Overuse Throwing Injuries of the Elbow

Dennis Schultz, PT
Director of Rehabilitation
Indiana Total Therapy
2014 Sports Medicine Update
KCAC
December 7th, 2014

INDIANA TOTAL THERAPY
"World Class Rehabilitation Care"

So what ages are we talking about?

- Pediatric Athletes – Ages 6-12
- Adolescent Athletes – Ages 13-18

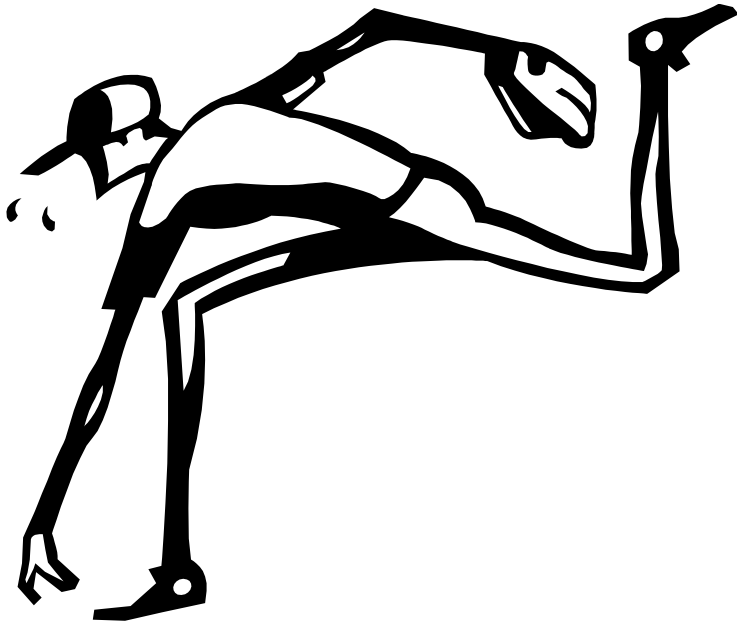
- Note: The occurrence of puberty, followed by skeletal maturity, is a far more important marker of maturity than chronologic age when managing pediatric overuse injuries.[15]

Are we using the words overuse and repetitive trauma as the same?

- Yes

Causation Factors for Overuse Injuries

- Excessive training
- Inadequate rest
- Improper technique
- Muscle weakness
- Training errors
- Early specialization[15]



How many kids play baseball?

- Every year in the United States, approximately 15 million children and adults play organized baseball. This includes 5.7 million children in eighth grade or lower, representing 17% of all children participating in baseball.[8]

How many kids sustain a serious throwing injury?

- Recently, the American Sports Medicine Institute (ASMI) published results of a prospective longitudinal study of 481 youth pitchers (aged 9 to 14 years). Each participant was a healthy, active pitcher at the onset of the study and was followed until he no longer played organized baseball or for 10 years (whichever happened first). The incidence of serious elbow or shoulder injury for pitchers was 5% (serious injury was defined as requiring surgery or retirement from baseball).[9]

So what are some common overuse elbow pitching injuries?

- Little Leaguer's Elbow
- Ulnar Collateral Ligament Sprains/Tear
- Flexor Bundle Injuries

Remember this?

- Throwing injuries of the elbow in pediatric baseball players usually involve the growth plate. The growth plate is the weakest link in the ligament-bone-cartilage unit.[30]

Little Leaguer's Elbow

What is it?

Little league elbow (LLE) syndrome is a valgus overload or overstress injury to the medial elbow that occurs as a result of repetitive throwing motions. [6]

Little leaguer's elbow is characterized by inflammation of the growth plate of the inner elbow. The medial epicondylar growth plate of the elbow becomes inflamed due to repetitive injury from muscular contraction. The muscles that bend the wrist attach to the medial epicondyle. The growth plate is an area of relative weakness, and injury to it occurs due to repeated stress or vigorous exercise. It is a temporary condition of the medial epicondyle that is uncommon after age 16.[1]

Little Leaguer's Elbow

How often does it occur?

A more recent study found a 26% frequency of elbow pain in 9-12 year old baseball players. [7]

