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The Elbow UCL: "The Epidemic," The Rehabilitation and the Prevention of UCL Injuries in Professional Baseball

By Ryan Bitzel, MPT
Rehabilitation Coordinator
San Diego Padres Baseball Organization

Please Allow Myself to Introduce…Myself…

- Physical Therapist and Minor League Rehabilitation Coordinator for the San Diego Padres Baseball Organization (2010-Present)
- Perform all of the evaluations, daily treatments and re-evaluations for all of the minor league players within the San Diego Padres organization at the Spring Training Complex in Peoria, AZ.

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Bio

- Originally from Canton, Ohio.
- Intern athletic trainer for the Houston Astros minor league affiliate in Salem, Virginia, in 2003
- Graduated with my Master's Degree in Physical Therapy from Walsh University, North Canton, Ohio, in 2006
- Staff physical therapist at The Steadman-Hawkins Clinic of the Carolinas (Spartanburg, SC) from 2006-2010 and was the consultant for the Boston Red Sox minor league affiliate Greenville Drive while there
- Hired as the Rehabilitation Coordinator for the San Diego Padres in 2010

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Course Objectives

- Describe the 5 phases of throwing.
- Identify which phase of the 5 phases of throwing the UCL is most stressed.
- Outline a clinical differential diagnosis between UCL injury and ulnar neuritis and flexor mass strains.
- List the 4 phases of UCL rehab.
- List at 4 exercises that correspond with the 4 phases of UCL rehab.
- Identify 3 risk factors that lead to UCL injuries in professional baseball players.
- List the 3 components of a post-op UCL reconstruction throwing program and the time frames that correspond with each component./precautions associated with each phase

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The UCL of the Elbow

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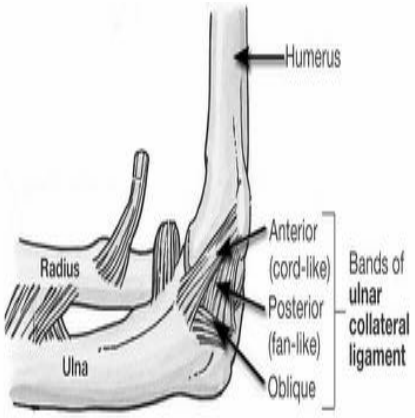
Basic Anatomy of the UCL

- Ulnar Colateral Ligament (UCL): Thick triangular band of tissue on the medial aspect of the elbow[1]
- Originates at the medial epicondyle of the humerus and inserts on the sublime tubercle of the ulna[1]



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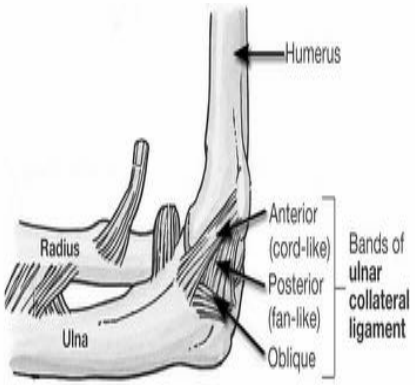
Basic Anatomy of the UCL Continued

- Consists of 3 bundles:
  - Anterior Bundle
  - Posterior Bundle
  - Transverse (Oblique) Bundle
- As a unit, they resist valgus stress to the elbow throughout the range of motion[1]



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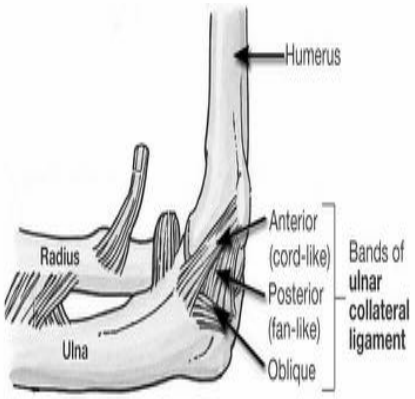
Bundles of the UCL

- Anterior Bundle
- Cordlike band that originates on the medial epicondyle of the humerus and inserts on the sublime tubercle of the ulna[1]
- Most important in providing stability against valgus stress because it provides stability to the elbow throughout the full range of motion[1]
- Subdivided into two bands:
  - Anterior Band: 0-90^{o} flexion
  - Posterior Band: 60^{o}-full flexion[1]



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Bundles of the UCL Continued

- Because it provides restraint throughout the entire range of the elbow, the anterior bundle of the UCL is the most commonly injured in overhead athletes [1]
- Most commonly the posterior band of the anterior bundle that is injured in overhead throwers because it's the primary restraint to valgus stress during higher degrees of elbow flexion[1]

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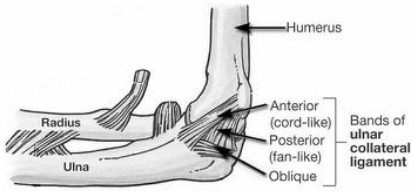
Bundles of the UCL Continued…

- Posterior Bundle
- Fan-like bundle that originates on the medial epicondyle and inserts on medial margin of the semilunar notch of the ulna[1]
- Thinner and weaker than the anterior bundle[1]
- Provides secondary stability to valgus stress beyond 90 degrees of elbow flexion[1]
- Less often injured because it has been shown to be vulnerable to valgus stress only if the anterior bundle is completely disrupted[1]



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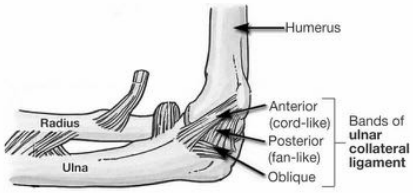
Bundles of the UCL Continued…

- Transverse (oblique) Bundle
- Does not cross the elbow joint as it originates on the medial olecranon of the ulna and inserts on the inferior aspect of the sublime tubercle of the ulna[1]
- Function is to simply help thicken the medial aspect of the joint capsule to provide support[1]
- Least injured of the bundles



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Additional Stabilizers of the Elbow

- Flexor-Pronator Mass
  - Pronator Teres
  - Flexor Carpi Radialis
  - Flexor Digitorum Superficialis
  - Flexor Carpi Ulnaris
- As a group, these muscles also provide dynamic functional resistance from valgus stress[1]

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Summary

- UCL is the ligament on the medial side of the elbow
- Primary function is to resist valgus stress on the elbow
- Divided into three bundles
  - Anterior Bundle: Resists valgus through full elbow ROM
  - Posterior Bundle: Secondary restraint of valgus stress in flexion beyond 90 degrees and only when the Anterior Bundle has been disrupted
  - Transverse (Oblique) Bundle: Reinforces the joint capsule
- Anterior bundle is subdivided into two bands
  - Anterior band: Resists valgus force during elbow extension
  - Posterior band: Resists valgus force during elbow flexion
- Most commonly, it is the anterior bundle that is injured because it is stressed throughout the entire range and primarily the posterior band because it stressed in higher degrees of elbow flexion

