1. **Tendinopathies: Current Concepts in Surgical Treatment**
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   July 21, 2017

2. **Tendinosis**
   - Defined as non-inflammatory intratendinous collagen degeneration
   - Histology - angiofibroblastic hyperplasia includes hypertrophic fibroblasts, vascular hyperplasia, disorganized collagen
   - Areas of focal necrosis, calcification
   - No acute inflammatory cells

3. **Tendinosis vs Tendinitis**
   - "Tendinosis“ implies intrinsic degenerative condition, determines therapeutic goals, sets reasonable outcome expectations
   - "Tendinitis“ implies an inflammatory condition, is misleading, allows misguided treatment, unreasonable expectations

4. **Corticosteroid Injections**
   - Mainstay of nonsurgical treatment
   - Mechanism of action is unknown since these are not inflammatory conditions
   - In most studies, injection follow-up is short
   - How many injections? Data suggest two injections, then surgery most cost effective

5. **Supraspinatus Tendinosis - Anatomy**
   - Originates on suprascapular fossa
   - Inserts on anterior facet, greater tuberosity
   - Insertional footprint
     - 12 mm (medial-lateral)
     - 25 mm (anterior-posterior)
     - 3.5 mm is superior GHJ capsule

6. **Pathogenesis**
   - Intrinsic factors
     - Hypovascular zone
     - Age-related microtrauma
   - Extrinsic factors
     - Acromial morphology (Bigliani)
     - Internal impingement
     - Glenohumeral joint instability
     - Sports-related trauma, overuse

7. **Athletes At-Risk**
   - Overhead athletes
     - Baseball pitchers
     - Tennis players
Volleyball players
Softball pitchers
Weight-lifters

8 Partial-Thickness Cuff Tears
- Location
  - Articular, bursal, interstitial
  - Tendon(s) involved
- Grade of tear (Ellman, CORR 1990)
  - I - < 3 mm (<25%)
  - II - 3-6 mm (25-50%)
  - III - > 6 mm (>50%)

9 Natural History
- No evidence of active healing
- Expect tear size to increase over time
- Lo, AAOS 2012 - 37 pts followed 4.4 yrs
  - Grade I or II - 14% increased in size
  - Grade III - 55% increased in size

10 Physical Findings
- Painful arc of motion
- + impingement signs (Neer, Hawkins)
- Pain (+/- weakness) on manual resistive muscle testing (shoulder ER, abduction)
- + impingement test (pain relief with subacromial injection)

11 Basis for Surgical Indication
- Patient factors
  - Age, activity level
  - Occupation, sports participation
- Clinical factors
  - Pain severity, history of trauma
  - Weakness, response to conservative therapy
- Pathologic factors (found on MR-arthrogram)
  - Location of tear
  - Grade of tear

12 Surgical Treatment Options
- Grade I or II (<50% thickness tear)
  - Arthroscopic debridement alone
  - Debridement and acromioplasty
- Grade III (>50% thickness tear)
  - Arthroscopic or open repair
  - Take-down or trans-tendinous repair

13 Proximal Biceps Tendinosis - LHB Anatomy
• Originates at supraglenoid tubercle
• Intra-articular, extrasynovial portion, 35 mm
• LHB stabilizers form biceps pulley sling
  • Superior glenohumeral ligament
  • Coracohumeral ligament
  • Subscapularis tendon, superior aspect
  • Supraspinatus tendon, anterior aspect

14 Pathogenesis
• Vascular anatomy (intrinsic)
  • Thoracoacromial, brachial arteries
  • Intra-articular hypovascular zone
• Mechanical stresses (extrinsic)
  • Intra-articular - compression, shear
  • Extra-articular - tension

15 LHB Lesions
• Isolated tendinosis lesions
• Tendinosis w/SLAP lesion
• LHB instability w/pulley sling rupture
  • Superior subscapularis tear
  • Anterior supraspinatus tear
• LHB rupture

16 Clinical Presentation
• Anterior shoulder pain radiating to biceps
• Overhead athletes, tennis, volleyball
  • + Speed, + Yergason suggest tendinosis
• Throwers w/scapular dyskinesis, GIRD
  • + O’Brien, + relocation indicate SLAP lesion
• MR-arthrogram best for biceps-labral view

17 Surgical Treatment Options
• LHB tenotomy
  • Degenerative tendon, older patients
  • Cosmetic deformity, biceps cramping
• LHB tenodesis
  • Arthroscopic, suture technique w/RCR
  • Open, subpectoralis technique