Little Leaguer's Elbow

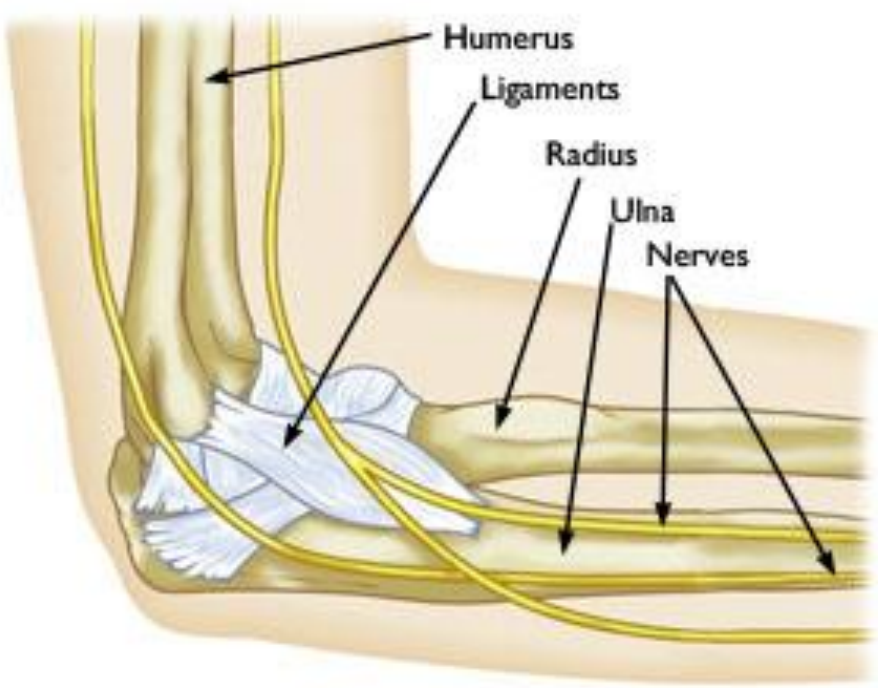
Anatomy[2]

Medial Apophysitis (Little Leaguer's Elbow)

Little Leaguer's Elbow

Anatomy[4]

Medial Apophysitis (Little Leaguer's Elbow)



Little Leaguer's Elbow

Anatomy[3]

Medial Apophysitis
(Little Leaguer's Elbow)

Little Leaguer's Elbow

Anatomy[5]

Medial Apophysitis/Avulsion (Little Leaguer's Elbow)

Little Leaguer's Elbow

Medial Apophysitis

Causes:

1. Throwing too hard
2. Throwing too often
3. Throwing too many "curves"
4. Poor mechanics

Little Leaguer's Elbow

Medial Apophysitis

Risk Factors[10]:

1. Age: 10-15 years old
2. Sex: Male
3. Baseball pitcher

Little Leaguer's Elbow

Medial Apophysitis

Symptoms:

1. Pediatric athlete may report a "pop" with immediate pain over the medical epicondyle area.
2. Pain with throwing overhead but no one incident reported.
3. Athlete may report general soreness in the medial elbow region.
4. Athlete may report decreased ROM.
5. Athlete may report he/she can't throw hard anymore.

Little Leaguer's Elbow

Medial Apophysitis

Evaluation: (ATC/PT Direct Access)

1. History/Subjective Data: How/When/Where

2. Objective: Inspection – edema, Q-angle
   Palpation- medial epicondyle area
   ROM- all planes
   Motor- shoulder/elbow/wrist
   Neuro- esp ulnar region
   Special – Valgus Stress Test

Refer or Treat????????

