Arthroscopic Bicep Tenodesis

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I (and/or my co-authors) have something to disclose. Detailed disclosure information is available via: Printed Final Program or AAOS Orthopaedic Disclosure Program on the AAOS website at http://www.aaos.org/disclosure
We learn wisdom from failure much more than success

Samuel Smiles
Proximal Biceps Pathology

Theories of Function

- The Appendix of the Shoulder
  - “An Unimportant Vestigial Structure Unless Something Goes Wrong With It”
  - Lippman, 1943
- Provides a Critical Role in Shoulder Stability
  - Depressor of the Humeral Head
  - Anterior Shoulder Stability
  - Proprioception

Proximal Biceps Pathology Disorders

• Inflammatory
  – Tendonitis
    • Primary
      – Pathology of the Sheath
      – Uncommon
        » Diagnosis of Exclusion
    • Secondary
      – Associated Shoulder Pathology Leads to Tendonitis

• Instability
  – Subscapularis Tear
    • Weight Lifters
  – Hypoplastic Bicipital Groove
  – “Biceps Pulley” Lesions

• Traumatic
  – Acute
  – Repetitive

Physical Examination

• Point Tenderness in the Bicipital Groove
  – Arm in 10° of Internal Rotation
    • 7 mm Below Acromion

• Provactive Tests
  – Speed’s Manuever
    • Resisted Forward Flexion of Arm
  – Yergason’s Test
    • Resisted Supination of Forearm
  – Biceps Instability Test
    • Tendon Migration with Internal and External Rotation
  – Active Compression Test
    • Resisted Forward Flexion at 90° Flexion and 10° Adduction
      – First in Maximal Pronation then in Maximal Supination
  – Gerber’s Lift Off Test
    • Access Subscapularis Integrity
      – Many Subluxing Biceps are Secondary to Subscapularis Tear
  – Subpectoral Biceps Tendon Test
    • Palpate Tendon Below Pectoralis Major with Restricted Internal Rotation

• Slap Exams – all 100 of them

• Cosmetic Deformity
  – Complete Rupture of the Long Head Biceps Tendon
    • Popeye Arm

1. **Biceps Injection**  
   No relief, not likely biceps  
2. **IA injection**  
   a. No relief, could be SLAP  
   b. Relief, could be SLAP or Biceps
Biceps
Making the Diagnosis

Diagnostic accuracy in detecting tears in the proximal biceps tendon using standard nonenhancing shoulder MRI

Open Access Journal of Sports Medicine

Samuel A Dubrow¹
Jonathan J Streit²
Yousef Shishani²
Mark R Robbin³
Reuben Gobezie²

2014

Normal MRI 56%
Abnormal Arthroscopic 90%
Arthroscopic Diagnosis

Arthroscopic Versus Open Comparison of Long Head of Biceps Tendon Visualization and Pathology in Patients Requiring Tenodesis
Brian B. Gilmer, M.D., Ariana M. DeMers, D.O., Dolores Guerrero, M.S., John B. Reid III, M.D., James H. Lubowitz, M.D., and Dan Guttman, M.D.

Effects of Arm Position on Maximizing Intra-Articular Visualization of the Biceps Tendon: A Cadaveric Study
Nathan D. Hart, M.D., S. Raymond Golish, M.D., Ph.D., and Jason L. Dragoo, M.D.

Physical examination tests and imaging studies based on arthroscopic assessment of the long head of biceps tendon are invalid
Robert W. Jordan1,2 · Adnan Saithna1

Visualization of the Extra-Articular Portion of the Long Head of the Biceps Tendon During Intra-Articular Shoulder Arthroscopy
Anthony Festa, M.D., Jesse Allert, M.D., Kimona Issa, M.D., James P. Tasto, M.D., and Jonathan J. Myer, M.D.

Analysis of “Hidden Lesions” of the Extra-articular Biceps After Subpectoral Biceps Tenodesis
Seong Cheol Moon, MD, Nam Su Cho, MD, and Yong Girl Rhee, MD
Investigation performed at the Shoulder & Elbow Clinic, Department of Orthopaedic Surgery, College of Medicine, Kyung Hee University, Seoul, Korea

Underestimates, Misses or Doesn’t Correlate
Who needs biceps surgery?

