From Yesterday to Today

Since Dr. Jobe’s landmark diagnosis and surgical technique, our ability to identify and surgically treat UCL injuries in the overhead throwing athlete has improved tremendously.

- Multiple modern techniques using mostly tendon autografts passed through drill tunnels
- All with successful outcomes and evidence to support continued use.

UCL Reconstruction Today

- All treated with some variation of a surgical reconstruction procedure
- All require nearly 12 months to return to play
- All with 75-90% success
  - Low complication rates
- > 100 current MLB pitchers

75-90% Success = 10-25% Failure

Who Fails When and Why??
Epidemiology of UCL Reconstruction: 1429 Cases
Camp et al, JSES 27, 2018

- Epidemiologic report on EVERY UCL performed on pro pitchers 1974-2016
- MLB Injury Tracking System + 2 others
- 1429 pitchers underwent UCLr
  - 1334 primary UCLr (93.4%)
  - 95 revisions (6.6%)
- Rate of primary and revision UCLr increased annually (p<0.001)

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Return to Play Results

- 853/1429 (59.7%) UCLr 2005-2014
- 714 (83.7%) RTP at any level (ave 435 d)
  - MLB = 94.6%
  - MiLB = 79.0%
  - Primary UCL = 83.9%
  - Revision UCL = 80.7%
- RTP at prior level (ave 506 d)
  - MLB = 80.0%
  - MiLB = 69.1%

Survivorship Results

- Time free from revision and still playing
- Time between Primary & Revision UCLr
  - 1413 +/- 1089 days
  - MLB = 1816 +/- 1203
  - MiLB = 1034 +/- 834
- Mean career length after primary UCLr
  - 3.8 +/- 3.4 yrs (range 0-22 yrs)
  - MLB = 4.8 vs MiLB = 3.2
- Added career length after revision UCLr
  - Average 2.1 seasons

Trends in Revision Elbow UCLr in Professional Pitchers

Wilson et al, J Hand Surg Am 40, 2015

- Database review
- 271 professionals pitchers
- 40/271 (15%) required revision UCLr
- 3 cases of second revision UCLr
- Annual rate of revision DECREASING
- Time to revision UCLr = 5.2 +/- 3.2 yrs
- Length of career after UCLr
  - Primary UCLr = 4.9 +/- 4.3 yrs
  - Revision UCLr = 2.5 +/- 2.4 yrs
Why Does Primary UCLR Fail?

- Technical Issues?
  - Tunnel Placement or Graft Fixation
- Graft Issues?
  - Graft choice
  - Graft construct
  - Graft blood supply
- Rehabilitation Issues?
  - Graft strain during early rehab
  - Time to RTP after UCLR
- Work Load Issues?

Technical Issues

- Tunnel Placement
  - Effect on graft isometry
  - Never carefully studied
  - No conclusive evidence
- Graft Tension
  - Ideal initial graft tension unknown
    - Never studied
    - No conclusive evidence
  - Structural integrity of graft?
    - Intact or early compromise

Graft Issues

- Graft choice
  - Palmaris vs Gracilis
    - No definitive evidence
- Graft construct
  - Modified Jobe vs Docking
    - No definitive evidence
- Graft blood supply
  - Effect on graft incorporation?
Osseous Vascularity of Medial Elbow after UCLr: Docking vs Modified Jobe
Camp et al, OJSM 6(4), 2018

- Define vascular insult resulting from drilling ME and sublime tubercle
  - Docking vs Mod. Jobe
- Cadaveric Study – 8 matched pairs
  - Pre- and Post-Gad MRI
    - Quantify intraosseous vascularity
  - 3D CT
    - Contrast injection ulnar & brachial arteries
  - Gross dissection
    - Location of terminal perforating vessels

Vascular Areas of Interest

Surgical Drilling Patterns
CT Scan – Posterior Perforating Vessels

Results

Clinical Relevance

- Most common site of failure = ME insertion
- Possible contribution of diminished vascular supply to proximal graft??
Rehabilitation Issues

- Graft strain during early rehab
  - The killer curve all over again?
- Effect of time to RTP
  - No STATISTICALLY SIGNIFICANT effect

Length of Time between Surgery and Return to Sport

- Does earlier RTP increase revision risk?
- Database survey study 1974 – 2016
  - 569 pitchers with “reliable game logs”
- Time to RTP after primary UCLr (NS)
  - Revision group = 14.7 months
  - No revision group = 16.5 months
- Time to RSL after primary UCLr (NS)
  - Revision group = 15.2 months
  - No revision group = 17.7 months