18 Illustrative Case - HPI
• 48 yr-old female PA, CrossFit enthusiast
• 6-mo history right anterolateral deltoid pain
• Overhead weight-lifting, snatching 155 lb, dead-lifting 300 lb
• Could not tolerate CrossFit weight-lifting
19 **Physical Exam**
- Night pain unrelieved by NSAIDs, PT
- Active FF 150°, abd 165°, ER 56°
- Impingement signs were negative
- O’Brien test, SLAP test were positive
- Relocation and release test was positive
- No rotator cuff weakness, but pain on resisted shoulder abduction

20 **MR-Arthrogram showed partial supraspinatus tear, SLAP lesion.**

21 **Nonoperative Treatment**
- Modified work-out routine, but continued training for CrossFit competition
- Three subacromial injections during five-month training period
  - First injection helped for 6 wks
  - 2nd, 3rd injections helped for 2 wks

22 **Arthroscopy confirmed partial supraspinatus tear, Ellman grade III, which was treated with arthroscopic trans-tendinous repair.**

23 **Arthroscopy also confirmed high-grade SLAP lesion which was treated with LHB tenotomy, limited open subpectoralis tenodesis.**

24 **Surgical Outcome**
- At six months postop, right shoulder pain improved and she was satisfied
- On exam, FF 162°, abd 164°, ER 42°
- No rotator cuff weakness, but mild pain on resisted shoulder abduction
- Advised to modify CrossFit routine

25 **Epidemiology of Distal Biceps Rupture**
- Male mesomorphs (rare in females)
- Age range 30-60 years (mean 47 yrs)
- Dominant extremity (86%)
- Incidence 1.2 ruptures per 100K per yr
- Smokers 7.5 times greater risk

26 **Distal Biceps Partial Tears**
- Less common than complete ruptures
- Diagnosis increasing frequency (MRI, US)
- Anterior elbow pain radiating to biceps
- Injury event (lifting, forced extension)
- Unexplained elbow pain w/o trauma
- No sports-related predilection

27 **Distal Biceps Anatomy**
- Musculocutaneous innervation
- Elbow flexor, forearm supinator
- Posteroulnar radial tuberosity insertion
  - Short head inserts distal, better flexor
• Long head inserts proximal, supinator
• Bicipital aponeurosis (lacertus fibrosis)

28 **Pathogenesis**
• Blood supply (intrinsic factor)
  • Proximal third - brachial artery
  • Distal third - post interosseous recurrent
  • 2-cm middle-third is a hypovascular zone
• Mechanical impingement (extrinsic factor)
  • Washer-ringer effect with pronosupination
  • Radioulnar space 48% less in pronation

29 **Diagnosis**
• Physical findings
  • Palpable, tender distal biceps
  • Weakness resisted supination
• Radiographs usually negative
• Advanced imaging - MRI
  • To confirm partial tear, may be equivocal
  • Unnecessary for complete tear

30 **MRI - FABS Position**
• Shows full length of distal biceps
• Mandatory to show partial tear
• Patient is prone w/elbow on coil
  • Flexed elbow
  • ABducted shoulder
  • Supinated forearm

31 **Treatment Options**
• Nonoperative treatment does not help
• In situ distal biceps repair
• Distal biceps take-down, re-attachment
  • One-incision technique
  • Two-incision technique
  • Multiple re-attachment options

32 **Meta-Analysis of Surgical Outcomes**
• Behun, JHS 2016
• 19 studies, 86 partial tears repaired
• 65 pts failed trial non-surgical treatment
• Surgical repair - 94% satisfactory outcome
• LABC paresthesia common complication

33 **One-Incision Technique**
• Diagnosis of complete tear is clinical
MRI unnecessary
• Single incision, cortical button w/o screw
• Conservative postop & rehabilitation protocol

34 My Preferred Surgical Technique for Distal Biceps Repair
Tension-Slide Technique w/Cortical Button Fixation
Sethi, Tech Hand 2008

35 Postoperative Protocol
• Long-arm splint, wk 1
• Long-arm extension block orthosis, wks 2-4 with protected early motion
• Active pronosupination, wk 4
• Full active ROM, biceps isometrics, wks 7-12
• Progressive strengthening, wks 13-26
• Many surgeons are moving toward early active ROM postoperatively

36 Distal Biceps Tears in Women
• Rarely occur in women
• Jockel, JSES 2010 - 15 cases, mean 63 yrs
• 7 single injury, 8 insidious, 6 cystic mass
• 14 partial tears improved with repair
• Women - older, partial tears, atraumatic, associated w/peritendinous cyst

37 Distal Biceps Partial Tear - Illustrative Case - HPI
• 49 yow male RHD salesman
• 4-month history right elbow pain anteriorly w/o antecedent trauma
• Pain with elbow flexion, pronation, lifting
• IM cortisone, Dosepak - temporary relief