Pain
“\textit{I just want the pain gone}”

Performance
“I can tolerate the pain except when I do my sport or work, my performance is impaired”

✓ Those who don’t want it anymore

✓ Failed non-operative treatment

✓ Those with concomitant diagnosis already indicated for surgery
  - Instability, RCT esp Subscap, SLAP, DJD
Proximal Biceps Pathology At Arthroscopy

- Irreversible Changes
  - Partial Tearing >25% of Tendon
  - Any Subluxation of the Tendon From Within the Bicipital Groove
  - Any Disruption of the Bicipital Groove
  - Reduction in the Size of the Tendon that is >25% of the Normal Width
- Any Biceps Pathology and Pain in the Context of a Failed Previous Acromioplasty, Slap Repairs, Adhesive Capsulitis, and Painful RCT

Proximal Biceps Pathology
Debridement

• Indications
  – Increased Erythema on Dry Arthroscopy Indicating Biceps Tenosynovitis
  – Partial Tears of the Biceps with < 25% of Tendon Involvement
  – Tenosynovitis or Partial Tears with a Competent Medial Sling Not Demonstrating Medial Subluxation or Frank Dislocation by Physical Exam or MRI

Who should get a tenotomy?

1. Risk for infection
2. Unable to comply with post-op
3. Those with no cosmetic concern
Tenotomy…doesn’t always “work”

Arthroscopic Release of the Long Head of the Biceps Tendon
Functional Outcome and Clinical Results
Anne M. Kelly, MD, Mark C. Drakos,* MD, Stephen Fealy, MD, Samuel A. Taylor, and Stephen J. O’Brien, MD

Patient acceptance of long head of biceps brachii tenotomy
Samuel J. Duff, MBBS(Hons), BSc (Physio)*, Peter T. Campbell, MBBS(Hons), FRACS (Ortho)

Biceps Tenotomy Versus Tenodesis in Active Patients Younger Than 55 Years
Is There a Difference in Strength and Outcomes?
Jamie L. Friedleron,1 MD, Jennifer L. Pfeiffer2 MD, Lucas S. Pyleand3 MD, Christine Bennett,3 MD, Amarnco F. Vida,3 MD, and Eric C. McGarty,3 MD
Investigation performed at CU Sports Medicine, University of Colorado School of Medicine, Boulder, Colorado, USA

Good pain relief but….
35% poor functional result (ASES <70)
19% Cramping/Pain
38% Fatigue

AJSM 2005
JSES 2012
OJSM 2015
Ask you self 2 questions?

- What are the outcomes?
- What are the complications?
Who Wants Level I Evidence?

- Age > 55 y.o.
- Reparable RCT
  - Tenotomy = 77 pts
  - Tenodesis = 74 pts

F/U: 2 years

Zhang et al. KSSTA, 2015
NO DIFFERENCE

NSD Constant
NSD Popeye
NSD Cramping
NSD Flexn Strength
NSD Supn Strength

Faster OR Time
Faster Pain Relief
With
TENOTOMY

NSD Supn Strength

Table 2: Comparison of the clinical results observed in the patients of the tenotomy and the tenodesis groups

<table>
<thead>
<tr>
<th></th>
<th>Tenotomy</th>
<th>Tenodesis</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-constant</td>
<td>95.6 ± 3.0</td>
<td>96.5 ± 2.6</td>
<td>n.s.</td>
</tr>
<tr>
<td>d-constant</td>
<td>52.3 ± 8.1</td>
<td>52.7 ± 8.6</td>
<td>n.s.</td>
</tr>
<tr>
<td>Popeye sign</td>
<td>7</td>
<td>2</td>
<td>n.s.</td>
</tr>
<tr>
<td>Cramps pain</td>
<td>9</td>
<td>5</td>
<td>n.s.</td>
</tr>
<tr>
<td>VAS (2 weeks post-operatively)</td>
<td>3.1 ± 1.8</td>
<td>4.8 ± 1.9</td>
<td>P &lt; 0.001</td>
</tr>
<tr>
<td>VAS (4 weeks post-operatively)</td>
<td>2.0 ± 1.1</td>
<td>2.1 ± 1.6</td>
<td>n.s.</td>
</tr>
<tr>
<td>Time (min)</td>
<td>40.4 ± 4.0</td>
<td>50.4 ± 5.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Flexion strength index</td>
<td>0.9 ± 0.2</td>
<td>0.9 ± 0.2</td>
<td>n.s.</td>
</tr>
<tr>
<td>Supination strength index</td>
<td>0.9 ± 0.2</td>
<td>0.9 ± 0.1</td>
<td>n.s.</td>
</tr>
<tr>
<td>Degree of satisfaction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent or good</td>
<td>65</td>
<td>60</td>
<td>n.s.</td>
</tr>
<tr>
<td>Fair</td>
<td>12</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Poor</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Can You Get The Cosmetics Right?

- Difficult length tension relationship
- ? On-going pain
- ? Weakness
- ? Popeye

Cosmesis: The Modified Tenotomy Reducing The Popeye

- Incidence: ? > 70%
- Tenotomy + labrum
  - ↑ force to failure
  - 9% Popeye
  - MRI → 80% scar into biceps groove

Lee et al. JSES, 2016.
Cho et al. AJSM, 2015.
Zhang et al. KSSTA, 2015.
Does A Biceps Lump Bother People?