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UCL Injuries

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UCL Injuries

- Injuries to the UCL are the most common in overhead athletes due to the enormous amount of valgus stress the elbow is subjected to during overhead throwing[1]
- Medial elbow pain accounts for up to 97% of all elbow complaints in pitchers[1]
- Not isolated to just baseball
- Also seen in javelin throwers, tennis, volleyball and football but to lesser degrees[1]

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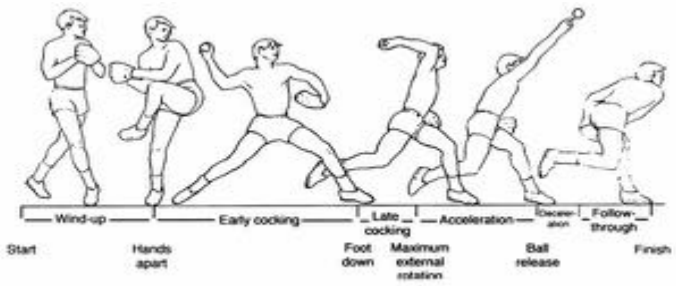
Phases of Throwing

- To understand UCL injuries, you have to first understand the phases of throwing



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Five Phases of Throwing

- Wind-Up
- Early Cocking
- Late Cocking
- Acceleration
- Deceleration/Follow-Through

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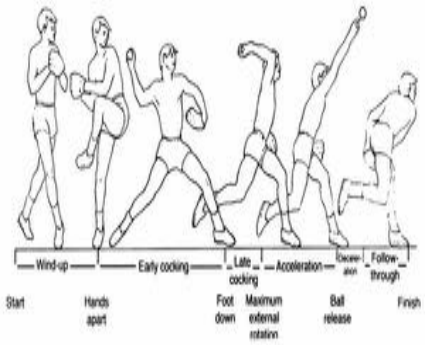
Wind Up

- Preparation to throwing[1]
- Begins when pitcher begins his initial movement and goes into single leg stance[1]
- Ends when the pitcher's hands break apart[1]



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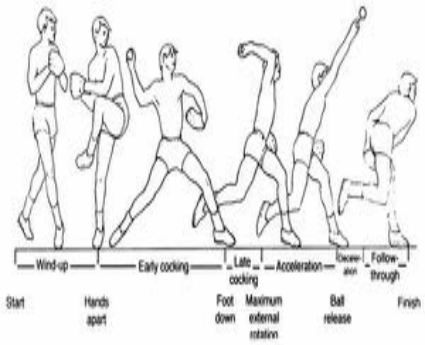
Early Cocking

- Begins when the hands break apart (ball leaves the non-dominant gloved hand)[1]
- Shoulder begins to ABD and ER[1]
- Ends when the pitcher's foot comes into contact with the ground[1]



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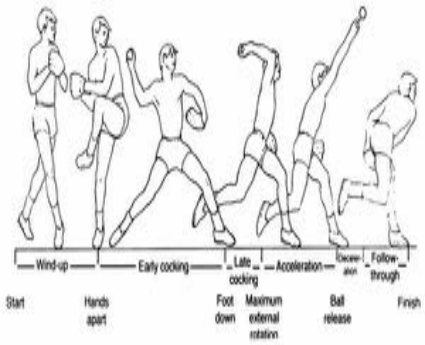
Late Cocking

- Begins when the pitcher's foot strikes the ground[1]
- Shoulder continues into ABD and achieves max ER[1]
- Elbow also comes into flexion between 90-120 degrees[1]
- Forearm pronates to 90 degrees[1]
- Ends when max shoulder ER is achieved[1]



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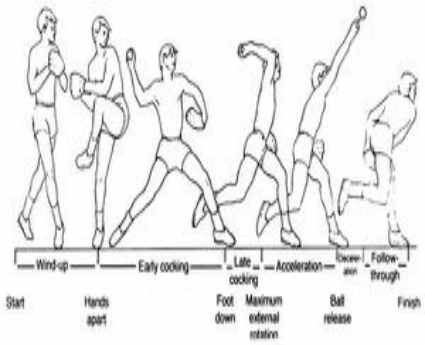
Acceleration

- Begins when max shoulder ER is achieved and the arm begins to come forward[1]
- Shoulder moves into IR and ADD[1]
- Elbow also comes into extension[1]
- Forearm continues to pronate[1]
- Ends with ball release[1]



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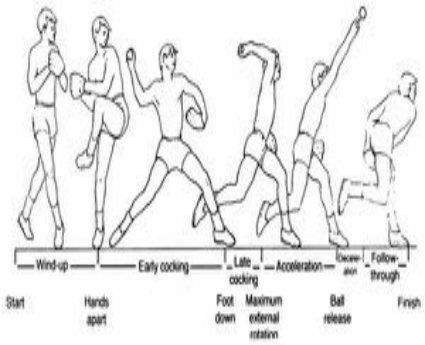
Deceleration/Follow Through

- Begins after the ball is released[1]
- Dissipation of all of the excess kinetic energy occurs during this phase[1]
- Elbow goes into rapid extension[1]
- Ends when all motion is complete[1]



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Forces on the Elbow During Phases of Pitching

- Acceleration Phase (IV) occurs over a period of 40-50 msec during which the elbow accelerates up to 600,000 degrees/sec_2[1]
- During this time, tremendous amounts of valgus stress are placed on the medial elbow[1]
- Anterior bundle of the UCL bears the majority of these forces[1] (Posterior Band)
- Flexor-Pronator mass helps to dissipate these forces[1]

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Forces on the Elbow During Phases of Pitching

- Deceleration Phase (V) occurs over a period of 50 msec during which the elbow decelerates up to 500,000 degrees/sec_2[1]
- Rapid and forceful deceleration of the arm places high valgus stresses on the UCL[1]
- Anterior bundle of the UCL bears the majority of these forces[1] (Anterior Band)

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Putting the Forces on the Elbow in Perspective

- With each pitch, the amount of force placed on the UCL at maximum ER is 100 Newton Meters of torque or equivalent of 60 pounds[2]
- Bowling ball weighs 12 pounds. So, to equal 100 Newton Meters of torque, each pitch that the pitcher makes would be like holding 5 bowling balls in the max ER position![2]
- In this position, the UCL provides a little over half (55 Newton Meters) the resistance against valgus stress[2]
- Cadaveric studies have shown that the UCL ***BREAKS*** at a force of 32 Newton Meters[2]
- Basically, every pitch that is thrown should tear the UCL (it doesn't due to the stability of the muscles of the flexor-pronator mass helping to absorb the remaining force) which is obviously not present in the cadaver[2]

