THE MANAGEMENT of SLAP & BICEPS TENDON INJURIES in the OVERHEAD ATHLETE

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... a need to repair!
- clinical evaluation broadened
- surgical techniques evolved
- early reports suggested G/E results
(Yoneda, 1991; Savioe, 1993; Pagnani, 1995;
Snyder, 2003; Cole, 2010; Brox, 2012)

Look more closely at existing data...
- Small study populations
- Heterogeneous groups
- Inconsistent follow up
- Minimal assessment of Return to Pre-injury Level of Play

More recent data is less optimistic...
- Persistent pain and stiffness
  (Weber, 2007; Franceschi, 2008)
- Difficulty returning to preinjury level
  (Cohen, 2012)
- Recurrence of SLAP tear
  (Andrews, 2011; Kibler, 2012)

Less optimistic results due to...
- Diagnostic Uncertainty
  Is it what we think?
- Equivocal Indications
  Should we fix it?
- Early Surgical Techniques
  How do we fix it?
- Narrow Postop Rehab
  How do we rehab it?
- Imprecise Scoring Assessment
  How do we determine success?

SLAP Tear in the Overhead Athlete

IS IT WHAT WE THINK?
... Diagnostic Uncertainty
Physical Exam - “SLAP” Tests

- Clunk Test (Andrews)
- Resisted Supination Ext Rot Test (Andrews)
- Crank Test (Liu)
- Biceps Load Test I and II (Kim)
- Anterior Slide Test (Kibler)
- Mayo Shear Test (O’Driscoll)
- Active Compression Test (O’Brien)
- Relocation Test (Eczer)
- Forced Shoulder Abd and Elbow Flex (Nakagawa)
- Modified Dynamic Labral Shear Test (Kibler)

*No single test or combination of tests reliably predicts a SLAP*
McFarland, AJSM, 2002; Stetson, AJSM, 2002; Snyder, AJSM 2003; Kuhn, 2003; Parentis, AJSM, 2006

Imaging – MR

- With or without enhancement?
- Asymptomatic changes exist in the superior labrum with age and in certain populations like overhead athletes
- Does not precisely define pathology

SLAP Tear in the Overhead Athlete

SLAP Tears: Imaging Pearls

- Contrast undercutting the superior labrum at and/or posterior to the biceps root >2mm
- Detachment of superior labrum from glenoid
- Irregular borders of sublabral recess anterior to biceps anchor
- Peri-labral cyst formation

SLAP Tears: Arthroscopy Pearls

Need to Assess:

- Labral-Glenoid interface
- Tissue quality
- Presence of exposed non-articular glenoid
- Mobility of labrum

Inter and Intraobserver Variability in Diagnosis and Treatment of SLAP Tears

73 EXPERT surgeons queried with video clips on diagnosis and proposed treatment of SLAP:

- Normal labrum – 66.7% correct
- Type I – 60.3% correct
- Type II – 51.9% correct
- Type III – 23.3% correct
- Type IV – 60.3% correct

IS IT WHAT WE THINK?

... Diagnostic evaluation of SLAP tears may often be ambiguous
**Should We Fix It?**

-. Equivocal Indications

- Biceps attachment site
- Deepens glenoid
- Distributes contact pressure between humerus & glenoid
  - Washer Effect
- Attachment site for glenohumeral ligaments & capsule
- Pressure sensor for proprioception

Harryman, 1992
Pagnani, 1995
Lee, 2005
Veeser, 2007
Lee, 2008
Kibler, 2011

**Predictable Series of Events in Throwers**

- Progressive Osseous changes
- Scapular and Cuff weakness
- Post. Soft Tissue contracture
- Post-sup. Instability in ABD and EXT ROT.
- Peel-back mechanism occurs
- SLAP, Biceps & Post-Sup Cuff Injury occur

General population is not routinely exposed to this “cascade of events” ... but throwers are!