Little Leaguer's Elbow

Medial Apophysitis

Valgus Stress Test

Palpating MCL 30° flexed

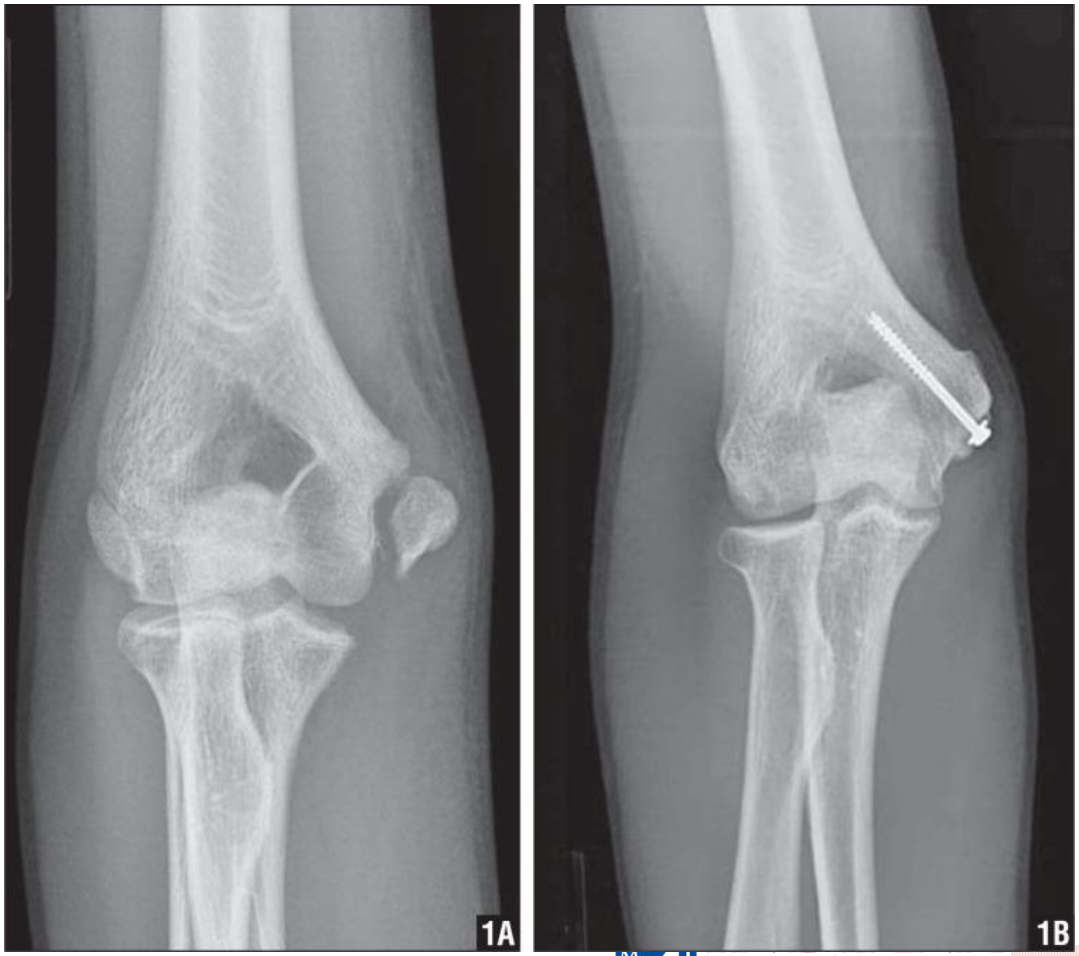
Little Leaguer's Elbow

Medial Apophysitis

Refer or Treat????

General thought:

For discussion:
Think avulsion if an immediate onset of symptoms while throwing.



Little Leaguer's Elbow

Medial Apophysitis

Treatment commonly consists of:[11 12 13]

1. Complete rest from throwing activities for a minimum of 4-6 wks
2. Ice

3. Non-steroidal anti-inflammatory medication (NSAIDs)
4. Elbow extension brace if a flexion contracture is present
5. Once pain free: ROM/Strengthening/Core

6. Return to throwing program once pain free with rehabilitation program.
7. Mechanical assessment.

Little Leaguer's Elbow

Medial Apophysitis

Prevention:

1. Limit amount of pitches and appropriate rest between outings.

2. Emphasize good throwing mechanics.

3. Limit "curves" and "sliders" .

4. Keep in shape and flexible.

Little Leaguer's Elbow

- Pitch Count Limits:[14]
- AAOS

Age	Max. Pitches/Game	Max. Pitches/Week
8 - 10	50	75
11 - 12	75	100
13 - 14	75	125
15 - 16	90	2 games / week
17 - 18	105	2 games / week

Little Leaguer's Elbow

- Ages for learning types of pitches:[14]
- AAOS

Fastball	8
Change-up	10
Curveball	14
Knuckleball	15
Slider	16
Forkball	16
Splitter	16
Screwball	17

Ulnar/Medial Collateral Ligament Injuries

Mechanism of Injury:

When athletes throw repeatedly at high speed, the repetitive valgus stresses can lead to a wide range of overuse UCL injuries. Problems most often occur at the inside of the elbow because considerable force is concentrated over the inner elbow during throwing.[20]

An overuse injury occurs gradually over time. In many cases, overuse injuries develop when an athletic movement is repeated often during single periods of play, and when these periods of play — games, practices — are so frequent that the body does not have enough time to rest and heal.[20]

Ulnar Collateral Ligament Injuries

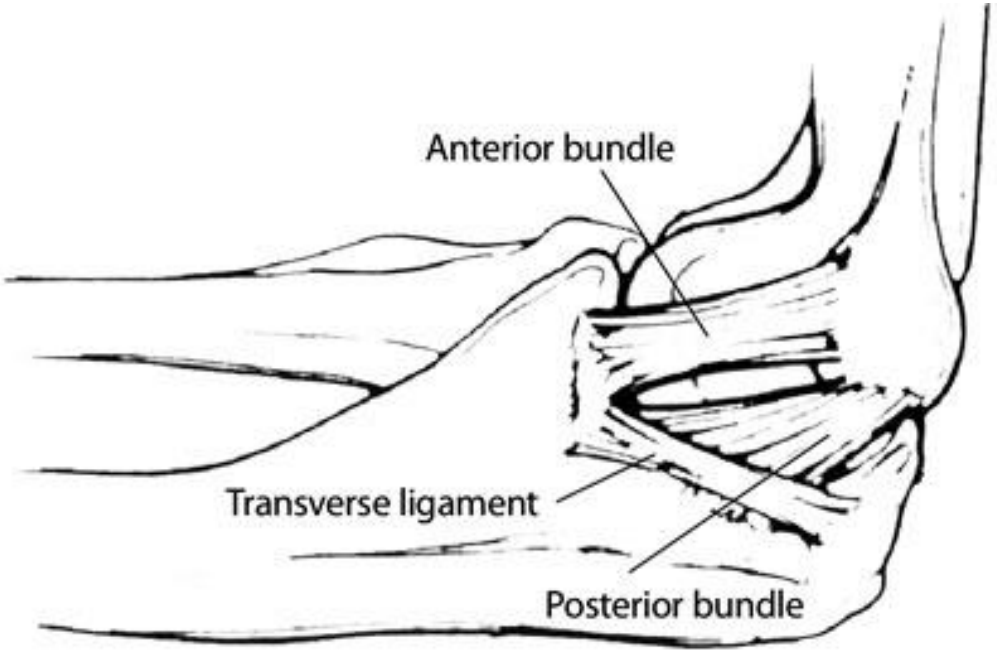
Types of injuries to the UCL:

1. Grade I Sprains – Stretch of ligament
2. Grade II Sprains – Partial tear of ligament
3. Grade III Sprains – Complete tear of ligament

According to a literature review in the May 2014 issue of the *Journal of the American Academy of Orthopaedic Surgeons* (JAAOS), overuse is the main cause of UCL injury.

Ulnar/Medial Collateral Ligament Injuries

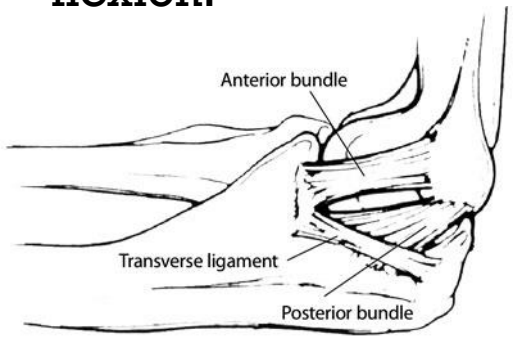
Anatomy:[17]



Ulnar/Medial Collateral Ligament Injuries

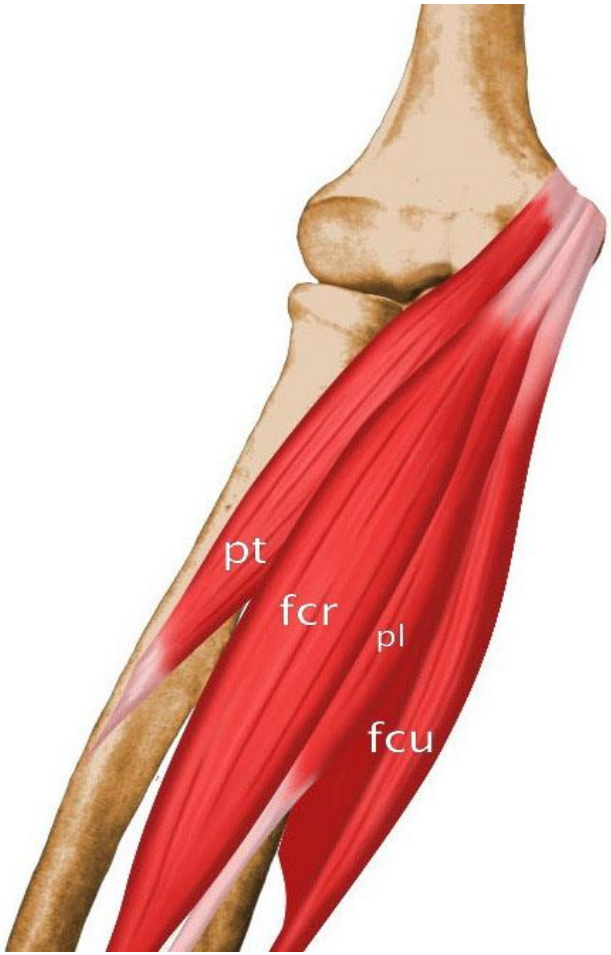
Anatomy:[17]

The primary soft tissue elbow stabilization source for the throwing athlete is provided by the MCL. At 90° of elbow flexion, the MCL accounts for 55% of the stabilizing resistance to valgus stress and 78% of the resistance to varus stress. The MCL is composed of three distinct parts: the anterior bundle, the posterior bundle, and the oblique bundle (transverse ligament). The anterior bundle originates on the medial epicondyle of the humerus and inserts on the medial aspect of the coronoid process. The anterior bundle is further divided into distinct anterior and posterior bands. The anterior band is the primary restraint for valgus strain for elbow flexion up to 90°, and the secondary restraint for further flexion. [31 32]



Ulnar/Medial Collateral Ligament Injuries

Anatomy:[18]