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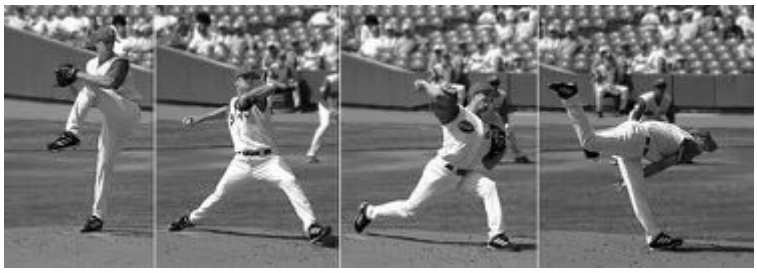
Putting Forces on the Elbow in Perspective

- Literally, the UCL is at max stress with each and every pitch!!!



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Mechanism of Injury to the UCL

- Micro-trauma to the UCL occur once the valgus forces generated during the late cocking-early acceleration phases of throwing exceed the intrinsic tensile strength of the UCL[1]
- Over time, with repetitive throwing creating stress on the UCL, these micro-trauma tears become larger and larger until valgus instability of the UCL occurs[1]
- Usually not a "one pitch event" but rather a cumulative effect that occurs over time

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Summary

- There are 5 phases of pitching
- Enormous rotational forces occur at the elbow especially during the late cocking and early acceleration phases of throwing
- When these forces exceed the tensile strength of the UCL, micro-trauma occurs to the ligament
- Basically, each pitch puts the UCL at max stress
- Over time, with repetitive throwing, these micro-traumas create UCL instability within the elbow

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The UCL "Epidemic" in Baseball

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UCL "Epidemic"

- MLB first started tracking UCL Reconstructions with Electronic Medical Records in 2010.
- From 2010-2015:
  - 208 UCL Reconstructions at the MLB Level[3]
  - 664 UCL Reconstructions at the MiLB Level[3]
- Is this just a problem for professional baseball (Major and Minor League)?

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UCL "Epidemic" Continued…

- From 2010-2015:
  - 206 amateur (high school/college) baseball players who were drafted by MLB teams in the Rule 4 draft had already underwent UCL reconstruction prior to being drafted[3]

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WHY???

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Risk Factors for UCL Injuries[3]

- ***Velocity!!!***
- ***Overuse!!!***
- Mechanics
- Fatigue/Conditioning
- Pitch Type
- Climate
- Shoulder GIRD
- LUCK??

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Velocity

- Studies have shown that pitchers who exhibit higher velocities are at increased risk of UCL injury[4]
- Higher velocity = Greater force placed on the stabilizers of the elbow (UCL, flexor mass)
- Greater forces on elbow = More micro-trauma to the tissue

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Overuse[5]

- Playing baseball year round
- Pitching too many inning/year
- Playing on multiple teams
- Specialization (focusing on only baseball)
- Playing other throwing sports
- Excess throwing on the side (showcases, radar gun)

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Mechanics

- Study by Davis et al revealed that better mechanics leads to lower loads and stress on the elbow[6]
- Lower loads and stress lead to decreased risk of injury
- Signs of Improper Mechanics:
  - "Holding Back" (shorter stride, lead with elbow, trunk forward)
  - "Inverted W" (Still in shoulder IR at foot contact)
  - Shoulder ABD less than 90 degrees (at foot contact/ball release)

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Mechanics Continued



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Fatigue/Conditioning

- Evidence shows that pitching when tired leads to poor performance and increased risk of injury (Mullaney, El Atrache)[7,8]
- When the shoulder fatigues and the angle drops to below 90 degrees of ABD, increased risk for elbow UCL injury
- Typically occurs around the 6th inning (starting pitcher)
- Causes of fatigue:
  - Poor conditioning
  - Pitching on consecutive days
  - Excessive pitch counts
  - Year round playing

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Pitch Type

- Widely assumed that throwing more curveballs lead to increased risk of UCL injury
- Reasoning is because curveballs require the elbow to decelerate over a shorter time interval, thus potentially resulting in greater angular velocities
- However, two separate studies by Nissen and Fleisig found no difference between the stresses on the elbow throwing a curveball vs throwing a fastball [9,4]
- Studies did reveal that the change-up was associated with 29% and 12% **reduced** risk of UCL injury respectively [9,4]
- Recent study by Chalmers et al followed up to discover a link that pitchers who threw a higher percentages of ***fastballs*** were at a higher risk for UCL injury[5]

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Climate

- Thought is that pitchers who live in a warm climate where they can play/throw year round are at higher risk than those in cold climates that are "forced" to take a break when the weather gets too bad to throw
- Study by Erickson et all took a look at climate effect on UCL repairs[10]
- Found that through June 2014, there were 247 UCL reconstructions performed in the Major Leagues
- Of those 247 surgeries:
  - 139 of those surgeries were from warm weather states (below 33rd parallel)
  - 108 of those surgeries were from cold weather states (above 33rd parallel)
- Slightly higher risk for warm weather climate pitchers but not statistically significant

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Shoulder ROM

- Study by Wilk et al examined 296 pitchers over an 8 year span (1998-2005)[11]
  - Pitchers with deficits of more than 5 degrees in total shoulder rotation in their throwing shoulder had a 2.6 times greater risk for elbow UCL injury
  - Pitchers with deficits of more than 5 degrees in shoulder flexion in their throwing shoulder had a 2.8 times greater risk for elbow UCL injury
- Study by Shanley et al assessed 115 pitchers pre-season shoulder ROM[12]
  - Pitchers with greater than 15 degrees horizontal ADD had a 4x greater risk of elbow UCL injury
  - Pitchers with greater than 13 degrees IR had a 6x greater risk of elbow UCL injury

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Luck??

- Personal feeling that luck actually plays a part in UCL risk factors
- Player who was drafted as a SS but found out that he also was a talented pitcher after he was drafted.
- Played the first part of his first season as a pitcher with a very carefully monitored pitch count
- Second part of the season he rested from pitched and played SS
- Coaching staff raved about his near perfect mechanics
- After 1 ½ seasons of pitching, began having elbow pain and eventually needed UCL reconstruction

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MLB Epidemic?