38 Physical Exam
• Full active elbow range of motion
• Tenderness along distal biceps tendon
• Trace weakness on resisted elbow flexion
• 4+/5 weakness on resisted forearm supination
• All provocations reproduced his elbow pain

39 At surgery, partial distal biceps tear was confirmed and treated by take-down and repair w/tension-slide technique.

40 Surgical Outcome
• At 3 months postop, elbow pain resolved
• Patient satisfied with early result
• Elbow ROM 0-148°, full pronosupination
• Progressive activity next 3 months
• Return to full activity at 6 months

41 Lateral Epicondylosis or "Tennis Elbow" - Epidemiology
• Affects 1-3% adults per year
• Age range 30-50 years
• Men and women equally affected
• Dominant side
• Risk factors - repetitive lifting, manual labor

42 Pathoanatomy
• Common extensor origin
  • ECRB affected in nearly all patients
  • EDC involved in 35-50% patients
• Pathohistology
  • No evidence of acute inflammation
  • Angiofibroblastic tendinosis

43 Clinical Presentation
• Sports - racquetball, squash, fencing, tennis (groundstrokes)
• Insidious onset or lateral elbow trauma
• Wrist extension activity is provocative
• Repetitive eccentric loading is causative

44 Diagnosis
• Physical findings
  • Tenderness at common extensor origin
  • Resisted wrist extension is provocative
• Radiographs - rarely alter management
• MRI - quantifies lesion, but unnecessary

45 Nonsurgical Treatment
• Activity modification
• NSAIDs
• Orthoses
• Stretching, ASTYM
• Eccentric strengthening
• Iontophoresis
• Steroid injection
• PRP injection
• Botox injection
• Autologous blood injection
• Extracorporeal shock wave

46 My Treatment Protocol
• Activity modification, counterforce strap, short-arm splint (night), encourage patience
• Therapy - stretching, strengthening, ASTYM
• Aggressive needling w/lidocaine
• After 1 yr, open CEO release, partial lateral epicondylectomy
• Recalcitrant - arthroscopy, denervation
Open vs Arthroscopic Technique

- Prospective, randomized, controlled trial
- Open - 15 women, 19 men (mean 47 yrs)
- Scope - 13 women, 21 men (mean 45 yrs)
- No difference in outcome 1 yr postop
- Level I study - McDonald, ASES 2014

My Preferred Surgical Technique for Chronic Tennis Elbow
Common Extensor Origin Release, Partial Lateral Epicondylectomy
Nirschl, JBJS 1979

Medial Epicondylosis or "Golfer's Elbow" - Epidemiology

- Overall prevalence < 1%
- Age range 30-60 years
- Men and women equally affected
- Other medial pathology in 10-20%
- Occupation-related (military, brick layers, carpenters)

Clinical Presentation

- Overhead throwing sports (baseball, javelin) in late cocking or early acceleration phase
- Other sports - tennis (serving), golf, rowing
- Insidious onset is most common
- Repetitive eccentric loading is causative

Physical Exam

- Tenderness at medial epicondyle
- Pain, weakness on resisted VF, pronation
- May occur with ulnar neuritis, subluxation
- Distinguish from elbow UCL insufficiency, cervical radiculopathy

Diagnostics

- Radiographs - usually normal, but up to 25% show medial calcification
- Ultrasound - focal tendon lesion, but operator-dependent
- MRI / MRA - to rule out other pathology

Nonoperative Treatment

- Activity modification
- Rest from throwing, golfing
- NSAIDs
- Counterforce strap, taping
- Short-term splinting
- ASTYM, but not ESWT
- Steroid injection, trephination
- Flexor-pronator stretching
- Concentric strengthening
- Eccentric strengthening
54 Surgical Option - Debridement of Focal Tendon Defect

55 Associated Ulnar Neuropathy
  • Negative prognostic factor
  • Gabel, JBJS 1995
    • 24/25 better w/mild ulnar neuropathy
    • 2/5 better w/mod-severe symptoms
  • Kurvers, JBJS 1995
    • 11/16 w/o ulnar neuritis symptom-free
    • 3/24 w/ulnar neuritis were asymptomatic

56 My Preferred Technique for Medial Epicondylitis with Concomitant Ulnar Neuropathy
  Ulnar Nerve Transmuscular Transposition with Step-Cut Lengthening of the Flexor-Pronator Fascia

57 de Quervain's Disorder
  • Fritz de Quervain, Swiss surgeon, 1895
  • Stenosing tendinosis 1st dorsal compartment
  • Degenerative tendon changes, retinacular thickening
  • Middle age, dominant side, repetitive lifting
  • Women 6 times more often than men