**Nonoperative Treatment is an appropriate option . . .**

Edwards, Ahmad, Levine et al AJSM, 2010
Fedoriw, Ramkumar, Lintner et al AJSM, 2014

**Nonoperative Treatment of SLAP Tears**

- 39 patients with clinically documented SLAP
- Patient-derived Validated Scores: SF-36, VAS, ASES, SST, EuroQol
- Nonoperative Pt Group (19 pts) –
  - All with improvements in pain, function and quality of life
  - Return to Play: 71% overall, 65% of overhead athletes

“A trial of nonoperative treatment should be considered in patients with a SLAP tear ”

Edwards, Ahmad, Levine et al AJSM, 2010

**Return to Play After Treatment of SLAP Tears in Pro Baseball Players**

- 68 players with clinically documented SLAP
- “Return to Play” (RTP) vs. “Return to Prior Performance” (RPP)
- 21 pitchers successful nonop: 40% RTP, 22% RPP
- 27 pitchers required operative tx: 48% RTP, 7% RPP

Fedoriw, Ramkumar, Lintner et al AJSM, 2014
Indications for operative treatment:
- overhead athlete
- persistent symptoms
- consistent exam
- consistent imaging
- failure of nonop tx

SHOULD WE FIX IT?
...Equivocal Indications
...Asymptomatic?
...Symptomatic, Rehabable?
...Symptomatic, Surgical?

HOW DO WE FIX THAT?
...Early operative techniques may have been too constraining

General Principles of Surgical Treatment
- Arthroscopic Assessment
- Debride vs Repair
- Implant Selection
- Arthroscopic Approach
- Implant Location
- Concomitant Pathology

Arthroscopic Evaluation
Superior Labrum
- Meniscoid (Snyder, 1998)
- Labral-Articular Interface (Huber, 1997)
- Mobile Superior Labrum (Davidson, 2004)
- “Peel-back” (Burkhart, 1998; Andrews, 2004)
Debride vs Repair

**Repair if . . .**
- Good quality tissue
- Hemorrhage/granulation tissue at interface
- Exposed non-articular glenoid
- Lift off >3-5mm
- “Peel-back” in overhead athlete

**IMPLANT SELECTION**
- Material (metallic vs bioabsorbable vs biocomposite)
- Load to Failure
- Fatigue Properties
- Creep of Bioabsorbables
- Incidence of Inflammatory Response
- Size of Drill Hole
- Ease of Insertion
- Ease of Suture Sliding
- Suture Type (braided vs enhanced; permanent vs absorbable)

**ARTHROSCOPIC APPROACH**
Arthroscopic fixation of SLAP Lesions through the Mid-Lateral Trans-Muscular Portal: An Anatomic Study
Ciccotti, Kuri, Leland et al, Arthroscopy, 2010

**IMPLANT LOCATION**
DiRaimondo et al, AJSM, 2004
Morgan et al, Arthroscopy, 2008
Yoo et al, JSES, 2008

**CONCOMITANT PATHOLOGY**
- Snyder – 43% with biceps and rotator cuff tearing
  - 15% with instability
- Maffet – 48% with biceps and rotator cuff tearing
  - 20% with instability
- Pagnani – 18% with biceps and rotator cuff tearing

. . . **Especially the biceps!**

**Biceps Injury in the Overhead Athlete**
Clinical Utility of Traditional and New Tests in the Diagnosis of Biceps Tendon Injuries and SLAP Lesions

- 325 consecutive patients with shoulder pain underwent standardized clinical evaluation (6 traditional and 2 new tests)
- Clinical exam correlated with surgical findings
- Sensitivity, specificity, accuracy, +/- predictive value, and +/- likelihood ratio were calculated

Kibler, Sciascia, Hester et al., 2009

Superior Labrum – Modified DLS

Modified DLS Test was most accurate (.84) and highest likelihood ratio (31.57)

Modified DLS & O’Brien’s together provided best prediction

Kibler, Sciascia, Hester et al., 2009

Biceps – Upper Cut

Upper Cut Test was most accurate (.877) and highest likelihood ratio (3.38)

