SLAP Or Biceps: Repair or Tenodesis?

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Disclosure

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Consulting: Smith and Nephew, Minivasive
Research and educational support: Arthrex, Smith and Nephew, DJO, Ossur, Tornier

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>LOF (shoulders) (FL)</th>
<th>Ave f/u age (yr)</th>
<th>Results (frac. 3G/E; frac. of athletes)</th>
<th>RTP (frac. same level)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>Morgan</td>
<td>4 102 3</td>
<td>1 97% G/E</td>
<td>84% of bb pitchers</td>
<td></td>
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<tr>
<td>2002</td>
<td>Kim</td>
<td>4 34 2.6 26</td>
<td>26 94% satisfactory</td>
<td>22% of 18 OH athletes</td>
<td></td>
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<tr>
<td>2005</td>
<td>Ide</td>
<td>4 40 3.4 24</td>
<td>24 90% G/E</td>
<td>75% of 19bb players</td>
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<tr>
<td>2005</td>
<td>Rhee</td>
<td>4 44 2.8 24</td>
<td>24 86% G/E</td>
<td>76% of athletes</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>Enad</td>
<td>4 27 2.5 32</td>
<td>32 89% G/E</td>
<td>77% of participating</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>Brockmeier</td>
<td>4 47 2.7 36</td>
<td>36 87% G/E</td>
<td>74% of OH athletes</td>
<td>71% of 11 bb players, 4/8 tennis/squash players.</td>
</tr>
<tr>
<td>2009</td>
<td>Neri</td>
<td>3 50 3 25&lt;40 25&gt;40</td>
<td>&gt;80% G/E</td>
<td>No diff in age</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>Boileau</td>
<td>3 10 2.9 37</td>
<td>37 40% satisfied</td>
<td>20% return with repair vs 87% with tenodesis.</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>Friel</td>
<td>4 48 3.4 33</td>
<td>33 79% G/E</td>
<td>54% of collegiate OH athletes (6/7 bb, only 1/4 tennis/squash players).</td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td>Alpert</td>
<td>3 52 2.3 32</td>
<td>32 88% G/E</td>
<td>88% satisfied</td>
<td></td>
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</tbody>
</table>

2/3 Of Overhead Athletes Return to Sport following SLAP Repair.
SLAP Repair

Outcome of Arthroscopic Repair of Type II SLAP Lesions in Worker`s Compensation Patients

Nikhil N. Varma, MD; Ralph Gartshore, MD; Anthony A. Romeo, MD

21 Patients with Type II SLAP Repair and work related injury

Significant improvement in VAS, SST, SF-36

5/21 (24%) Required Revision Surgery

33% RTW at same Level
47% RTS at Reduced Level
16% Did not return to work

37% Failure Rate

A Prospective Analysis of 179 Type II Superior Labrum Anterior and Posterior Repairs - Outcomes and Factors Associated With Success and Failure

Matthew T. Proctor, MD, MC, UCI, LACMA Family Medicine, MD, MC UCI, DCRM, PLR, LACMA Family Medicine, MD, MC UCI, DCRM, PLR, LACMA Family Medicine, MD, MC UCI, DCRM, PLR

37% Failure (Revision or ASES < 70)

Older AGE > 36 Associated with Failure
Poor Prognostic Factors

- **Social Factors**
  - Age > 40
  - Alcohol use
  - Tobacco use
  - Heavy lifting at Work
- **Preoperative Tests**
  - Pain in Bicipital groove
  - + O’Brien’s Test
  - + Speeds Test
  - + Yergason’s Test

Risk of revision surgery had a significant association with age less than 20 years and throwing activity.

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SLAP Repair Outcomes

Primary Surgery = Unpredictable Outcomes

Revision Better??

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What is a SLAP?

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Anatomy
Vasculature & Neuroanatomy

Mistake
Bad biology and hurts without mechanical instability

Origin of long head biceps

Also means 40% to 60% comes from superior labrum

- 100 shoulders
- 40% to 60% origin from supraglenoid tubercle
- Rest from Labrum

Vangsness, JBJS Br 1994

Pain Generator
Outcomes: SLAP Repair

- Reason? Poor outcome is due to persistent pain
  - Too tight?
  - Loss of normal motion/function of superior labrum?
  - Poor Healing Capacity?
  - Hardware Complications?
  - Wrong Diagnosis?

