UCL Repair and Augmentation with Collagen-Coated Fiber Tape (Internal Brace) in Overhead Throwing Athletes

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Disclosures

- I am a consultant for Arthrex
- I receive a royalty on a kit that was created by Arthrex to support this technique
- ASMI receives research and education support from Arthrex, Biomet Sports Medicine, Smith & Nephew, Cayenne, Mitek, Aesculap

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Get ready to throw tomatoes…

- Learning from history …..
  - Wise, mature, visionary, etc
- Definition of insanity …..
  - Doing the same thing and expecting a different result?

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UCL Repair: History

- Norwood 1981 2/4 RTP at same level
- Conway, Jobe et al, JBJS 1992
  - 70 patients 1974-1987
    - 14 Repairs to bone, 56 Reconstructions
      - G/E in 10/14 repairs (71%)
      - G/E in 45/56 Reconstructions (80%)
    - 7/14 Repairs (50%) returned to same level
      - 2/7 MLB (29%)
    - 38/56 Reconstructions returned to same level
      - 12/16 MLB (75%)

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UCL Repair History

- Azar, Andrews et al 2000 AJSM
  - 91 patients with UCL reconstruction or repair
- Repair patients did not fare well compared to UCL reconstructions
- Less than 30% of repairs returned to same or higher level of play

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UCL Repair: History

- On the basis of these experiences and those of other surgeons around the baseball world, UCL repair was largely abandoned in favor of UCL reconstruction.
  - Keep in mind that these were (and still are) some of the best elbow surgeons EVER.
- Until……..

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UCL Repair: History

- Argo, Savoie, Field, et al AJSM 2006
  - UCL repair in 18 female athletes
    - 6-plication, 11-anchors, 1-drill holes
    - Softball, Gymnastics, Tennis
  - 16/17 return to previous level
    - Mean return time of under 3 months
- Savoie, Field, et al AJSM 2008
  - 60 overhead athletes, 47M/13F, avg age 17.2 yrs
    - Mean f/u 59 months
  - 51/60 Suture anchor repairs
    - 9/61 sutures passed through drill tunnels
  - 93% good/excellent
  - 58/60 Returned to Same or Higher level of play at avg 6 months post-op

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Total UCL Repair History

- Less than 200 cases before 2017 reported in peer-reviewed literature
- Generally poor outcomes compared to UCL reconstruction
  - Until Savoie changed the game
    - Went largely unnoticed despite publication in AJSM
- Renewed interest with newer technology and more experience with the operation

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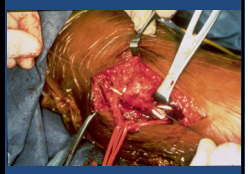
UCL Reconstruction History

- Cain et al AJSM 2010
  - 1261 patients collected over 10 years
    - 100% of reconstructions done w Modified-Jobe
      - UNT in ALL patients
    - AVG RTP nearly 12 months
  - 84% RTP at same or higher level
    - Low complication rate



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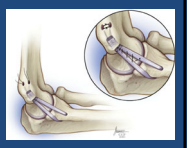
UCL Reconstruction History

- **Docking Technique**
  - Dave Altchek 1990's
    - Widely accepted technique with excellent outcomes
- **Hybrid Techniques**
  - Docking and tunnels
    - Altchek, ElAttrache, others
      - Accepted techniques with similar outcomes



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Revision UCL Reconstruciton

- **Poorer outcomes in the overhead athlete**
  - RTP rates as low as 30%
  - Healing potential?
  - Length of recovery
    - Tends to be more than 15 months
  - Loss of velocity, stamina, control

- JSES 2016
- 31 MLB UCL revisions since 1999
- Avg time to RTP 21 months
- 65% able to return for at least 1 game, but only 42% able to return for at least 10 games
- Compared to primary, revision TJ had:
  - 2 year less survivorship
  - Less innings pitched
  - Less total pitches

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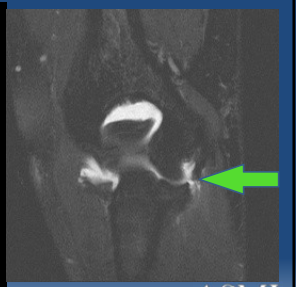
Adolescent and Young Adults

- **These athletes typically have end-avulsions of the UCL or partial tears of the ligament.**
- **Rarely is the UCL tissue deficient or deteriorated from chronic repetitive injury**

IS UCL RECONSTRUCTION NECESSARY in THIS POPULATION?