58 Clinical Diagnosis
  • Radial-sided wrist pain, localized swelling
  • Provoked by thumb abd, wrist UD
  • Tenderness - radial styloid, 1st DC
  • Provocative tests - Finkelstein, Eichhoff
  • Thumb pseudo-triggering, retinacular cyst
  • Distinguish from basal thumb arthrosis

59 Local Anatomy
  • APL, EPB in 1st dorsal compartment
  • APL is radial-volar, multiple slips (2-7)
  • EPB is dorsoulnar, usually one small slip
  • Vertical septum often separates APL, EPB
    • 20-40% cadavers
    • 70-90% at surgical release
  • Proximity of superficial radial nerve

60 Treatment Options
  • NSAIDs, splinting are palliative
  • Injection effective only if in EPB subcompartment
  • 1st DC release if wrist pain persists
  • Yuasa, JHS 1998 - May decompress only EPB if septated 1st DC

61 Preferred surgical treatment is release of 1st dorsal compartment including EPB subcompartment if present.
62 **Intersection Syndrome**
- APL, EPB muscle bellies cross ECRL, ECRB
- “Intersection syndrome” coined by Dobyns
- Tendinosis of 2nd dorsal compartment
- Repetitive motion (rowing, weight-lifting)
- Majority improve with 2nd DC injection
- Injection failures require 2nd DC release

63 **Nonoperative treatment of intersection syndrome is injection at intersection 1st and 2nd dorsal compartments.**

64 **Preferred surgical treatment of intersection syndrome is 2nd dorsal compartment release.**

65 **ECU Tendinopathy**
- 2nd most common dorsal tendinopathy
- Uncommon cause of ulnar-sided wrist pain
- Spectrum of pathology
  - Tendinosis
  - Subluxation
  - Tear (partial, complete)

66 **ECU Tendinosis**
- Majority from direct blow or twisting injury, some from repetitive motion or overuse
- Pain, swelling along ECU tendon sheath
- Exam - tenderness, bogginess along ECU
- Pain reproduced by resisted wrist DF, UD
- Injection - effective first line treatment
- Release 6th compartment if injection fails

67 **ECU Synergy Test**
- Described by Ruland, JHS 2008
- Distinguishes ECU tendinosis from wrist intra-articular process (TFC tear)
- ECU contracts on resisted thumb abd, wrist in neutral, forearm supinated

68 **ECU Subluxation**
- Anatomy - ECU subsheath, distal ulnar groove
- Injury mechanism - wrist supination, VF, UD
- Racquet, stick sports - baseball, golf, tennis
- Painful tendon snapping w/pronosupination
- ECU subluxes ulnar and volar to groove with supination, reduces with pronation
- Diagnosis made on clinical grounds

69 **ECU Subluxation - Treatment Options**
- Acute (< 6 wks) - immobilize wrist in pronation, dorsiflexion, radial deviation
- Chronic (> 6 wks)
  - Stabilize ECU with retinacular flap (Spinner-Kaplan, CORR 1970)
• Stabilize ECU subsheath to ulnar groove

70 ▶️ Patellar Tendinosis - Arthroscopic Patellar Tendon Release
• 30 athletes (27 men), 4.4-yr follow-up
• Synovial hypertrophy inferior patellar pole
• Fat pad resection, release inferior patella
• Knee function improved, pain decreased
• 97% pts had good or excellent outcomes
• Level IV study - Maier, 2013 Arthroscopy

71 ▶️ Illustrative Case - HPI
• 36 yow male golf coach
• Bilateral knee pain after fall snow skiing
• Anterior pain aggravated by twisting, sports, squatting
• NSAIDs, PT did not help

72 ▶️ Physical Exam
• Normal, non-antalgic heel-to-toe gait
• Full active passive knee ROM bilaterally
• Patellar tenderness bilaterally
• No instability to valgus or varus stress
• Negative anterior, posterior drawer
• Negative Lachman, McMurray

73 ▶️ Knee radiographs were normal.

74 ▶️ MRI - T2-weighted sagittals showed nonhomogeneous signal at patellar tendon insertion on the patella.

75 ▶️ At arthroscopy, there was synovial hypertrophy treated with debridement, partial patellar tendon release from inferior pole.

76 ▶️ Surgical Outcome
• At 3 wks postop, knee pain resolved
• Passive range of motion: 0-130°
• No patellar tendon tenderness
• Good quadriceps set, no extension lag

77 ▶️ Achilles Tendinosis - Surgical Treatment Options
• Non-insertional tendinosis
  • Open debridement of compromised tendon
  • Protected weight-bearing, early motion
• Insertional tendinosis
  • Debridement retrocalcaneal bursa, devitalized tendon, calcaneal traction spur, Haglund’s lesion
  • Repair / reattachment of Achilles to calcaneus