Retained biceps a pain generator?

Outcomes: SLAP Repair

- Reason? Poor outcome is due to persistent pain
  - Too tight?
  - Loss of normal motion/function of superior labrum?
  - Poor Healing Capacity?
  - Hardware Complications?
  - Correct Diagnosis?

Retained biceps a pain generator?

Biceps tendinitis in chronic rotator cuff tears: A histologic perspective

...the etiology of anterior shoulder pain with macroscopic changes in the biceps tendon is related to the complex interaction of the tendon and surrounding soft tissues, rather than a single entity.
Alternative Treatment Approach

- Instead of fixing the SLAP tear – treat with a biceps tenodesis

Alternative Treatment Approach

- 25 patients treated
- SLAP repair or biceps tenodesis
- SLAP repair (10 patients)
  - 60% unsatisfied
- Biceps Tenodesis (15 patients)
  - 93% satisfied
  - 87% returning to recreational athletics without symptoms

Applicable to the Overhead Athlete?

- Biceps Tenodesis Group
  - Average Age: 52 (28-64)
  - 8/15 Overhead Sport
  - 60% Single Event trauma

How Does this Apply to our Athletic Patients?
Retrospective Review

N=15 BT (Average Age 47)
N=10 SLAP Repair (Average Age 31)

No Difference ASES, Patient Satisfaction, Return to Sport (73% vs. 60%)
BT Group had primarily degenerative type tears.

Question: What is the functional role of Biceps?

Comparative anatomy and EMG suggest minimal role for biceps in shoulder activities, BUT Biomechanical data suggest a secondary but possibly important role, at end ROM. (e.g. overhead sports? Instability?)

What is the role of Superior Labrum?

• Little is known about the role a torn superior labrum plays in shoulder stability and function in the presence of a biceps tenodesis
Questions

- Evaluate the contribution of a SLAP tear to glenohumeral (shoulder) stability in the presence of a biceps tenodesis
- Does a SLAP tear need fixation following a biceps tenodesis?

Methods

- Controlled laboratory study: 20 shoulder specimens
- Glenohumeral translation data collected:
  - Intact
  - Experimental Type II SLAP Lesion (10 Posterior Lesions, 10 Anterior Lesions)
  - Biceps Tenodesis
  - Anatomic SLAP Repair
- Translation data compared between 4 testing conditions

Results:

Effect of Experimental SLAP Lesions

Both anterior & posterior Type II SLAP lesions led to significant increases in glenohumeral translation
+ Increased Laxity, not “pseudo-laxity”
Impact of Biceps Tenodesis Following SLAP Lesions

Bicep Tenodesis did not significantly impact glenohumeral translation compared to the lesion state.

Impact of SLAP Repair Following Biceps Tenodesis

- Anterior SLAP: arthroscopic repair does not restore baseline anterior translation stability
- Posterior SLAP: arthroscopic repair restores baseline translation parameters

Results

- Experimental Type II SLAP lesions led to increases in glenohumeral translation
- Biceps tenodesis did not increase translation, and it did not restore baseline glenohumeral translation
- Repair of an anterior Type II SLAP lesion only partially restored abnormal anterior translation
Prior Studies

**Glenohumeral Translations are Only Partially Restored after Repair of a Simulated Type II Superior Labral Lesion**

Andreas Bakhsh, MS, Richard R. O’Brien, MD, Victor Morazan, MD, Wesley C. Anderson, MD

Significant increase in anterior, inferior translation after simulated Type II SLAP lesion. No change in posterior.

Anterior translation only partially restored with repair using two Suretac devices.

Biomechanical analysis of isolated type II SLAP lesions and repair

Kola I, Yonemoto, MD, Tawoski, MD, James F. Bolognese, MD, Michael J. Henss, MD, Michelle H. Cost, MD, and Robert J. Jee, MD, Los Angeles, Long Beach, and Irvine, CA

Significant increase of anterior-posterior translation associated with creation of a Type II SLAP lesion.

