Overview

• Epidemiology
• Biceps Anatomy
• Mechanism of Injury
• Treatment Implications
• Complications

Epidemiology

• Rare Incidence
• Men 30 to 60 years of age
  – Dominant extremity
  – Some Bilaterality (Len Ruby)
  – Women age 70??
• Risk Factors
  – Anabolic steroid use
  – Hypovascularity of tendon
  – 7.5 X risk in smokers
  – Intrinsic degeneration
  – Mechanical impingement

Biceps Tendon Anatomy

• Radial tuberosity acts as a cam, increasing the biceps moment arm.
Mechanism of Injury

- Unexpected extension force to flexed elbow with a reactive eccentric contraction of biceps

- Underlying factors
  - Hypovascularity
  - Intrinsic degeneration
  - Mechanical impingement

Hypovascularity at Zone 2

50% Decrease in Radial-Ulnar Space with Pronation
Nonoperative outcomes

- Complete tears
  - Loss of strength:
    - 40-50% supination
    - 20% flexion
    - 15% grip strength
  - Loss of endurance
- Partial tears
  - Chronic tendinosis: extended conservative care ~ 1 year
  - Partial traumatic tears
    - If an event, surgery!!

Distal Biceps Tendinosis: Evidence-Based Review

- Micah C. Hobbs, DO, Joe Koch, BS, H. Brent Bamberger, DO
- JHS 2009 Volume 34, Issue 6, Pages 1124–1126
- We believe that acute traumatic detachment can be partial. When a patient presents with acute symptoms after an injury, without pre-existing symptoms of elbow pain, and the MRI scan demonstrates partial detachment of the distal biceps tendon without substantial tendinosis, we favor a treatment approach comparable with that for acute complete ruptures.

Evolution of Operative Treatment

- Tenodesis
- Boyd and Anderson 1961 Two Incision
  - Radioulnar Synosis Concern
  - Muscle Split
- Single Incision
- Arthroscopic
**Singe vs. Two-Incision Technique**

- Point of controversy for quite some time
- Timeline
  - Boyd and Anderson developed 2 incision technique due to nerve injuries with one incision approach
  - Later modified by Failla with muscle splitting approach

**Two Incision Bone Tunnel Repair**

- Best visualization of tendon footprint
- Violates interosseus membrane
  - Increased risk of HO ???
  - Avoid violation of ulnar periosteum
- Reduced risk for nerve injury

**Single Incision Fixation**

- Suture Anchor
- Interference Screw
- Cortical Button
  - with/without interference screw
- Reported increase risk for LABC and PIN neuropraxia
- No violation of interosseus membrane
Anatomic vs. Non-Anatomic Repair

- Could be considered complication if taking into account weakness
- Relevant?
- Possibly better supination strength

- Cadaveric biomechanical study
- Comparison of moment arm and range of motion in pronation/supination.
- Reattachment in Anterior/Central position
  - Reduced supination ROM
  - Reduced torque at 60 deg supination
  - Relative to native insertion/anatomic repair
Operative Treatment

• A = anatomic
• ACA = anterior/central

Anatomic vs. Non-Anatomic Repair

• Make sure to maximally supinate
• Or....

JHS 2012
Reviewed 198 patients
72 (36%) complications
> complications with repair >28 days from injury
  Minor:
  • LANC paresthesia 26%
  • Radial sensory paresthesia 6%
  • Superficial infection 2%
  Major:
  • PIN injury 4%
  • Symptomatic HO 3%
  • Re-rupture 2%
  • 6 additional surgeries
Complications

• 10-40% of time complications occur
  - Nerve Injury
    • Palsies
    • Neurapraxias
    • Heterotopic Ossification
    • Synostosis
    • Rerupture
    • Tearing
    • Vascular

6% of Time Require Reoperation

Nerve Injuries

• Lateral Antebrachial Cutaneous
  - Encountered regardless approach but more common with anterior/single incision
  - 20 to 25% Cases
  - Painful neuroma or paresthesias
  - Increased Complications if greater than 3 weeks
    • Kelly, JBU 2000

Nerve Injuries

• Posterior Interosseous Nerve
  - Wraps around proximal radius 1.0-1.5 cm distal to midpoint of tuberosity
  - 5% of Cases, Most Neurapraxia
  - Supination Moves Nerve from Field
  - Drilling in ulnar direction preferred
• 30 degree ulnar drilling technique resulted in greater distance from PIN
• Confirmed with other studies
  — Sakuda et al Arthroscopy 2008
  — Lo et al Arthroscopy 2011