- 127 biceps tenotomy
  - 95% pts satisfied
- 34/127 = 27% Lump
- 4/34 = 11% concerned

3% Concerned of Biceps Lump

Duff et al. JSES, 2012.
The Painful Cramping Myth

- Always talked about
- rarely reported

- Revision Subpec BT for previous biceps Sx
- 20/21 pts = prev. BT
- 1/21 pt = prev. tenotomy


TOTAL 7 CASES REPORTED

- Revision Subpec BT for previous biceps Sx

7 CASES of Humerus Fracture By Tenodesis
How do I manage the Biceps

- I leave it alone... a lot!
- Do Not Always need to treat, but...
  - Over the age of 50
  - Thick arm and torso
  - Fast recovery
  - No Cosmetic concerns
  - Some Subscap Tears
  - Difficult revision, Irreparable cuff
Who should get a Tenodesis?

- Everybody else.....
Trends in Biceps Tenodesis

Trends in Biceps Tenodesis

- Arthroscopic Tenodesis
- Open Tenodesis
Where to tenodese?

Soft tissue to cuff “PITT technique”

Arthroscopic within bicipital groove

Arthroscopic/Open Subpectoral
Tenodesis Location Options

- Proximal to groove – incorporate into cuff repair, PIT'T technique
  - Potential for Groove Pain
- In Groove –
  - open sheath fully
    - Like DeQuervains…
      - Impact on Pain??
- Distal to groove
Tenodesis Options

- Soft Tissue
- Bone Tunnels
- Suture Anchors
- Screw Fixation
- Interference Screw
- Button Fixation
- Staples
Biceps Tenodesis: No Consistent Technique

- Multiple tenodesis sites
  - Intra-articular, supra-pec, sub-pec
- Multiple fixation methods
  - Soft tissue, tunnel, anchor, screw
- Multiple rehabilitation protocols
  - No immobilization, early ROM
Proximal vs Distal

Where to Tenodese the Biceps

Proximal or Distal?

David M. Lutton MD, Konrad I. Gruson MD,
Alicia K. Harrison MD, James N. Gladstone MD,
Evan L. Flatow MD

40% Chronic Pain in Proximal Tenodesis

0% in distal tenodesis
Problems with Proximal Fixation

Distribution of the axillary nerve to the subacromial bursa and the area around the long head of the biceps tendon

H. Nasu · A. Nimura · K. Yamaguchi · K. Akita

Anterior branch of axillary n innervates lateral border of LHB and cortex proximally near THL
Problems with Proximal Fixation

Proximal Biceps Tendon
Injuries and Management

Darren J. Friedman, MD,* † John C. Dunn, BA,‡ Laurence D. Higgins, MD,†
and Jon J. P. Warner, MD*

- 188 patients
- Revision
  - Proximal Arthroscopic 36%
  - Proximal Open 12.5%
  - Distal Open 2.7%
  - Proximal Open Sheath Release 0%

Clinical success of biceps tenodesis with and without release of the transverse humeral ligament

Brett Sanders, MDa,* Kyle P. Lavery, BAb, Scott Pennington, MDC, Jon J.P. Warner, MDb
Bone Quality is Relevant

Interference Fixation in the sub pectoral area relies essentially only on cortical purchase.
Why NOT go SupraPec…

• It is very safe!
• There is really nothing there
• Closest trouble is the cephalic vein and that is well medial
• More likely to get nerve issue Sub pec!
• But, there is a learning curve…
• And the little vessel of Visualization
Biceps Groove Lateral Ascending Branch of the Anterior Circumflex

There every time-lateral side of the groove and must cauterize as the groove is opened
Operative Portals

Both 30 and 70 degree scopes utilized

Anterior Accessory Portal: 3 fingers away on 45 degree angle from interval portal

Lateral Portal at "30 yard line"
Surgical Technique

Standard Procedures included:

• Removal of suture material
• Partial intra-articular synovectomy
• Posterosuperior capsular release
• RTC interval release
• Subacromial debridement with revision acromioplasty when needed
• Suprapectoral arthroscopic tenodesis below the groove
• Removal of tenosynovium within groove
Surgical Technique

• Biceps stay suture 1 cm away from labral attachment
Subdeltoid Bursectomy (biceps identification)

Scope through lateral portal
Shaver through anterior accessory portal
Surgical Technique

Deinervate the Biceps

Identify location of Biceps Placement
Surgical Technique

Drill Tunnel

Overream by 0.5 mm to avoid overstuffing tunnel

Place Swivelock

Use cannula to protect biceps

Assistant tensions biceps prior to screw tunnel insertion
Surgical Technique

Place Swivelock

Use cannula to protect biceps

Assistant tensions biceps prior to screw tunnel insertion
Intra-articular Distance