Ulnar/Medial Collateral Ligament Injuries

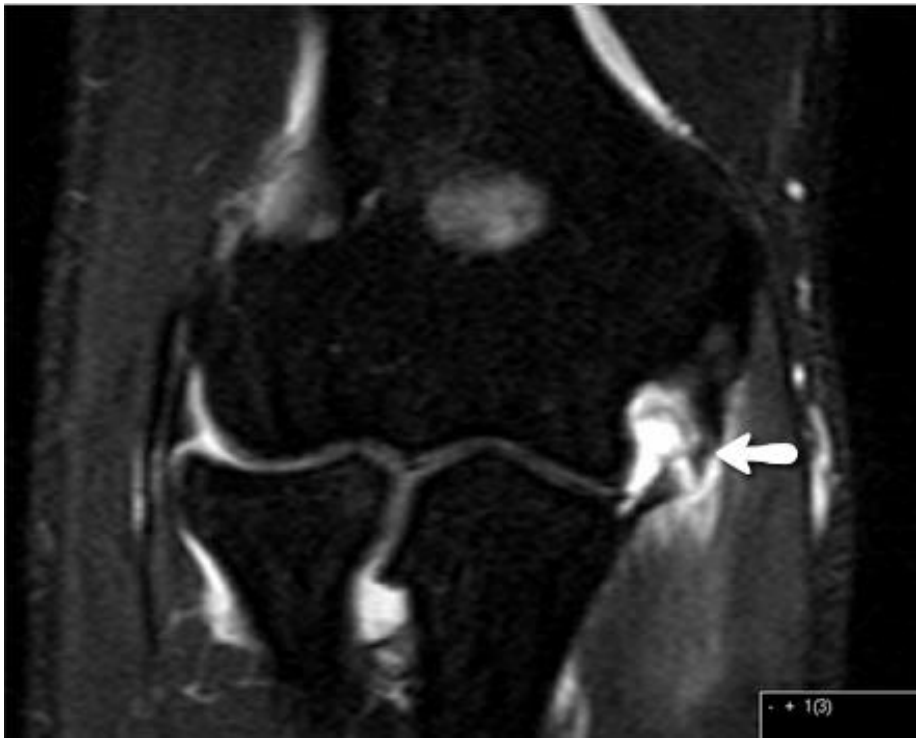
AP x-ray shows calcification at the site of MCL injury[18]

Ulnar/Medial Collateral Ligament Injuries

Normal MRI of the anterior bundle :[20]

Ulnar/Medial Collateral Ligament Injuries

Abnormal MRI of the anterior bundle :[20]



Ulnar/Medial Collateral Ligament Injuries

Causes:

Elbow medial collateral ligament (MCL) sprain occurs when the elbow is subjected to a valgus, or laterally directed force, which distracts the medial side of the elbow, exceeding the tensile properties of the MCL.[16]

Ulnar/Medial Collateral Ligament Injuries

Risk Factors:

1. Excessive amount of pitches.
2. Excessive velocity.
3. Limited rest between outings.
4. Abnormal mechanics.
5. Limited flexibility.
6. Arm/Scapular/Core/LE weakness.
7. Poor training habits.

Ulnar/Medial Collateral Ligament Injuries

Symptoms:

1. Complaints of medial elbow pain with acceleration phase of throwing.

2. Decrease in velocity.

3. Gradual onset with pain when above 75% of pitching max.

4. Acute onset with c/o "pop" or "snap" and unable to continue pitching.

5. Swelling in medical elbow region.

Ulnar/Medial Collateral Ligament Injuries

Evaluation: (ATC/PT Direct Access)

1. History/Subjective Data: How/When/Where
2. Objective: Inspection
   Palpation
   ROM
   Motor
   Neuro
   Special – Moving valgus stress test
3. Physician: X-rays and/or MRI

Refer or Treat???

Ulnar/Medial Collateral Ligament Injuries

Moving valgus stress test

Moving valgus stress test with arrows indicated examiner applying valgus stress while moving the elbow form flexion to extension (From Ahmad, Orthopaedic Knowledge Update: Shoulder and Elbow 3:Athletic Elbow Injuries in the Throwing Athlete Elbow, AAOS.)

…

Ulnar/Medial Collateral Ligament Injuries

Differential Diagnosis:[21]

1. Flexor-pronator tendon injury
2. Valgus extension overload
3. Ulnar neuropathy
4. Ulnar nerve subluxation
5. Medial epicondyle avulsion (skeletally immature),
6. Loose bodies/OCD
7. Olecranon osteophytes

Ulnar/Medial Collateral Ligament Injuries

Treatment: (non-operative)

1. Complete rest from throwing activities for a minimum of 6-8 wks.

2. Ice/Modalities

3. Non-steroidal anti-inflammatory medication (NSAIDs)

4. Once pain free: ROM/Strengthening/Core

5. Return to throwing program once fully pain free with rehabilitation program.

6. Mechanical assessment of pitching

Ulnar/Medial Collateral Ligament Injuries

Treatment: (non-operative) – Platelet Rich Plasma

PRP is a whole blood filtrate containing a high concentration of platelets, at least 1 million per microliter. It is also highly enriched in growth factors, including transforming growth factor-beta, vascular endothelial growth factor, and multiple species of platelet-derived growth factor.