- Velocity. MLB pitchers tend to throw faster than their counterparts who do not reach elite levels. Average velocity is 92 with several guys now pitching in the 100mph range
- Overuse.
  - MLB pitchers tend to have been pitching since a young age.
  - Were likely overused by previous coaches at the amateur level because they were the best player on the team
  - As a pro, throwing on a daily basis for 10+ months of the year as part of the job
- Mechanics. Elite MLB players with flaws in their mechanics who also throw at high velocities are at increased risk

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MLB Epidemic?

- Fatigue. Throwing on a daily basis and increased workload compared to amateur
- Pitch type. Predominately a fastball establish league
- Shoulder ROM: Normal response to throwing (retroversion of the humerus) leads to increased ER and decreased IR due to tight posterior structures (cuff, capsule

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MLB Epidemic?

- All of these factors start at a young age before they reach professional status
- Key is paying attention to the risk factors early and monitoring/preventing at a young age
- By time they get to us…damage is already present

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Summary

- Many factors that predetermine the risk of injury of the UCL in overhead throwers
- Velocity seems to be the primary risk factor according to research
- Overuse, improper mechanics, fatigue/conditioning, pitch type and shoulder ROM are also significant risk factors
- To a degree, climate can play a role in increased risk of injury

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Diagnosing UCL Injuries

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Evaluation[1]

- Evaluation of UCL injury usually will consist of:
  - 1. Patient History
  - 2. Physical Evaluation
  - 3. Radiology

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Patient History

- Are they an overhead athlete that performs repetitive overhead activities?
- Where is the pain located?
- How long have they had pain? (chronic injuries)
- Pinpoint when their elbow began to hurt? (ie after long session of throwing, post-game, etc)
- At what point in their throwing mechanics do they feel the pain?

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Patient History Continued…

- What is their typical velocity?
- How much throwing/how many innings have they pitched?
- When did they start throwing and do they take any periods of prolonged rest?
- Why type of pitches to they tend to throw?

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Signs and Symptoms of UCL Injury[1]

- Sudden or gradual onset of pain in the medial elbow generally **after throwing**
- Pain occurs during the **late cocking/early acceleration phases** of throwing (chronic injury)
- Audible "pop" may or may not be present
- Inability to continue throwing or can only throw at less than 50% of their normal max intensity
- Ulnar nerve symptoms

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Physical Examination

- Palpation
- ROM
- Strength Testing-MMT
- Special Tests
- Neurological Testing
- Shoulder Evaluation
- Scapulo-Thoracic Evaluation
- Mechanics/Video Analysis

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Palpation

- Point tenderness directly over the UCL (sublime tubercle)
- Unlike the shoulder, with the elbow examination, usually where the patient is pointing to or point tender to palpation is the involved structure

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Rang of Motion

- Commonly, lack of full elbow extension is present with UCL injuries
- Due to edema
- Due to flexion contracture (common in more chronic UCL injuries; result of body's repeated attempts of healing and stabilization by laying down scar tissue)[1]
- Note: Small flexion contractures (less than 20 degrees from full extension) are common and do not compromise throwing, as full extension is not required and is functional with a flexion arc between 20-120 degrees[1]

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Strength Testing

- Mainly use this as a form of differential diagnosis
- With UCL injuries, elbow and wrist strength is typically **normal and does not increase pain** unless there is a flexor-pronator strain along with it or neurological involvement (ulnar neuritis) that results in weakness[1]
- KEY: With MMT of wrist flexion, if pain increases with this test and is **localized slightly posterior to the common flexor origin**, then this is a differential diagnosis ruling in a flexor strain[1]

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Special Tests

- Milking Maneuver
- Valgus Stress Test
- Moving Valgus Stress Test

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Milking Maneuver[1]

- Player is seated on the table with their forearm supinated and elbow flexed to 90 degrees
- Examiner pulls on the player's thumb, creating a valgus stress on the flexed elbow
- Positive sign:
  - Feeling of apprehension or instability
  - Reproduction of pain over the UCL
- Tests the Posterior Band of the Anterior Bundle

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Milking Maneuver

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Milking Maneuver

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Valgus Stress Test[1]

- Player is seated on a chair with elbow flexed to 20-30 degrees (to unlock olecranon from fossa)
- Valgus stress is applied to the elbow with one hand while palpating the UCL with the other hand
- Positive Signs:
  - Increased gapping of the UCL when compared to contralateral side
  - Pain may or may not be present but is NOT an indicative finding on test
- Tests the Anterior Band of the Anterior Bundle

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Valgus Stress Test

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Moving Valgus Stress Test[1]

- Player is seated with their shoulder flexed/ABD and ER (at least 90 degrees) and the elbow flexed to 120 degrees
- One hand palpates the UCL while applying a valgus stress on the elbow
- The other hand gradually takes the elbow from flexion into extension while maintaining the valgus force
- Positive Signs:
  - Increased gapping of the UCL compared to the contralateral side
  - Pain over the UCL
- Tests the entire Anterior Bundle throughout the full range (both posterior [flexion] and anterior [extension] bands)

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Moving Valgus Stress Test

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Neurological Testing

- Somewhat common to have ulnar nerve symptoms in addition to UCL injuries[1]
- Secondary to local inflammation of the ligamentous structure which produces secondary irritation of the ulnar nerve within the cubital tunnel [1]
- Also a good way to differential diagnose between UCL injury and Ulnar Neuritis

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Neurological Testing

- Dermatome testing over the ulnar nerve pathway
- Myotome testing over the ulnar nerve pathway
- Ulnar Nerve Entrapment Special Tests
- Ulnar nerve tension test

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Neurological Testing

- Ulnar Nerve Dermatome
  - C8: Sensation on the palmar side of the 5th digit and medial half of the fourth digit
- Ulnar Nerve Myotome:
  - C7: Wrist Flexion
  - C8: Finger Flexion
  - T1: Finger ABD

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Neurological Exam

- Ulnar Nerve Entrapment Sites
- Most common in the cubital tunnel
- Special Test: Tinnel's Sign
- Ulnar nerve tension test to determine if the ulnar nerve is possibly begin entrapped by soft tissue along the pathway

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Shoulder Exam

- Shoulder ROM, especially flexion & total arc (ER/IR)
  - Remember, studies have shown that deficits of 5 degrees of shoulder flexion and total arc rotation increase risk of UCL injury by nearly 3x!!
- Shoulder Joint Mobility
  - Remember, posterior capsule tightness increases risk of UCL injury
- Shoulder MMT
  - Remember, weakness in RTC strength can result in shoulder ABD dropping below 90 degrees and increases the risk of UCL injury
- Functional Strength
  - May have good strength but do they have motor control to sequentially fire their neuromuscular patterns correctly?
  - PNF Patterns

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Scapulo-Thoracic Examination

- Scapular Mobility
  - Scapular mobilization
- Winging Scapula/scapular control
  - Scaption/return from scaption (weight)
  - Scapular PNF patterns
- Scapular MMT
  - Middle trap
  - Lower trap
- Thoracic Mobility

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A Step Further…

- Diaphragmatic breathing
  - PRI
- Core assessment
- Hip assessment
- And the list goes on…..

