress on UCL and subsequent injury

Valgus Extension Overload

- Pain develops as a result of repetitive microtrauma to posteromedial elbow
- Repetitive impact of olecranon at olecranon fossa
- Can develop osteophytes at posteromedial elbow
- Complaints:
 - Pain at the end of throwing cycle – deceleration phase
 - Posteromedial elbow pain

Case #1

- HPI: 17 yo RHD M, high school baseball pitcher with plans/offer to play baseball in college:
 - Pitching and felt a pop in his right medial elbow
 - Unable to keep throwing
 - Pain, swelling, and stiffness
- Exam:
 - Tender over medial epicondyle
 - + opening to valgus stress



Treatment Plan?

- Discussed activity modification/stopping throwing vs surgical treatment
- Reviewed UCL repair vs reconstruction
- Recommend reconstruction
- No palmaris tendon on right side – used hamstring autograft

Treatment Course



10 mm diameter socket created with corresponding osteochondral allograft



Plug press-fit into defect to restore articular surface

Case #2

- HPI: 29 yo RHD F who was previously competitive gymnast with elbow issues since age 17-18:
 - Diagnosed with OCD lesion of capitellum
 - Underwent arthroscopic microfracture
 - Repeat microfracture in 2019
 - Continues to have ongoing pain and crepitus at the elbow
- Exam:
 - Elbow stable to varus/valgus stress
 - Tender to palpation over lateral joint line

Thank you!

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Treatment Plan?



Full-thickness cartilage lesion at postero-central capitellum



Measures 10 mm in diameter