Work Loads After RTP

- Keller et al, JSES 2016
  - Relative workload changes vs pre-UCLr
- Games/innings pitched, total pitches
  - Compared 3 yrs before/after 1st UCLr
- Games Pitched
  - Revisions > 14.1%  Non-revision < 13.6%
- Innings Pitched
  - Revisions < 9.8%  Non-revision < 26%
- Pitch Counts
  - Revisions > 6.6%  Non-revision < 19.6%
Work Loads After RTP
Keller et al, JSES 2016
- 21 MLB revisions vs 121 MLB primary UCLr
Games/innings pitched, total pitches
- Compared seasons from 1st UCLr to revision
Games Pitched
- No significant difference
Innings Pitched
- No significant difference
MLB – only Pitch Counts
- No significant difference

Work Loads After RTP
Erickson et al, AJSM 44, 2016
Performance metrics Year 1 after UCLr
135 primary UCLr, 19 revision UCLr
No significant differences
- Number of innings in season after UCLr
- Number of pitches in season after UCLr
- Number of innings in career after UCLr
- Number of pitches in career after UCLr
No differences if < or > 180 innings Yr 1

Conclusions
No clearly identifiable risk factors for predicting need for UCL revision
No clearly modifiable factors
Possible relative workload factors compared to pre-injury performance
- Is a lower performing pitcher what we want to produce?
Making the Diagnosis

- Clinical History
  - Similar to presentation for chronic UCL

- Physical Exam
  - Similar to examination for chronic UCL

- Imaging
  - X-rays – heterotopic ossification, fracture
  - Ultrasound – dynamic laxity
  - MRI – graft integrity

Can be confusing!

39 yo MLB, 12 yrs s/p UCLr

27 yo MLB, 18 mos s/p UCLr
Not ALL UCLr failures are due to graft failure!

- Intra-articular pathology
  - Posterior humeral chondrosis
  - Radiocapitellar DJD
  - Posteromedial osteophytes
- Extra-articular pathology
  - Graft related
    - Heterotopic ossification
  - Non-graft related
    - Ulnar nerve

Symptomatic H.O. after UCL Reconstruction
Andrachuk et al, AJSM 44-5, 2016

- Prevalence = 0.6% (8/1420)
- 6/8 = gracilis graft
- 8/8 = HO at proximal graft @ medial epicondyle
- 6/8 treated with HO excision
  - Mean time to surgery = 21 mos post-op
- 6/8 returned to play
Technical Considerations
- Prior Technique
- Bone Quality
  - Tunnel placement
  - Tunnel size
- Tissue Quality
  - Residual graft or native ligament
- Graft Selection
  - Hamstring preferred
- Fixation Options
  - Any way you can!

Surgical Principles
- Appropriate Tunnel Placement
- Robust graft construct
- Good graft tension
- Reliable graft fixation
Possible Construct Options?

35 yo MLB s/p UCLr x 2

- Poor residual graft tissue
- Compromised ME bone stock
- Extremely thin ulnar bone bridge
- Deficient posterior bundle
Hamstring graft
Button fixation on humeral side
Distalize ulnar tunnel
  Single tunnel, screw fixation
Reconstruct posterior bundle

Rehabilitation Protocol

- Individualize
  - Timing of UCLr revision
    - Prior RTP or never RTP
  - Tissue factors
  - Construct
  - Compliance of athlete

How are we doing?

What do we tell our athlete?
### Functional Outcomes Following Revision UCLr in MLB Pitchers

**Jones et al, JSES 22, 2013**

- **18 MLB pitchers**
- **14/18 (78%) RTP within 2 years**
- **Low rate of RTP to pre-injury workloads**
  - Relievers – 50% pre-injury pitch workload
  - Starters – 35% pre-injury pitch workload
- **Performance Statistics**
  - Relievers performed better than starters
  - ERA, K/9, BB/9

### Pitching Performance and Longevity After Revision UCLr in MLB Pitchers

**Marshal et al, AJSM 43, 2015**

- **33 MLB pitchers s/p revision UCLr**
- **33 age/position matched controls**
- **Compared performance and longevity**
  - **65.5% RTP after revision UCLr**
  - **No statistically significant differences**
    - ERA, WHIP, WAR, RAR
  - **Statistically significant differences**
    - < innings pitched, > BB/9, < Wins
    - 0.8 years shorter career after RTP

### Outcomes in Revision Tommy John Surgery in MLB Pitchers

**Liu et al, JSES 25, 2016**

- **235 MLB pitchers s/p UCLR since 1999**
- **31 (13.2%) underwent revision UCLr**
  - **37% revision within 3 yrs of index UCLr**
- **26 > 2 yrs flup**
  - 17/26 (65.4%) pitched in 1 MLB game
  - 11/26 (42.3%) pitched in > 10 MLB games
- **Ave length of recovery = 20.76 months**
- **Compared to age matched controls**
  - Shorter career (4.9 vs 2.6), decreased work
Conclusions

- Risk of revision UCL up to 15%
- No clearly identifiable risk factors
- Technically challenging
- Lengthy recovery
- Likely reduced workload capacity
- Mixed performance metrics for RTS
- Shortened career

Role for Repair and Augmentation??

- Limited experience
- 6 cases to date
- 2 MLB
- 2 MiLB
- 2 College

Thank You