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Mechanical Evaluation

- If possible, it might be helpful to breakdown video of the player's pitching mechanics to determine any of the "red flag" mechanics (Hanging back, Inverse W, loss of shoulder ABD)
- Gives the player something to focus on with the pitching coach during the rehab process to help reduce the risk of future injury

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Diagnostic Imaging[1]

- X-Rays
  - Show changes consistent with chronic instability such as calcifications and occasional ossification of the ligament
- MRI-Arthrogram
  - Shows ligamentous evulsions, partial ligamentous injuries, midsubstance tears and the status of the surrounding soft tissues (ie flexor mass)
- Stress X-Rays
  - Used to confirm ligamentous instability
  - Medial joint opening of more than 3mm is consistent with instability

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Grades of UCL Injury

- As discussed earlier, injury to the UCL is due to microtrauma to the tissue over time, not a "one pitch" injury
- Therefore, the grades of UCL injury are described based on the chronic valgus instability of the ligament
- Four different classifications of UCL sprains

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Grades of UCL Sprains[13]

- Type I: Edema in the UCL only, low grade partial tear
- Type II: Partial thickness tear of the UCL with no extravasation of fluid on arthrogram
- Type III: Full thickness tear of the UCL with extravasation of fluid on arthrogram
- Type IV: Tear in more than one location on the UCL (ulna and humerus)

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Differential Diagnosis

- Flexor Strains
  - Palpation: Pain posterior to common flexor tendon
  - Pain and weakness with wrist flexion MMT
  - Negative ligamentous special tests
- Ulnar Nerve Entrapment
  - Negative ligamentous special tests
  - Positive Nerve Entrapment tests (Tinnel's and/or Ulnar nerve tension tests)

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Other Causes of Elbow Pain to Differentiate from UCL Injury

- Posterior Capsule Entrapment
  - Complaint of pain during follow through (**NOT** late cocking/early acceleration)
  - Palpation: Pain on posterior elbow
  - Negative ligamentous special tests
- Bone Spurs
  - Similar symptoms as capsule entrapment with pain during follow through and not late cocking/early acceleration
  - Mainly in older pitchers
  - Confirmed with X-Rays

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Summary

- Proper evaluation of UCL injury involves a solid patient history, physical examination and diagnostic imaging
- Signs and Symptoms usually include medial elbow pain after throwing, pain during the late cocking/early acceleration phase of throwing and inability to pitch
- Special Orthopedic Tests for ligament instability are most indicative of UCL injury
- Must also examine the shoulder/scapulothoracic joints and it's helpful to look at pitching mechanics as well, as the "root" of the problem is usually not the elbow itself, rather the elbow "takes the brunt" of the forces from weaknesses elsewhere

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Summary Continued…

- It is important to have good palpation skills during the elbow evaluation as to help differentiate the involved structure
- Important to evaluate for and differential UCL injuries from flexor mass strains and/or ulnar nerve involvement
- Radiology, especially stress X-rays, are the gold standard in confirming your clinical findings of UCL injury

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Rehab of UCL Injuries

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Conservative vs Surgical Treatment

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Conservative Rehab

- Why Treat Conservatively?

- "Having TJ surgery is 100% guaranteed!"
- "I'll come back even stronger if I have surgery"
- "I'm going to need it eventually"

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Conservative Rehab[14]

- In a study by Ford et al, 43 professional baseball players from 2006-2010 were diagnosed at the Steadman-Hawkins Clinic for UCL injury

- Of those 43 players:
  - 8 had complete (Grade III) tears and underwent immediate TJ surgery
  - 7 had partial tears (Grade II) with 4/7 undergoing TJ after MRI and 3/7 underwent TJ after failing conservative
  - 28 had partial tears (Grade II) and did conservative rehab

- Results
  - Of the 8 complete tears who underwent TJ 75% (6/8) returned to play with 63% (5/8) returning to their pre-injury level or higher
  - Of the 7 partial tears who underwent TJ 100%(7/7) returned to play with 86% (6/7) returning to pre-injury level
  - Of the 28 partial tears who did conservative rehab, 93% (26/28) returned to play with 93% (26/28) returning to pre-injury level

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Conservative Rehab[14]

- Conclusion: Incomplete UCL injuries can successfully be treated non-operatively with very high return to pre-injury level play in most cases
- Complete UCL tears are more successfully treated with surgery
- Important to have an idea of the grade of UCL injury you are dealing with to help guide your choice of non-op vs operative treatments

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Conservative Rehab Guidelines

- **Minimum** of 6 weeks of no-throwing
- Symptoms will dictate how quickly you progress
- Don't skip steps and resist the urge to rush
- Treat the **player** not the elbow (-Rienold)

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5 Keys to Conservative Rehab[15]

- 1. Reduce pain/inflammation, restore range of motion and give the ligament proper time to heal
- 2. Correct imbalances throughout the chain
- 3. Shoulder/Scapular Strengthening
- 4. Dynamic Forearm Strengthening
- 5. Functional Return to Play Program

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Key #1: Reduce Pain & Inflammation

- NSAIDS
- Modalities
  - Ultrasound/Phonophoresis
  - Low Level Laser
  - Hivamat
  - H-Wave/ E-stim
  - Ice
  - Compression
- AVOID re-testing the UCL with stress tests
  - Continual testing will not allow ligament to heal
  - Re-test usually 4 week mark and 6 week mark

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Key #1 Restore Range of Motion

- Likely will have swelling that prevents full ROM which will continue to be treated from the previous slide
- Also, with any injury, the surrounding muscles will tend to go into a protective/guarded position creating soft tissue restrictions that limit ROM
- To restore soft tissue restrictions:
  - Soft tissue techniques (MRT, ART, FRR)
  - Instrument-assisted soft tissue techniques (Graston, Fascial Abrasion, Hawkgrip, dry needling)

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Key #2: Correct Imbalances Throughout the Chain

- During your assessment, likely to find several imbalances throughout the chain and now is an optimal time to address them, as it is likely those imbalances contributed to the initial injury
- Shoulder ROM (flexion and IR)
- Scapular mobility
- Thoracic Mobility
- Core Stability
- Hip/Lower Body
- Also a great time to review throwing mechanics by watching video with the pitching coaches and making mental adjustments now