Translation restored with two anchor repair (one anterior, one posterior)

Discussion

- Findings support the concept of capsular pseudolaxity associated with Type II SLAP lesions

Type II SLAP Lesions: Their Symptoms and Their Relationship to Superior Inability and Rotator Cuff Tears

Craig D. Harris, MD, Joseph S. Jost, MD, Harrison Flanigan, MD, and Mario Calvaneo, MD

Diagnosis and Treatment of Shoulder Injuries in the Throwing Athlete: The Role of Thermal-Assisted Capsular Strikings

James P. Holmes, MD

- Improved Repair Techniques?
- Tenodesis + SLAP
- When and how can we re-tension the superior glenohumeral ligament and the anterior capsule

Discussion

- The lack of a negative effect of biceps tenodesis on glenohumeral stability

  - Lends it use as part of the treatment armamentarium in managing SLAP lesions
    - Supporting the findings reported by Boileau et al

- Primary repair is the first line treatment but for cases of persistent pain following SLAP repair: biceps tenodesis may be a useful revision option
  - Recreational athletes
  - Caution with elite overhead athletes
    - Inability to restore normal translation stability
What About In Vivo?

The Long Head of the Biceps Tendon Has Minimal Effect on In Vivo Glenohumeral Kinematics
A Biplane Fluoroscopy Study

Giphart, Elser, Dewing, Torry, Millett

Upper Extremity Motion In The Overhand Pitch: Repair or Tenodesis?

Reconstructive Restoration of Upper Extremity Motion and Neuromuscular Control During the Overhead Pitch: Evaluation of Tenodesis and Repair for Superior Labral Anterior-Posterior Tears
Rush University Medical Center
Chicago, IL
Demographics

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Biceps Tenodesis</th>
<th>SLAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>7</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Age</td>
<td>21.8</td>
<td>23</td>
<td>25.5</td>
</tr>
<tr>
<td>BMI</td>
<td>25.9</td>
<td>29.7</td>
<td>31.5</td>
</tr>
<tr>
<td>Hand dominance</td>
<td>100% R</td>
<td>50/50 R/L</td>
<td>50/50 R/L</td>
</tr>
<tr>
<td>Level of play</td>
<td>6 College, 1 semi-pro</td>
<td>5 College, 1 high school</td>
<td></td>
</tr>
<tr>
<td># games/season</td>
<td>14.5</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Hours per week spent pitching</td>
<td>6.25</td>
<td>6.5</td>
<td>6.5</td>
</tr>
</tbody>
</table>

Pitch phase

Surface EMG

Biceps
- Long head
- Short head

Deltoid

Infraspinatus

Long head of biceps EMG:
No Difference

No Significant Differences

No significant kinematic differences
Conclusions

Both BT and SLAP repair can restore neuromuscular activation patterns.

BT may better restore physiologic biceps activation and normal kinematics.
Should we do Both??

Concomitant subpectoral biceps tenodesis and superior labral repair: a comparison with tenodesis and repair alone for SLAP tears

<table>
<thead>
<tr>
<th>Variable</th>
<th>BT</th>
<th>Repair</th>
<th>BT+R</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent male</td>
<td>61%</td>
<td>72%</td>
<td>80%</td>
<td>0.372</td>
</tr>
<tr>
<td>Percent dominant extremity</td>
<td>100%</td>
<td>60%</td>
<td>60%</td>
<td>0.007</td>
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<tr>
<td>Worker’s Compensation</td>
<td>35%</td>
<td>4%</td>
<td>50%</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Manual Laborers</td>
<td>61%</td>
<td>45%</td>
<td>70%</td>
<td>0.126</td>
</tr>
<tr>
<td>Percent athletes</td>
<td>26%</td>
<td>69%</td>
<td>55%</td>
<td>0.028</td>
</tr>
<tr>
<td>Percent overhead athlete</td>
<td>21%</td>
<td>45%</td>
<td>40%</td>
<td>0.173</td>
</tr>
<tr>
<td>Percent revision</td>
<td>0%</td>
<td>4%</td>
<td>10%</td>
<td>0.254</td>
</tr>
<tr>
<td>Age (years)</td>
<td>49±13</td>
<td>34±13</td>
<td>37±12</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Length of follow-up (years)</td>
<td>2.2±0.9</td>
<td>3.3±0.9</td>
<td>2.9±1.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pre-operative Simple Shoulder Test</td>
<td>6.5±3.9</td>
<td>9.2±1.7</td>
<td>7.8±3.7</td>
<td>0.106</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SLAP type</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>56%</td>
<td>35%</td>
<td>4%</td>
<td>4%</td>
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<tr>
<td></td>
<td>100%</td>
<td>90%</td>
<td>10%</td>
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<table>
<thead>
<tr>
<th>Variable</th>
<th>BT</th>
<th>Repair</th>
<th>BT+R</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Return to pre-operative level of play</td>
<td>67%</td>
<td>65%</td>
<td>78%</td>
<td>0.666</td>
</tr>
<tr>
<td>Return to full duty at work</td>
<td>86%</td>
<td>89%</td>
<td>59%</td>
<td>0.040</td>
</tr>
<tr>
<td>Percent requiring re-operation</td>
<td>4%</td>
<td>24%</td>
<td>21%</td>
<td>0.188</td>
</tr>
<tr>
<td>Post-operative Simple Shoulder Test</td>
<td>9.3±3.7</td>
<td>10.4±2.5</td>
<td>8.6±3.7</td>
<td>0.052</td>
</tr>
</tbody>
</table>