Upper Cut & Speed’s Test together high clinical prediction

Kibler, Sciascia, Hester et al., 2009

Operative Treatment Technique Options

- Biceps Debridement
- Biceps Tenotomy
- Biceps Tenodesis (Arthroscopic/Open)
- Intra-artic Soft Tissue (UPitt)
- Supra-Pect
- Sub-Pect
Can the Biceps/Superior Labrum be torn TOO much to repair? ... should we tenodese? ... for just failed SLAP Repair or as primary treatment for SLAP Tear? (Walch, 2010; Hawkins, 2011; Romeo, 2014)

SLAP Repair + Biceps Debridement
SLAP Repair + Biceps Tenodesis
SLAP Repair + Biceps Tenotomy
Biceps Tenodesis/Tenotomy Alone (?Primary SLAP vs. Failed SLAP Repair)

General Principles of Operative Treatment
- Assess superior labral tear
- Assess biceps tendon
- Tenodese biceps
  - Variety of Techniques (Subpect)
- +/- Repair SLAP tear

... ? poorer results in throwers with SLAP Repair and Biceps Tenodesis (Erickson, Romeo et al. 2017)

DEBATE CONTINUES
- Type of implants
  - suture vs. knotless
- Number of implants
  - 1 vs. 2 vs. 3/more
- Location of implants
  - ant + post vs. only post to biceps
- Suture type
  - absorbable/nonabsorbable/enhanced
- Suture placement
  - simple vs. mattress
- Concomitant Pathology ... especially the biceps method of treatment
  ...there’s no final word yet!

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HOW DO WE FIX THAT?
... operative techniques are more precise ... but the SLAP vs. Biceps debate continues

SLAP Tear in the Overhead Athlete

SLAP Tear in the Overhead Athlete

HOW DO WE REHAB IT POSTOP?
... Previously, narrow postop rehab focused primarily on glenohumeral joint
SCAPULA  
Shoulder ROM

CORE  
Hip and Legs  
...Kinetic Chain...

SLAP Tear in the  
Overhead Athlete

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Kibler et al. AJSM 2003

Treatment of the Throwing  
Shoulder

- Short Toss/Long Toss/  
Mound Programs
  - Tossing – progressive  
from 30' to 180'
  - Mound – fastballs first  
with increasing effort;  
then off-speed pitches
  - Focus on technique  
throughout

Slenker et al. AJSM 2014

Fielding Programs
- Grounders & Fly Balls  
to player
- Full Fielding
- Rehab Starts  
  - 5 inning
  - 7 innings
  - 9 innings
- Return to Play

Slenker et al. AJSM 2014

SLAP Tear in the  
Overhead Athlete

Return to Play After Type II  
SLAP Lesion Repairs in Athletes  
(Sayde, Cohen, Cicotti et al. CORR, 2012)
- Systematic Review – 1950 to 2010
- 506 patients with Type II SLAP Repair
- Minimum 2 yr follow-up
- 83% G/E subjectively
- 63% overhead athletes return to prior level
- Tremendous variation in surgical technique,  
postop rehab and outcome assessment

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Deficiencies in Pitching Biomechanics in  
Baseball Players with History of SLAP Repair  
(Lejghfeld, Fleisig, Cain, Dugas et al. AJSM, 2014)
- 65 pitchers:
  - 33 collegiate and pro after successful SLAP Repair
  - 32 healthy controls
  - 3-D Motion Analysis while throwing fastballs
  - SLAP Repair with less shoulder horizontal adb,  
shoulder ext rot, and forward trunk tilt
- Authors recommend postop rehab focused on  
correcting above noted deficiencies

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**How do we rehabilitate postoperatively?**

Postop rehab should focus on the entire athlete – Kinetic Chain!

**How do we determine success?**

Previously, our postop scoring assessment has been imprecise.