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Remember…

- Both shoulder flexion and rotation (mainly IR) deficits are both linked to increased risk for UCL injury
- Surprisingly, most of these elite athletes will have core strength deficits and this is a great time to start to focus on core stability
- Critical to focus on glute strengthening during this time
  - Athletes are in single leg stance all of the time
  - Relationship between glute and scapula that is vital to these athletes
  - "I like big butts and I cannot lie" (-Sir Mix-A-Lot)

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Key #3: Shoulder and Scapular Strengthening

- Shoulder weakness correlated with UCL injuries in high school athletes (Tyler/Reinold)
- UCL rehab is 80% shoulder and 20% elbow
- Thrower's 10 Exercises
- Avoid the 90-90 position at this time until they are completely asymptomatic with valgus stress re-testing

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Thrower's 10

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Problem with the Thrower's 10

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Modified Thrower's 10

- Try to add in a core component and a glute component when possible to get "more bang for your buck"
- Add core ball, single leg stance on foam, manual perturbations and glute involvement

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Thrower's 10 on Ball for Core

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Thrower's 10 on foam for Glute

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Thrower's 10 Variations/Manuals

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Tubing Program with Glute

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Tubing Program with Glute

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Key #4 Dynamic Forearm Strength

- Remember…Each pitch produces 100 N/m of force on the elbow
- 55 N/m is resisted by the UCL
  - Should fail at 32 N/m
- 45 N/m is resisted by the flexor-pronator mass
- Because the integrity of the UCL is compromised by injury, it is vital to strengthen the flexor-pronator mass to significantly reduce the amount of stress on the ligament

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Key #4 Dynamic Forearm Strength

- Forearm strengthening
  - Concentric (Dumbbells, tubing, rice bucket)
  - Manual (PNF Patterns)
  - Eccentric
  - Plyometrics
- Grip Strengthening
  - Putty, hand grippers, power webbing
  - Dynamic grip strength with power webbing
- Finger strengthening
  - Webbing
  - Manuals (PNF patterns, eccentric)
- Don't forget about Flexi Carpi Ulnaris!

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Forearm Eccentrics

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Forearm Ball Drops

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Dynamic Grip with Power Webbing

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Key #5: Functional Return to Play Program

- Only begin when the player is asymptomatic with valgus stress testing and has full ROM and 5/5 MMT with all shoulder/scap/forearm testing
- Begin to gradually stress them with exercises in the 90-90 position
- Dynamic strengthening (plyometric work) during this phase
- Includes a gradual return to play throwing program that is closely monitored throughout and adjusted as needed by the PT and pitching coach

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Functional Return to Play Exercises

- Shoulder D1/D2 PNF patterns
- Manual Stabilization in the 90-90 position
- Wall dribbles/scap clocks
- Ball Drops-sidelying ER and scapular planes
- Rebounder ball tosses
- Deceleration ball tosses

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Shoulder PNF Patterns (D1/D2)

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Ball Drops

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Ball Drops with Manuals

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Deceleration Ball Tosses

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Rebounder Ball Tosses

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Med Ball Tosses

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Tubing in 90-90?

- Common Exercise given to pitchers
- Problem?
- Pitchers have retroversion of their humeral head
- Creates posterior tightness and anterior laxity
- Tubing in the 90-90 position results in anterior glide of the humeral head into an already unstable anterior capsule
- Stay below 90! Can accomplish same thing without risking more laxity

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Return to Play Throwing Program

- Functional Assessment for upper body??
- Not much research
- Baseball and pitcher's especially play an endurance-based sport
- What is the minimum number of reps for training to create a max endurance exercise? (24)
- What mimics the functional firing patterns used in throwing? (PNF patterns)
- Functional Assessment: Can the player perform 24 repetitions of D1/D2 PNF patterns with proper form, good strength and without fatiguing
- If so, I'm comfortable letting them begin their throwing program (address specifics later in the power point)

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PRP Injections

- Over the past several years, PRP (Platelet-Rich Plasma) injections have become increasing common in the treatment of UCL injuries
- Draw the patient's own blood and spin it in a centrifuge
- Different types of blood cells separate and they take the layer of platelets and inject them back into the injured area
- Thought is to help promote healing

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PRP Injections

- With a typical UCL injury, the player is usually shut down from throwing for 6 weeks
- "Down time" for players who receive PRP injections where they are not throwing tends to average ~6 weeks
- If the player sustains a UCL injury and is going to be down from throwing for 6 weeks anyways, why not perform a PRP injection at the same time!
- Benefits: No downside
- Drawbacks: Cost
- Big question: Do they work??

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PRP Injections[13]

- Study by Misra et al, 50 baseball players with UCL injuries confirmed and graded with MRI imaging underwent a PRP injection
- Failure was determined by need for surgery or cessation of playing with a 5 year follow-up
- 39 of the subjects had grade I-II tears
- 3 of the subjects had grade III tears
- 8 of the subjects had grade IV tears

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PRP Injections-Study Results[13]

- 24/39 (61%) of the grade I-II tears returned to play without surgery
- 3/3 (100%) of the grade III tears returned to play without surgery
- 1/8 (12.5%) of the grade IV tears returned to play without surgery
- Of the 22 that failed to return, 10 of them had a second PRP injection. Of that group, 3/10 (30%) returned to play without surgery after their second injection
- 19/22 that failed PRP injection ended up having TJ surgery with only 9/19 (47%) returning to play after UCL reconstruction

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PRP

- In a similar study by Dines et al, 44 baseball players with confirmed UCL injuries under MRI imagining underwent a PRP injection[15]
- Most of these athletes were high school players with mean age 17.4 yrs (only 6 professional)
- Found that 64% of these subjects had excellent/good results with 4/6 (67%) of the professional players returning to play without surgery

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PRP Take Aways

- Partial tears can be treated with PRP injections with decent return to play results than complete tears
- Seems to be more effective in younger subjects
- Still more research to be done but making progress

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Success!!!!

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Summary

- Research has shown that conservative treatment of partial UCL injuries are successfully at returning professional baseball players to their previous level of competition
- Keys to conservative rehab:
  - Reduce pain/inflammation and restore ROM
  - Address imbalances throughout the chain
  - Shoulder/Scapular strengthening
  - Dynamic forearm strengthening
  - Gradual functional return to sport program

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Surgical Treatment Of UCL Repairs

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Surgical Treatment of UCL Injuries

- Performed when conservative treatments fail to make improvements and the player is still unable to return to play
- It is a COMMITMENT! Average recovery time is 15-18 months
- Performed by taking an autograft of either the palmaris longus or hamstring tendon to perform a reconstruction of the UCL
- Recovery time frame and comorbidities are no different depending on whether you have a palmaris vs a hamstring graft, surgeon is simply looking for the most viable tissue

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Phases of UCL Rehab

- Acute Post-Op (0-6 weeks)
- Strengthening Phase (6 weeks-12 weeks)
- Functional Strengthening Phase (3 months-5 months)
- Return to Play Throwing Program (5 months-15-18 months)

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Good News….