There were no significant differences in rates of return to play, reoperation rate (which was common in the repair and combined groups). Return to work was significantly decreased in the combined group.
The combined BT and repair group had significantly worse ASES scores ($p=0.021$), VAS scores ($p=0.026$), and satisfaction scores ($p=0.001$). All three results remained the same in the non worker’s compensation subgroup.

<table>
<thead>
<tr>
<th>Complications</th>
<th>SLAP Repair (30%)</th>
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</thead>
<tbody>
<tr>
<td>Stiffness</td>
<td>Chondrolysis/Chondral Injury</td>
</tr>
<tr>
<td>Persistent Pain</td>
<td>Nerve Injury</td>
</tr>
</tbody>
</table>

Complication Rate $\rightarrow 2\%$ (7/353)

**Complications:**
- Persistent pain (2)
- Failure of fixation (2)
- Infection (1)
- Musculocutaneous neuropathy (1)
- RSD (1)

Revision

The Efficacy of Biceps Tenodesis in the Treatment of Failed Superior Labral Anterior Posterior Repairs

42 Patient Previously Failed Type II SLAP Repair managed with open sub-pectoral biceps tenodesis

ASES 68 $\rightarrow$ 89
SANE 64 $\rightarrow$ 84
WOSI 65 $\rightarrow$ 81

Statistically Significant Improvement ROM

81% Return to Sports and Active Duty
Answer

For most patients requiring re-operation for failed primary SLAP Repair:

*Biceps Tenodesis*

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Preferred Technique: Sub-Pectoral Tenodesis

- Inter-Muscular Plane
  - Short Head Biceps
  - Pectoralis Major
- Cosmetic Incision
- Eliminates all potential Pathologic Tendon

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Small Retrospective Review (12 Patients)
Mean age 32 (range 19-67)

- ASES 72.5
- Satisfaction Level 6.4
- Return to Work 57%
- Return to Sport 42%
42/46 Active Military with persistent Pain after SLAP Repair

Managed with subpectoral tenodesis (39.2 yrs)

ASES 89
SANE 84
WOSI 81

LHB Tenodesis: The Holy Grail?

MLB Data

Between 2010 and 2013 17 professional baseball players underwent BT
-71% were pitchers
-29% were in the major league
-47% had a history of a prior shoulder surgery
-47% underwent concomitant labral repair

Return to Play:
-Overall RTP: 35%
-RTP for isolated BT: 44% in 0.8±0.5 years
-RTP for biceps tenodesis w/ labral repair: 25%
-Return to professional play was significantly more common among position players than pitchers (17% vs. 80%, p<0.028).

Rush Experience:
Number of SLAP Repairs Over Time

Number of SLAP Repairs

Year


0 10 20 30 40 50 60 70 80 90 100
**Rush Experience:**
Age of SLAP Repair Patients Over Time

- **Practice Patterns: ABOS**
  - % of SLAPs repaired decreased from 69% to 45%
  - Biceps tenodesis increased from 1.9% to 19%
  - SLAP repair with cuff repair decreased from 60% to 15%

**Where Are We In 2016?**

- Suspected SLAP Tear
- Non Operative Management

Elite / Overhead athletes: Primary Repair

Biceps Syndrome: Consider Repair + Tenodesis

Age Over 35: Consider Tenodesis

Revision: Consider a Revision
Midwest Orthopaedics at Rush

Thank You