### Results of Arthroscopic Repair of Type II SLAP Lesions in Overhead Athletes

Return to Preinjury Playing Level

- Brian Neuman MD, Brittany Boisvert MD, Brian Reiter MD, Kevin Lawson BS, Michael Ciccotti MD, Steven Cohen MD

- 30 overhead athletes with isolated Type II SLAP
- Avg ASES Score (0-100): 87.4
- Avg KJOC Score (0-100): 77.6
- ASES focuses on ADL’s and may give a falsely elevated success rate
- The KJOC score better examines the demands of elite overhead athletes
- The outcome measures that we use impact our perception of success

**Outcome of Type II SLAP Repairs in Elite Overhead Athletes**

- 23 overhead athletes with Type II SLAP tears
- 57% (13/23) returned to pain-free pre-injury level at final follow-up
- ASES Scoring: 96% G/E
- KJOC Scoring: 52% G/E

**SLAP & Biceps Tear...**

- Electromyographic
- Biomechanical

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**SLAP Tear in the Overhead Athlete**

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**SLAP Tear in the Overhead Athlete**
Postop Restoration of UE Motion & Neuromusc. Control During the Overhand Pitch: Evaluation of Tenodesis & Repair for SLAP Tears

- 18 pitchers:
  - 6 S/P successful SLAP Repair; 5 S/P successful Subpect Biceps Tenodesis; 7 controls
  - Surface EMG & Motion Analysis while pitching
  - No differences in majority of pitching kinematics
  - SLAP Repairs had altered thoracic rotation and lead knee flexion at front foot contact

Role of the Superior Labrum After Biceps Tenodesis in Glenohumeral Stability

- 20 cadaveric shoulders tested for translations:
  - At baseline
  - After creating Ant SLAP(10) and Post SLAP(10)
  - After Biceps Tenodesis (20) and SLAP Repair (20)
  - Biceps Tenodesis showed no significant improvement in stability compared to SLAP Tear
  - SLAP Repair restored Posterior and ABD/Max ER translations, but not Ant translation.
  - Authors recommend biceps tenodesis as possible tx of SLAP Tear, but caution in throwers because of its inability to restore translational stability

Research Data

- Electromyographic
- Biomechanical
- Clinical

Superior Labral Anterior-Posterior (SLAP) Tears in the Military

- PubMed, Embase and MEDLINE database review from 1985 thru 2016
- Increased risk for SLAP tears in military personnel
- In high-demand, military pts under 36yrs, SLAP Repair is supported
Return to Play after Biceps Tenodesis in Major League Baseball Players
Chalmers, Erickson, Verma, Romeo, OJSM 2017
- 17 professional baseball players with SLAP Tears underwent Biceps Tenodesis
- 12 pitchers; 5 position players
- Overall 35% (6/17) Returned to Play
- 80% (4/5) position players RTP
- 16% (2/12) pitchers RTP

HOW DO WE DETERMINE SUCCESS?
... thrower specific scoring allows a more accurate assessment of return to pre-injury play

SLAP & Biceps Injury in the Overhead Athlete

. . . should we leave it alone?
. . . or fix it?
. . . or consider tenodesis?

Fix it if . . .
- Clinically straightforward
- Traumatic/repetitive micro-traumatic history
- Positive exam and imaging
- Clear-cut Indications
- High level overhead/throwing athlete
- Failed nonop tx

Tenodese it if . . .
- Clinically significant biceps tendon symptoms
- Positive biceps tendon findings on exam
- Significant biceps tendon damage on imaging and arthroscopy
- Complex, degenerative superior labral tear
- Failed nonop tx
- Recurrent SLAP Tear in overhead athlete

SLAP Tear in the Overhead Athlete

Leave it alone if . . .
- Clinically ambiguous
- Soft Indications
- Older patient
- Non-athlete
- Non-throwing, recreational athlete
- Some throwing athletes

SLAP Tear in the Overhead Athlete

. . . but this may very well be a small percentage of SLAP tears in throwers!
Optimize results by . . .

- Diagnostic Precision
- Specific Indications
- Nonconstraining Surgical Techniques
- Broad Postop Rehab
- Precise Outcome Assessment

...continued research...

THANK YOU.