Biceps origin to sheath distance

30 - 42 mm
Outcomes of Arthroscopic Biceps Tenodesis for Treatment of Failed Type II SLAP Repair

- Reviewed surgical outcomes on patients who underwent revision of type II SLAP to arthroscopic biceps tenodesis due to unsuccessful outcome
  - 2010-2014

- N=26, all followed-up for minimum of 2 years
  - Mean age= 37
  - 22 men, 4 women
  - 15 overhead laborers

- Isolated procedure (excluded if concomitant pathology)
Significantly improvement seen in all outcomes measures following arthroscopic tenodesis

- Range of motion improved in all 4 measured planes:
  - Forward flexion
  - Abduction
  - Internal rotation
  - External rotation
- Patients with lower preoperative ROM showed significantly greater ROM improvement
The UMass Experience

- 1.8 year follow-up mean improvements
- SST
  - 6.1 to 9.2
- VAS
  - 7.45 to 2.45
- ASES
  - 41.66 to 88.3
- SF-12
  - 45.5 to 53.8
The UMass Experience

- 85% of patients previously unable to work were able to return
  - Average return = 6 mos post-op

- 2 complications:
  - Os acromiale fracture requiring repair
  - Conversion to total shoulder arthroplasty 30 months post-op due to chondrolysis
Outcomes

Arthroscopic Suprapectoral and Open Subpectoral Biceps Tenodesis

A Comparison of Minimum 2-Year Clinical Outcomes

Brian C. Werner,* MD, Cody L. Evans,* MD, Russel E. Holzgrefe,* BS, BBA, Jeffrey M. Tuman,* MD, Joseph M. Hart,* PhD, Eric W. Carson,* MD, David R. Diduch,* MD, Mark D. Miller,* MD, and Stephen F. Brockmeier,* MD

Investigation performed at the University of Virginia Health System, Charlottesville, Virginia, USA

2007-2012
32 arthroscopic, 50 open
Isolated SLAP or biceps pathology
Any concomitant pathology was criteria for exclusion
Minimum 2-year follow-up
Outcomes

- Arthroscopic Suprapectoral and Open Subpectoral biceps tenodesis both yield excellent clinical and functional results for management of isolated superior labral or long head of biceps pathology.

- No significant differences in clinical outcomes.

- No range of motion or strength discrepancies noted at minimum 2 year follow-up.
REALLY need an implant?
Arthroscopic Biceps Intraosseous Tenodesis (ABIT)

- 2 mm guide holes (2) drilled 1.5cm distal to tenodesis hole for shuttling and tying of suture limbs over the tendon for final fixation
- Method as described by Sampatacos and Getelman
ABIT Video
SubPec Biceps Tenodesis

How do I do it?
Portals

Left Shoulder

Tenodesis Portal

Mid-Lateral Portal
SubPec Portal

Axillary Fold
Incision

Pec Major
(inferior border)
Release All Vincucale
Biceps in the Groove
Biceps in the Groove
Switching Stick through SubPec Portal

- Pec Tendon
- Humerus
Biceps Musculotendinous Junction
Proper Biceps Tension
Guide Pin for Drill
Drill 7mm Tunnel
7mm Tunnel
Spinal Needle in to Distal Hole
Retrieve Chia PercPasser through the cannula
Pass sutures and biceps in to the tunnel
Final Tenodesis
Challenges: Learning Curve

- **Tendon Sizing**
  - Can be variable
  - Remove all investing tissue, synovitis

- **Establishing accurate tension**
  - Possible to under and over tension

- **Tendon Wrapping**
  - Secure tendon with suture
  - Upsize hole (0.5mm)
Complications

• Tenodesis ~ 2-3%
  – Groove pain
  – Hematoma
  – Infection
  – Neurologic injury
  – Humeral fracture
  – RSD
  – Vascular injury

• Tenotomy
  – Deformity
  – Cramping
  – Supination fatigue

Tenotomy vs Tenodesis

- Tenotomy Really Fast
- Certainly Cheap and EASY in OR
- TRUE Informed Consent in the OFFICE---PAINFUL
  - Have to Explain the Risk and Incidence of Weakness, Cramping and of course Popeye Deformity
  - Most ask …Can Popeye can be prevented?
  - Yet level 1 evidence in the right patient has success !!!
Tenotomy vs Tenodesis

• In Surgery
• Can be Technically demanding and has a learning curve for sure for Scope SupraPec or SubPec
• May add 20-30 minutes to the case over the Tenotomy
• Much RATHER add minutes to OR case vs 20 min in Clinic talking about it!!!
Do What is Right for the Patient
Thank You