- The goals of post-op UCL rehab are exactly the same as your conservative UCL rehab
- 1. Reduce pain/swelling; ROM
- 2. Correct Imbalances Throughout the Chain
- 3. Strengthen the shoulder/scapula
- 4. Dynamic forearm strengthening
- 5. Gradual functional return to play program
- Remember: Avoid Valgus Stress to the elbow for 3 months!

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Phase I: Reduce Pain/Swelling

- Player is most likely going to be in a hard splint for the first 10 days to help control swelling with compression and protect the incision from infection
- After 10 days, player is placed in a ROM brace (usually use a compression sleeve to keep control the swelling)
- Use of modalities to control swelling:
  - Game ready (ice + compression and keeps incision dry)
  - H-wave to pump swelling out
  - Hivamat (once incision is closed) for lymphatic drainage
  - Gentle manual milking for swelling

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Phase I: Restore Range of Motion

- Surgeon's preference on how quickly or slowly they would like you to progress the player's range of motion
- Getting to the point where some surgeons do not even use the ROM brace (prevent the players from getting tight) with the exception of sleeping in it to prevent then sleeping in a valgus position
- Perform ROM in all elbow planes (supinated, pronated and neutral forearm) as well as PROM of the wrist and gentle AROM of the fingers
- AVOID VALGUS STRESS TO THE ELBOW
- Typically will wear the brace for 6 weeks (revascularization of the graft takes place, so graft is the weakest up until this point)

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Phase I: Restore ROM

- Also working on soft tissue flexibility during this phase, especially at terminal extension, as this tissue is usually in a guarded and tight state
- Use a combination of manual techniques (ART/FRR, etc) to accomplish terminal ranges
- Can begin riding the stationary bike after the splint is removed and begin some core/diaphragmatic breathing exercises, thoracic mobility and any lower body imbalances
- May start on the bike/lower body later if they have had a hamstring graft (as symptoms allow)
- Milestone to complete phase I: Full painfree active elbow ROM and minimal joint edema

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Phase II: Restore Baseline Strength

- Begin after full active ROM is achieved
- Now that motion is re-gained, its time to strengthen in the full ranges
- Still avoiding all valgus stress at this time
- Begin strengthening of the shoulder/scap/forearm
- Begin lower body (weight vest only/no holding weights) and continue with conditioning with beginning to run at 8 weeks post-op

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Phase II Exercises

Wrist/Hand/Forearm

- Wrist PNF patterns
- Finger PNF patterns
- Putty
- Webbing (no dynamic res)

Shoulder/Scapula

- Throwers 10 (modified)
- Tubing Program (modified)
- Scapular PNF Patterns (prone and sidelying)
- Manual stabilizations (ie supine punch)
- UBE
- Serratus wall slides
- Rhythmic stab with ball on wall
- Body blade at side

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Don't Forget….

- Engage the glutes/core whenever possible with these exercises
- Shoulder ROM, especially flexion
- Always thinking function, function, function down the line!

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Phase II Goals

- Milestone for completing Phase II:
- Shoulder (flexion, scaption, ER),
- Scapula (mid trap, low trap),
- Wrist (flexion, extension, ulnar/radial deviation, supination/pronation)
- Elbow (flexion/extension)
- Move on to the functional strengthening phase

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Phase III: Functional Strengthening Phase

- Can begin to gradually place valgus stress on the graft (move them into the throwing position and progress past neutral ER)
- Plyometric phase
- Add eccentric exercises
- Can begin upper body lift in the weight room and begin holding weights for their lower body lift

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Phase III Exercises

Wrist/Hand/Fingers

- Continue wrist/finger PNF
- Isolate FCU with manuals
- Forearm ball drops
- Webbing with dynamic resistance
- Eccentric strengthening
- Rice Bucket

Shoulder/Scapula

- Shoulder PNF Patterns
- Manual stabilization in throwing positions (half kneeling on foam and progress)
- Ball drops (ER/T/Y)
- Wall dribbles
- Scap clocks
- Deceleration ball tosses
- Rebounder
- Med ball tosses
- Manual resisted T/Y rows

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Don't Forget…

- Dynamic forearm strength is CRITICAL, so try to incorporate some type of forearm grip into shoulder exercises
- Example: For manual stabilization exercises in the overhead position, have them hold a ball to get some finger/grip/forearm activation

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Phase III Goals

- Functional tests for the upper extremity?
- My functional test: PNF patterns
- If the player is able to complete 24 repetition of all PNF Patterns, then I feel comfortable letting them begin their Phase IV throwing program
  - Shoulder D1/D2 and rotation
  - Elbow flexion/extension
  - Wrist flexion/extension and pronation/supination
  - Finger flexion and FCU-isolated flexion
  - Scapular Diagonals

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Summary

- If a player fails to improve or return to play with conservative rehab, UCL reconstruction in the next step
- Phases of UCL reconstruction rehab are no different than the conservative….just have to be cautious of the timeframes not to break contraindications
- Be creative!!

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Return to Play Throwing Programs

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Return to Throwing Program

- Several different throwing programs that exist and are dependent on surgeon's preference, but none are right/wrong, better/best
- Most of them are very similar, small differences in volume of throws and distances but most follow same basic guidelines
- Goal: Make it a GRADUAL progression and make it as functional as possible for the player

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Keys to a Throwing Program

- There is no rush to begin your throwing program
- UCL graft maturation usually occurs between 15-18 months
- 12 month return to play thinking is becoming a thing of the past
- Most throwing programs are now recommending beginning the throwing program at 5 months post-op at the earliest
- Also perfectly OK to give the players scheduled breaks throughout the program
- Recovery is just as important as building arm strength
- Count on AT LEAST 10 months of throwing before they are in an actual game, so there is absolutely no need to rush or let the calendar dictate the pace

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Keys to a Throwing Program

Expect minor set backs. In order to strengthening the graft, you have to gradually stress the graft.