16 of 17 teenage and young adult patients with partial ulnar collateral ligament (UCL) tears were able to return to regular play within 15 weeks of receiving PRP injection, said Scott Crow, MD, of the Kerlan-Jobe Orthopaedic Clinic in Los Angeles.[29]

Ulnar/Medial Collateral Ligament Injuries

Treatment: (operative)[22 23 24 25 26]

Surgical indications include:

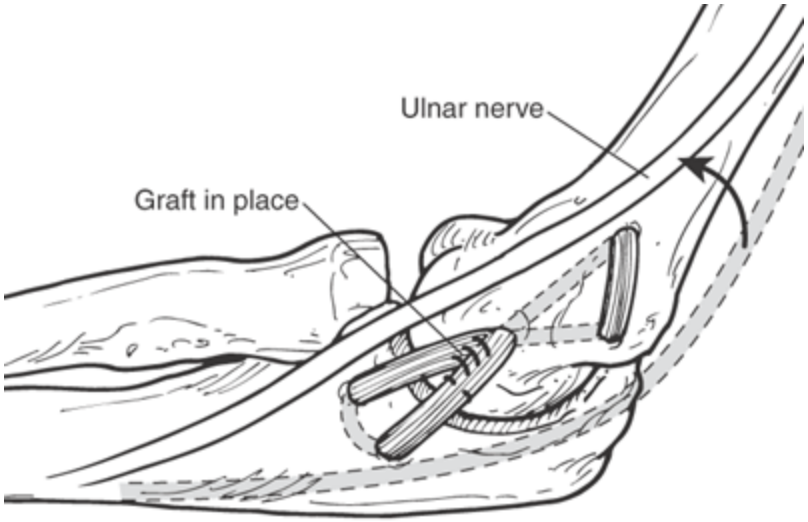
(a) throwing athletes with a complete UCL tear;
(b) partial tears that have failed rehabilitation;

Current surgical options include reconstruction or direct repair. Reconstruction is the most widely accepted surgical modality today, whereas direct repair is typically only considered in the presence of an acute traumatic avulsion.

Ulnar/Medial Collateral Ligament Injuries

UCL Reconstruction:[28]

"Tommy John" surgery.



Adolescent athletes in the 14 to 16 year old age group have a lower return to sport after UCL reconstruction surgery than the 18 and over age group, 75 percent versus 85 percent, respectively.[27]

Ulnar/Medial Collateral Ligament Injuries

Prevention:

UCL Injury: Prevention is Key

Throwing with fatigue is the main risk factor for overuse injury, whether it is event fatigue (too many pitches in a game), season fatigue (too many pitches in one season) or year-round fatigue (not taking the appropriate 3-4 months off from throwing). In fact, throwing athletes with fatigue are 36 times more likely to suffer shoulder and elbow injuries.[27]

UCL Reconstructed Protocol

Load thumb drive.

Flexor Bundle Injuries

Definition:

Flexor bundle injuries refer to muscle strain and tendon injuries (tendonitis or tear) of the common wrist flexor muscles and tendon attachment to the medial epicondyle (inner part of the elbow). Pain is localized to the inner (medial) part of the elbow, but is more noticeable at ball release rather than at the cocking or acceleration phases of throwing.[30]

Flexor Bundle Injuries

THINK ABOUT THIS:

In cadaveric studies, the MCL has been directly measured to fail at between 22.7–33 Nm, while 120 Nm of peak valgus torques have been measured at the medial elbow of experienced overhead throwers. This discrepancy is explained by flexor-pronator musculature activation as a dynamic elbow joint stabilizer. [33] [34] [35] [36]

Flexor Bundle Injuries

Cause:

Micro-trauma associated with repetitive valgus elbow stress.

Flexor Bundle Injuries

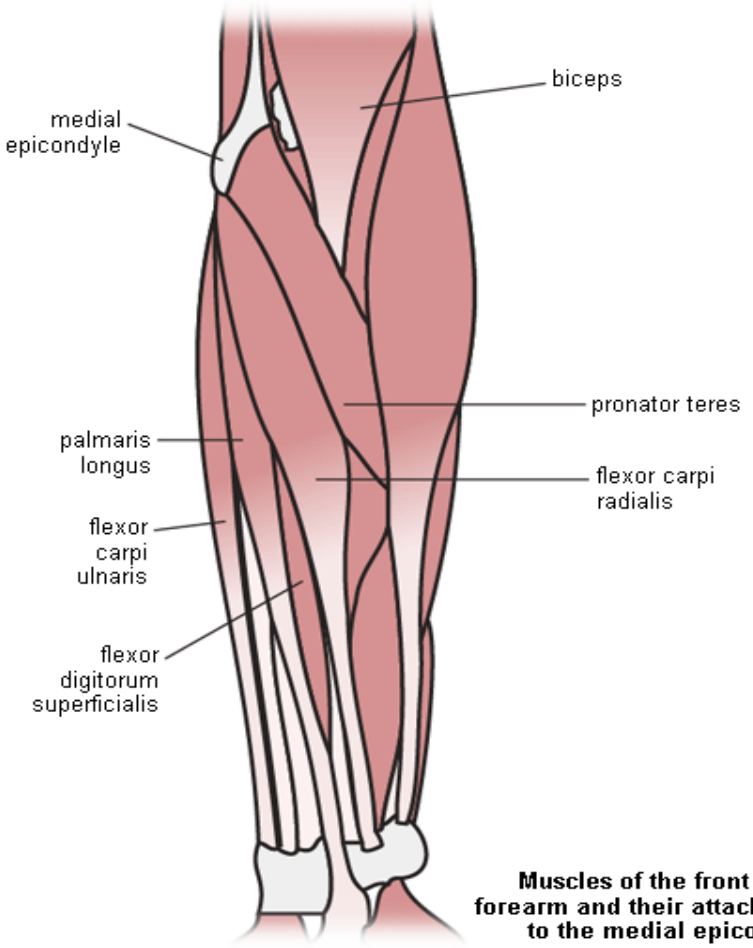
Anatomy:

The flexor-pronator musculature, which originates from the medial epicondyle and the distal medial epicondylar ridge of the humerus, helps to provide dynamic stability of the elbow against valgus stress. The flexor-pronator musculature includes:

pronator teres,
flexor carpi radialis,
palmaris longus,
flexor digitorum superficialis,
and flexor carpi ulnaris. [37 38 39]

Flexor Bundle Injuries

Anatomy:



Muscles of the front of the forearm and their attachment to the medial epicondyle

Flexor Bundle Injuries

Symptoms:

1. Athlete reports decrease velocity.
2. C/O medial elbow pain at ball release.
3. C/O medial elbow pain with wrist flexion.

Flexor Bundle Injuries

Evaluation:

Differentiation between an injured MCL and flexor-pronator muscle injury is verified by the absence of increased pain near the origin of the flexor-pronator musculature origin with wrist flexion. [37]

Flexor Bundle Injuries

Treatment:

1. Complete rest from throwing activities for a minimum of 2-8 wks.
2. Ice/Modalities
3. Non-steroidal anti-inflammatory medication (NSAIDs)
4. Once pain free: ROM/Strengthening/Core
5. Return to throwing program once fully pain free with rehabilitation.
6. Mechanical assessment of pitching

Flexor Bundle Injuries

Prevention:

1. Control amount of pitches per day, per week and per year.

2. Control rest between outings.

3. Control what type of pitch is being thrown.

USA Baseball Youth Baseball Pitching Recommendations .

MLTJ Muscles, Ligaments and Tendons Journal CIC Edizioni Internazionali 2013 April-June; 3(2): 91–100. ISSN: 2240-4554
Published online 2013 July 9. doi: 10.11138/mltj/2013.3.2.91.

Arm pain	**Remove from game immediately; if >4 days of arm pain, seek medical attention**			
Pitch Counts	**Game**	**Week**	**Season**	**Year**
9–10 years old	**50**	**75**	**1000**	**2000**
11–12 years old	**75**	**100**	**1000**	**3000**
13–14 years old	**75**	**125**	**1000**	**3000**
Pitch Types	**No breaking pitches until bones have matured around puberty (~ 13 years old)**			
Multiple Appearances	**Once removed from the mound, do not return to pitching in the same game**			
Showcases	**De-emphasize and/or avoid, if necessary; then give adequate time to prepare with no overthrowing**			
Multiple Leagues	**Pitch for only 1 team at a time, with no overlapping seasons**			
Year-round Baseball	**Baseball pitchers should compete in <9 months of baseball each year**			

Baseball pitcher minimum rest recommendations based on player age and the number of pitches thrown

MLTJ Muscles, Ligaments and Tendons Journal CIC Edizioni Internazionali 2013 April-June; 3(2): 91–100. ISSN: 2240-4554
Published online 2013 July 9. doi: 10.11138/mltj/2013.3.2.91.

Age (years)	1-Day Rest	2-Day Rest	3-Day Rest	4-Day Rest
8–10	21 ± 18	34 ± 16	43 ±16	51 ± 19
11–12	27 ± 20	35 ± 20	55 ± 23	58 ± 18
13–14	30 ± 22	36 ± 21	56 ± 20	70 ± 20
15–16	25 ± 20	38 ± 23	62 ± 23	77 ± 20
17–18	27 ± 22	45 ± 25	62 ± 21	89 ± 22

IRM COSM

INDIANA TOTAL THERAPY

"World Class Rehabilitation Care"

IRM COSM

INDIANA TOTAL THERAPY

"World Class Rehabilitation Care"