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We Had an Idea

- After doing nearly 2000 UCL reconstructions over 15 years of practice, we still only had one answer for the entire spectrum of injury to the UCL
  - Some form of reconstruction
- Were we doing too much of an operation for ***SOME*** of the pathology we were seeing?
  - Lower grade injuries, end avulsions

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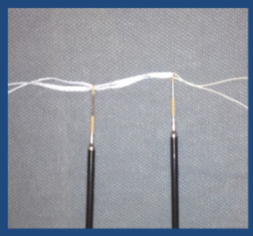
Novel Construct for UCL Repair

- 2 x 3.5 mm corkscrew PEEK anchors
- Collagen-coated Fiber Tape
- Size 0 super-suture



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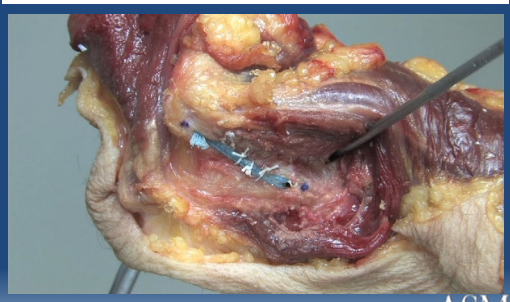
UCL Repair with Augmentation



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Cadaveric Study vs Reconstruction

		Age	Intact Gap	Torn Gap	Proc. Gap
		(yrs)	(mm)	(mm)	(mm)
Reconstruction	Mean ± SD	63 ± 5	0.43 ± 0.19	0.58 ± 0.34	**0.53 ± 0.23**
Repair	Mean ± SD		0.33 ± 0.12	0.51 ± 0.22	**0.35 ± 0.16**
p-value (one-tailed paired t-test)			*0.09*	*0.3*	***0.03***

AJSM 2015, Dugas et al

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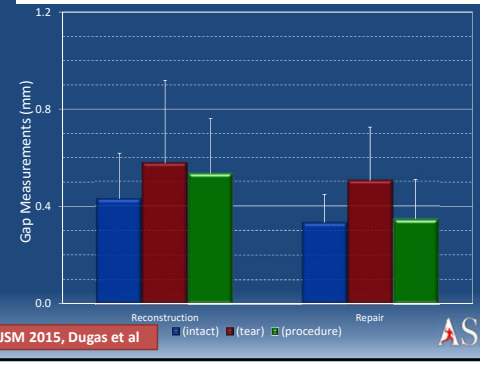
Cyclic Results



AJSM 2015, Dugas et al

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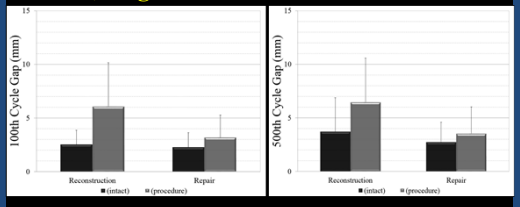
Cyclic Loading Study

- **Jones, Dugas et al AOSSM 2017 Toronto**



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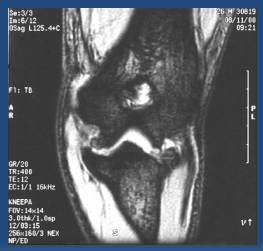
Repair Candidates?



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Current Clinical Study

- Recent success by Savoie with UCL repair
- Basic science showing time-zero success
- First patient underwent UCL repair with internal brace augmentation 8/8/2013
- Total of 128 performed through 12/31/2016
  - Now over 300 total at Andrews SM
    - *Estimated over 1500 done total to date*
      - *Arthrex internal estimate*
      - *Rapidly gaining support and experience*

Demographics

- 17 lost to follow up making 111 available for inclusion in the study (87%)
  - 107 males (96%), 4 females (4%)
  - Ages 13.5-33.2, Mean age 18.25 years
  - ALL dominant arms

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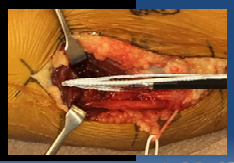
Demographics

- Baseball – 102 (81% pitchers, n=90)
- Softball – 4 (3/4 pitchers)
- Javelin -1
- Football – 4 (4/4 QB's)



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Demographics

- Level of Play at the Time of Injury
  - 74 (67%) High school
  - 31 (28%) Collegiate
  - 1 (.9%) Middle Sch
  - 4 (4%) recreational
  - 1 (.9%) Professional

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KJOC – Reported Norms

- Franz et al, AJSM 2013
- Healthy MLB: Avg 97.1
- Healthy Minor League: Avg 96.8
- Professional Pitchers: Avg 90.9
- History of UE injury: Avg 86.7
- History of UE surgery: Avg 75.4

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Results

- 87% Follow up at minimum 12 months
- All 111 patients attempted to return to play
- 102 of the 111 (92%) were able to RTP at same or higher level
- KJOC score for pts after 12 mos avg 86.23
- KJOC score for pts after 24 mos avg 91.07 (p=.04)
- Throwing athletes rated their elbows as 95.6% normal at 12 months post-op
- Average time to Return to Competition was 6.68 months post surgery

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Results - UNT

- 53/111 had UNT, 55 left in-situ
  - 3 had previous UNT
- Avg 1 yr KJOC 86.14 with UNT
- Avg 1 yr KJOC 89.13 with no UNT (p=.3)

- I try to leave the nerve in place if they have no pre-surgical symptoms and the nerve is stable at the conclusion of the case.