At some point, the demand on the graft will exceed it's strength and the player will become sore. It's OK and NORMAL. Make sure you give them proper time off and reduce the stress (distance or volume) if need-be

Throwing programs will vary based on the pitcher's role (starter vs reliever)

Fastball ONLY during their throwing program and do not mix in breaking balls until they are 9 months post-op

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Pre-Throwing Phase

- Usually start with a pre-throwing phase where the player performs towel drills and works on mechanics prior to actually throwing a baseball
- Usually occurs around the 4.5-5 month post-op mark
- Great time to address any mechanical issues because more than likely those mechanical issues are what got them on the operating room to begin with, so it's the opportune time to clean it up to prevent re-injury from occurring

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San Diego Padres Throwing Program

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Our Philosophy

- Player will throw 3x week with a day off in between in the early stages, making 25 throws (endurance exercise, “heavy inning”)
- Not concerned with sets/reps to reach their designated distances, we would rather the player make as many (within a certain degree) at a distance to warm up as they move back because some guys take longer than others to get loose
- Don’t give percentages of intensity because guys always throw harder. We want firm throws to the target with just a little bit of air under the ball
- Guys will only advance distances if they complete the week with good firm throws with proper mechanics and are symptom-free
- OK with repeating a distance if they player isn’t ready to move back yet
- Players get a FULL week off after throwing for four continuous weeks as a scheduled breather (also a break from upper body work in the weight room)

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San Diego Padres Throwing Program

5 Month Post-Op

- Week 1: 45 feet
- Week 2: 45 feet
- Week 3: 60 feet
- Week 4: 60 feet

- 1 week break from throwing

6 Month Post-Op

- Week 1: 70 feet
- Week 2: 80 feet
- Week 3: 90 feet
- Week 4: 100 feet

- 1 week break from throwing

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San Diego Padres Throwing Program

7 Month Post-Op

- Week 1: 110 Feet
- Week 2: 120 feet
- Week 3: 135 feet
- Week 4: 150 feet

- Once they hit 135 feet, can begin playing catch every day

- 1 week off following completion of 150 feet week

8 Month Post-Op

- Begin playing catch off of the half slope 2x week to introduce throwing down at an angle

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San Diego Padres Throwing Program

- At the 9 month mark, the player is now ready to begin their mound progression as long as they have completed the previous throwing stages and are symptom free
- The first month of bullpens will be fastball only
- Mound progression will vary depending on if they are a starter or reliever
- At 9 months, can start playing catch flat ground (not off of the mound) with the change-up
- At 9.5 months, can start playing catch flat ground (not off of the mound) with the curveball

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San Diego Padres Throwing Program

- Player will throw 2 bullpens per week with at least two days in between pens
- Can play catch one day and long toss the other day in between pens
- OK to give them an extra day of catch or an off day from throwing if needed to prevent fatigue

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San Diego Padres Mound Progression

- Week 1: 20 pitch FB only
- Week 2: 25 pitch FB only
- Week 3: 30 pitch FB only
- Week 4: 35 pitch FB only

- 1 week break

- Both starters and relievers will both go through this same progression, then the next phase will vary based on role

- Begin up/down bullpens (7 minute rest in between to simulate innings, time on the bench between)

- Start to mix in change-ups/curveballs in pens

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San Diego Padres Throwing Program

- After this phase of up/down bullpens, the pitcher will throw their up/down bullpen during one of their two scheduled mound days (ie Tuesday)

- The second bullpen now becomes a touch/feel pen (easy bullpen, less intensity and 20 or so throws just to work on mechanics)

- Helps simulate a normal 5 day schedule for starters that they would be on during the regular season

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10 Month Bullpens

Starter

- Week 1: 15/15 (30) FB/CH
- Week 2: 20/20 (40) FB/CH
- Week 3: 15/15/15 (45) FB/CH
- Week 4: 15/15/20 (50) FB/CH

- 1 week break

Reliever

- Week 1: 10/10 (20) FB/CH
- Week 2: 10/15 (25) FB/CH
- Week 3: 15/15 (30) FB/CH
- Week 4: 20/20 (40) FB/CH

- 1 week break

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11 Month Bullpens

Starter

- Week 1: 15/20/20 (55) All
- Week 2: 20/20/20 (60) All
- Week 3: 15/15/15/20 (65) All
- Week 4: 15/15/15/15/15 (75) All

- 1 week break

Reliever

- Week 1: 10/10 (20) All
- Week 2: 10/15 (25) All
- Week 3: 15/15 (30) All
- Week 4: 20/20 (40) All

- 1 week break

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San Diego Padres Throwing Program

- At 12 months post-op, player is now cleared to face live hitters for the first time….but not in an actual game setting!!
- Live BP and simulated game progression
- Begin with either a 25 pitch or a timed 6 minute live BP for month 13
- Progress to a simulated game (play defense, call balls/strikes, work on game situations ie pick-offs) starting with one inning/25 pitch max
- Build up to 5 innings (adding a 15 pitch cap to each inning) over the next month (month 14)
- Example: Pitcher throws 1 inning and makes 20 pitches, his second simulated game would be 2 innings/35 pitches, whichever he completes first

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UCL Reconstruction Success Rates

- "TJ surgery is a guarantee and I'll come back throwing harder and better than before."
- Most players and even coaches/parents think that TJ surgery is 100% foolproof and everyone is back at 1 year after surgery

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UCL Reconstruction Success Rates[16]

- In a study Makhni et al, 147 Major League pitcher underwent TJ surgery from 1999-2011
- 118/147 (80%) Pitchers returned to pitch at least 1 game in the Major Leagues (previous level)
- Only 99/147 (67%) Pitchers returned to pitch more than 10 innings the rest of their career!
- 57% of these pitcher returned to the disabled list for injuries to their throwing arm
- Also a decline in performance (ERA, BAA, WHIP, K/9 innings, BB/9 innings, innings pitched and fastball velocity), however they were not statistically different from similar age-matched controls who did not under surgery

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Summary

- Throwing programs begin at 5 months post-op
- They are to be slow and gradual
- Bullpens begin at 9 month post-op
- Pitchers can begin facing live hitters at 12 months post-op
- Actual success rate of Major League pitchers that returns to the previous level of competition (Major Leagues) and pitches more than 10 innings for the remainder of their careers is actually on 60-70%

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Prevention

- Epidemic in Major League Baseball?
- Problem is, by the time they get to us, the damage has already been done in most cases
- Answer to prevention must start in little league and extended all the way into the major league training room

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Prevention

- Limit the amount of throwing kids do at a young age
- Pitch counts
- Don't play overhead sports year round (play another sport)
- No extra show cases, radar gun sessions etc
- Do not pitch when fatigued

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Prevention

- Screens for players
  - FMS, SFMA for imbalance assessments
- Daily screens in the training room
  - Flexion
  - Rotation
  - Horizontal adduction
- Design prevention programs that stress shoulder/scap strength, dynamic forearm strengthening
- Keep an eye on mechanics
- Give your athlete a day off if fatigued

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Thank You for Your Time

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Best of Luck on Your Exams!

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Questions?

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