References

1. https://control.vistacan.com/vistacan/sportmeds/149
2. http://orthoinfo.aaos.org/topic.cfm?topic=a00328
3. http://www.fpnotebook.com/legacy/Ortho/Elbow/MdlEpcndylAphysts.htm
4. http://orthoinfo.aaos.org/topic.cfm?topic=a00328
5. http://blog.brianschiff.com/?cat=39
6. http://emedicine.medscape.com/article/97101-overview
7. ↑ Adirim T, Cheng T. Overview of injuries in the young athlete. Sports Medicine [serial online]. 2003;33(1):75-81. Available from: CINAHL Plus with Full Text, Ipswich, MA. Accessed November 21, 2011
8. Sporting Goods Manufacturers Association Single sport report 2011: baseball. http://www.sgma.com/reports/21_Baseball-Participation-Report-2011. Accessed April 9, 2012
9. Davis JT, Limpisvasti O, Fluhme D, et al. The effect of pitching biomechanics on the upper extremity in youth and adolescent baseball pitchers. Am J Sports Med. 2009;37:1484-1491
10. http://pediatrics.med.nyu.edu/conditions-we-treat/conditions/little-league-elbow
11. Benjamin HJ & Briner WW. Little League Elbow. Clin J Sport Med. 2005; 15:37-40.
12. Crowther M. Elbow pain in pediatrics. Current Reviews In Musculoskeletal Medicine [serial online]. June 2009;2(2):83-87. Available from: MEDLINE with Full Text, Ipswich, MA. Accessed November 27, 2011.
13. Cassas K, Cassettari-Wayhs A. Childhood and adolescent sports-related overuse injuries. American Family Physician [serial online]. March 15, 2006;73(6):1014-1022. Available from: MEDLINE with Full Text, Ipswich, MA. Accessed November 27, 2011.
14. http://orthoinfo.aaos.org/topic.cfm?topic=A00185

References

15. J Athl Train. 2011 Mar-Apr; 46(2): 206–220. **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,¶ and Christopher White, MS, ATC#
16. Curr Rev Musculoskelet Med. Dec 2008; 1(3-4): 197–204. Published online Jun 6, 2008. **Elbow medial collateral ligament injuries** Ra'Kerry K. Rahman, William N. Levine, and Christopher S. Ahmad
17. http://www.orpt.org/productlist.asp?id=655
18. http://www.drtomaino.com/article.php?id=97
19. http://drkhalfayan.com/tommy-john-surgery-seattle-washington/
20. http://orthoinfo.aaos.org/topic.cfm?topic=A00644
21. Review Medial elbow problems in the overhead-throwing athlete.[J Am Acad Orthop Surg. 2001
22. Reconstruction of the ulnar collateral ligament in athletes.Jobe FW, Stark H, Lombardo SJJ Bone Joint Surg Am. 1986 Oct; 68(8):1158-63.
23. David T S. Medial elbow pain in the throwing athlete. Orthopedics 2003. 2694–103.103
24. Chen F S, Rokito A S, Jobe F W. Medial elbow problems in the overhead-throwing athlete. J Am Acad Orthop Surg 2001. 999–113.113
25. Cain E L, Dugas J R, Wolf R S. *et al* Elbow injuries in throwing athletes: a current concepts review. Am J Sports Med 2003. 31621–635.635
26. Salvo J P, Rizio L, 3rd, Zvijac J E. *et al* vulsion fracture of the ulnar sublime tubercle in overhead throwing athletes. Am J Sports Med 2002. 30426–431.431
27. http://newsroom.aaos.org/media-resources/Press-releases/throwing-injuries-no-longer-just-for-the-pros.tekprint
28. http://www.msdlatinamerica.com/ebooks/SurgicalTechniquesinSportsMedicine/sid223525.html

References

29. http://www.medpagetoday.com/MeetingCoverage/AAOS/31140
30. http://drkhalfayan.com/elbow-throwing-injuries/
31. Miller CD, Savoie FH 3rd. Valgus extension injuries of the elbow in the throwing Athlete. J Am Acad Orthop Surg. 1994;2(5):261–269
32. Morrey BF, An KN. Articular and ligamentous contributions to the stability of the elbow joint. Am J Sports Med. 1983;11(5):315–319
33. Werner SL, Murray TA, Hawkins RJ, Gill TJ. Relationship between throwing mechanics and elbow valgus in professional baseball pitchers. J Shoulder Elbow Surg. 2002;11(2):151–155.
34. Ahmad CS, Lee TQ, ElAttrache NS. Biomechanical evaluation of a new ulnar collateral ligament reconstruction technique with interference screw fixation. Am J Sports Med. 2003;31(3):332–337
35. Fleisig GS, Barrentine SW, Zheng N, Escamilla RF, Andrews JR. Kinematic and kinetic comparison of baseball pitching among various levels of development. J Biomech. 1999;32(12):1371–1375.
36. Paletta GA Jr, Klepps SJ, Difelice GS, Allen T, Brodt MD, Burns ME, Silva MJ, Wright RW. Biomechanical evaluation of 2 techniques for ulnar collateral ligament reconstruction of the elbow. Am J Sports Med. 2006;34(10):1599–1603.
37. Chen FS, Rokito AS, Jobe FW. Medial elbow problems in the overhead-throwing athlete. J Am Acad Orthop Surg. 2001;9(2):99–113.
38. Callaway GH, Field LD, Deng XH, Torzilli PA, O'Brien SJ, Altchek DW, Warren RF. Biomechanical evaluation of the medial collateral ligament of the elbow. J Bone Joint Surg Am. 1997;79(8):1223–1231
39. Chen FS, Diaz VA, Loebenberg M, Rosen JE. Shoulder and elbow injuries in the skeletally immature athlete. J Am Acad Orthop Surg. 2005;13(3):172–185.