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Results – Tear Characteristics

- Proximal (n=55): KJOC = 88.15
- Distal (n=53): KJOC = 87.13 (p=0.7)
  - 4 tears with both proximal and distal components avg KJOC = 86.88, not enough n to compare.
- Partial tear (n=63): KJOC = 88.83
- Complete Tear (n=43) KJOC = 86.27 (p=0.4)

- No difference in location or extent of injury

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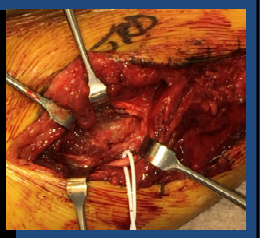
Results - Complications

- No known major complications to date
- 5 reoperations
  - to remove retained subcuticular stitch
    - Full return to HS baseball at 10 months post-op.
  - To remove heterotopic bone
    - Full return to NCAA baseball at 10 months post-op, 2nd excision of HO at 16 months
  - 2 To perform UNT
    - 8 mos after UCL repair
    - Both RTP at 4 mos post UNT
  - 1 to perform revision UNT for nerve instability after UNT
    - RTP at 4 mos post revision UNT
- All RTP



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Complications: Failure

- 1 high school pitcher who underwent UCL repair with IB after his 9th grade season, played/pitched 10th, 11th, and 12th grade seasons and re-tore his UCL and the IB in April of his senior year.
  - Original tear was distal
  - Later tear was proximal with complete UCL and IB disruption at ME origin
- Declined revision surgery and discontinued throwing activities after high school.
  - Reports no elbow complaints at most recent follow up.

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Results – Post-op Course

- Patients achieved full ROM by 6-8 weeks post surgery in all cases
- Plyometric exercises initiated after wk 6 when ROM is FULL.
- Throwing program initiated after 4 weeks of plyometrics (avg beginning of week 11)
- RTP average WEEK 8 after surgery in baseball
  - Just over 6 months.

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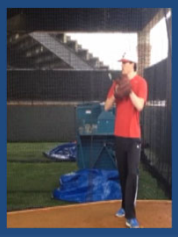
Results - MJ

- Alpha patient MJ
  - 18 yo HS senior PO
  - Injury 6/2013, rest 8 weeks
    - Pain w throwing
    - Repair, PRP, or quit?
  - Surgery 8/8/2013
  - Video taken 1/11/2014



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Limitations

- Largely high school and collegiate athletes in this group
  - First MLB pitcher done 6/20/16 with this technique
    - Returned to competition 3/2017, MLB 5/2017
  - Total of 10 professional baseball players to date
  - NCAA pitcher pitched 2 games in 2016 CWS (TCU)
- No control group
  - Relative to known experience with UCL-recon

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Other Results

- 8 Gymnasts and 12 Cheerleaders have all returned to competition at 4-5 months
- Others:
  - wrestlers who required surgery due to lateral sided injuries resulting from dislocations
  - tennis players
  - volleyball players

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Other Results - Revisions

- I have revised 5 prior UCL reconstructions using this technique.
  - 4/5 had modified Jobe, 1/5 had docking
  - ALL torn at ME origin of UCL
  - – Used 4.5 mm anchor in ME for all
- 3 have RTP at same or higher level
  - Other 2 are less than 6 months post-op
    - – Have seen 4 patients regarding revision in the last 2 months
  - Increase in interest

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Thoughts

- As with other ligamentous injuries in the body, end-avulsions of the UCL can be repaired back to bone.
  - – Partial thickness tears can be augmented
- Addition of ultra strong biologic-enhanced tape and modern anchor technology may provide protection to the repair while healing, and a backstop over time after healing
- NOT a ligament replacement

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Thoughts

- May be a better option for revision than reconstruction
  - Large mass of tissue to repair to ME
- Don't know if tape is structural or simply a scaffold for healing
  - It is never the primary restraint to valgus stress
- Need for UNT post repair?
  - – Not a previous problem for reconstructions
    - All were transposed prior to repair technique

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Thoughts - Revision

- People have asked about my opinion of revising repair with IB?
  - Less bone loss
    - Plastic anchors, no soft tissue in tunnels
      - » Should have good bone stock to work with
  - Creating tunnels for reconstruction
  - Anticipate easier revision
    - Improved outcomes of revision to reconstruction?
      - » No data YET!

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Thoughts

- Cautious optimism in patients with partial thickness injuries and end-avulsions.
- Not likely to use this technique in those who have attritional ruptures and poor quality tissue in the native UCL
  - Tissue deficiency demands more collagen
  - Have recently done 2 of these with time issues necessitating a shorter recovery
    - Stay tuned on this one… not expecting much.
- Now moving into higher levels of sports, outcomes to follow

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Thank You

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