An Assessment of Nerve Proximity During Distal Biceps Brachii Tendon Reattachment: A Cadaveric Study
Matthew Daggett, DO, MBA, Taylor Brown, MS, Barth Wright, PhD, Anthony Olinger, PhD, Ganesh Thiagarajan, PhD, James Harris, MS, Timothy Roberts, DO

Guide wire angled 45 deg vs previous studies of 30 deg
• 9 of 280 patients with PIN Palsy (3.2%)
• Average Time to Resolution 86 days (Range 41-145 days)

NERVE INJURIES

• Superficial Branch of Radial Nerve
  – 5%
  – Neurapraxia
  – Typically due to excessive lateral retraction

Superficial Radial Nerve
Heterotopic Ossification

- Distal biceps repairs are predisposed to this condition
- Asymptomatic HO reported in 10-25% cases
- May result in radioulnar synostosis

Clinically Relevant

Related Distal Biceps Repairs with Heterotopic Ossification Following the Endobutton Repair

- Kelly et al JBJS 2000
- Sotereanos et al. JSES 2004

Increased with 2 Incisions

Bottom Line: Rates of Radialulnar Synostosis are rare and can occur in both types of Repair Keener et al JSES 2011

- 104 patients received medication with synostosis rate 0.96%
- 8 patients did not receive medication with synostosis rate of 37%

Underpowered, Retrospective but...may be of benefit
Heterotopic Ossification

• Tips and Tricks For Prevention
  – Hemostasis
  – Clearing of Bone Debris
  – NSAIDs

Any approach may cause HO, the issue becomes radioulnar synostosis
May need to reattach tendon if bone excised

Rerupture

• Rare occurrence, 1.2%-4.4%
• Typically occurs within 3 weeks
• Chronic Repairs >60 degrees of flexion at musculotendinous junction
• Does technique matter?
  – Bottom Line: Avoidance of Eccentric Load in Early Post-op Period

Biomechanical Evaluation of 4 Techniques of Distal Biceps Brachii Tendon Repair

• Cadaveric study
• Comparison of load to failure
  – Bone tunnel (310N)
  – Suture anchor (381N)
  – Interference screw (232N)
  – Cortical button (440N)

• Clinical outcomes show no difference
RERUPTURE

• Revision
  – Increased Infection
  – HO
  – Repair Failure
  – NV Injury

Vascular Injuries

• More likely in chronic injuries
• Radial recurrent vessels
• Case Reports of Brachial Artery Injury

STIFFNESS

• 4% of time
• Limit post-operative mobilization to no more than 3 weeks
• Rotation concerns tend to be more common
• Does fixing in extreme flexion lead to increased stiffness?
No increased incidence of stiffness or flexion contracture

Timing
- Acute: Complication Rate 29%
- Chronic: Complication Rate 63%

CONCLUSIONS:
There were no significant differences in outcomes between the single and double-incision distal biceps repair techniques other than a 10% advantage in final flexion strength with the latter. Most complications were minor, with a significantly greater prevalence in the single-incision group.
Complications of Distal Biceps Tendon Repair
A Meta-analysis of Single-Incision Versus Double-Incision Surgical Technique

Nino H. Arora, MD; Alan Yip, BS; T. Sean Lynch, MD; Ronak M. Patel, MD; Douglas L. Curely, MD; Mark S. Schekerewa, MD; and Morgan H. Jones, MD, MPhil investigation performed at the Cleveland Clinic, Cleveland, Ohio, USA

- Overall, greater rates of complications in single incision group (28.3% vs. 20.9%)
  - Nerve palsies/neurapraxia
  - Rerupture rates
  - Most studies involved suture anchors
- LABC neurapraxia most common in single incision group
- HO most common in double incision group
- When comparing double-incision and single-incision repairs, there was a significantly higher rate of posterior interosseous nerve palsy (3.4% vs 0.8%, \( P = 0.01 \)), heterotopic bone formation (7.6% vs 2.7%, \( P = 0.004 \)), and reoperation (8.1% vs 2.1%, \( P < 0.001 \)).
- Most common nerve complication was LABC in single incision
- The overall rate of tendon rerupture was 1.9% (single incision, 1.6%; double incision, 2.8%)
- There were no significant differences in rates of motor neurapraxia, infection, rerupture, and reoperation with regard to surgeon's years of practice, fellowship training, or case volume.

Summary

- Repair of distal biceps can lead to excellent clinical outcomes in active patients
- Complications can and do occur. More common in the chronic setting
- Patients should be counseled about these potential complications
- Tips/Techniques to Lessen Complications
THANK YOU