Interventional MSK Ultrasound: Advanced Procedures

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Outline:
• Calcific tendinosis
• Tendon fenestration
• Tendon injection and PRP

Tendon Calcification:
• Degenerative: thin, linear deposit
• Calcific tendinosis:
  – Formative: well-defined, dense shadow
  – Resorptive:
    • Globular, amorphous
    • Variable shadow
    • Best success with aspiration


Degenerative Calcification

Calcific Tendinosis
• Hydroxyapatite deposition: metaplasia
  – Usually do not have cuff tear
• Appearance:
  – 79% hyperechoic & shadowing
  – No shadow: 7%
• Two phases:
  – Formative
  – Resorptive: painful

Farin et al. Skeletal Radiol 1996; 25:551
Calcific Tendinosis

Formative
Defined, shadow

Resorptive
Amorphous, little shadow

Calcific Tendinosis: resorptive phase

Patient #1

Patient #2: Intra-osseous invasion

Calcific Tendinosis: supraspinatus
Use of Tendon Anisotropy

Long axis

Subscapularis: calcific tendinosis

Calcific Tendinosis: aspiration

- Percutaneous lavage and aspiration
  - Best: rounded amorphous calcification
  - Correlate with radiography
- 3-10 cc syringes: Lidocaine
- 20 – 22 gauge needle
- Position patient: syringe is dependent

Calcific Tendinosis: aspiration

- Inject Lidocaine, then aspirate
  - Dilute calcification
  - Syringe dependent
  - Calcification will flow into needle
  - Repeat until calcification decreases
- Inject steroids into adjacent bursa
Calcific Tendinosis: results

- Calcium decrease correlates with symptom improvement
- Improvement: 91% at 1 year*
  - Calcium gone in 89%
  - Transitory recurrence at 15 weeks: 44%
  - Improved symptoms at 1 year
- No difference at 5, 10 years**

*del Crura, AJR 2007; 189:W128
**Serafini G, Radiology 2009; 252:157
**Outline:**
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**Tendinopathy**
- Degenerative, microtears, no inflammation
- Hypoechoic enlarged
- Anechoic clefts / partial tears
- Hyperemia: correlates with pain
- Eccentric physical therapy should be considered prior to any percutaneous treatment considerations


**Patellar Tendon: tendinosis**
- Color Doppler
- Power Doppler

**Percutaneous Tendon Treatments**
- Corticosteroid
- Fenestration (dry needling, tenotomy)
- Hyperosmolar dextrose
- Whole blood (autologous)
- Platelet-rich plasma
- Other: stem cells, deer antler velvet, amniotic membrane


**Peritendon Steroid Injections**
- Elbow: common extensor tendon
  - Pain returns worse than before injection¹
- Gluteal:
  - 72% showed improvement at 1 month²
- Hamstring:
  - 24% had symptom relief beyond 6 months³

¹Coombes BK et al. JAMA 2013; 309:461  
²Labrosse JM et al. AJR 2010; 194:202  
³Zissen MH et al. AJR 2010; 195:993

**Prolotherapy**
- Injection of an irritant
- Hyperosmolar dextrose or morrhuate sodium
- Unknown mechanism
  - Irritant attracts inflammatory mediators
  - Stimulate release of growth factors
  - Vascular sclerosant

Distel et al. PMR 2011; 3:S78
Prolotherapy

- Achilles
  - 36 patients with chronic tendinosis
  - Hyperosmolar dextrose every 6 weeks
  - Significant reduction in pain
  - Decreased vascularity in 55%


Achilles: hyperosmolar dextrose

Tendon Fenestration

- Also called "dry-needling" or tenotomy
- Needle repeatedly passed through areas of tendinosis
- Disrupts area of tendinosis
- Bleeding causes release of growth factors
- Stimulates tendon healing

Fenestration: technique

- No NSAIDS x 2 weeks prior
- Ultrasound guidance: in plane
  - Long axis to tendon
- 20 or 22 gauge needle
- 20 – 30 passes until area soft
- Minimal Lidocaine: over tendon

Percutaneous Fenestration

- 20 or 22-gauge needle
- 20 to 30 needle passes
- Continued until area covered and tendon softens

Fenestration: technique

- Cover entire tendon abnormality
- Contact bone if at tendon abnormality
- Pull needle out of tendon to redirect
- Also redirect medial to lateral
  - Pivoting at needle entrance
  - Cone-shaped area

Non-sterile technique for simulation only!
**Fenestration: technique**

- Contraindications:
  - Not delineated in literature
  - Prior steroid injection < 3 months ago
  - Bleeding disorders
  - Infection
  - Tendon tear > 50% thickness?

**Post-procedure:**

- Rest for 2 weeks
  - Daily activities okay
  - Gradual return to activities

- Follow-up:
  - Referring physician, physical therapy
- No NSAIDS: 2 weeks

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**Phases of Tissue Healing**


**Post-procedure:**

- Patellar tendon:
  - Knee brace (locked) x 2 weeks
  - First week non-weight bearing with crutches
  - Nothing?
- Achilles tendon:
  - Walking boot x 2 weeks

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**Tendon Fenestration**

- 14 tendons
- VAS score improved: 4, 12 weeks
- Patellar (5), Achilles (4)
- 1 each: gluteus medius, iliotibial tract, rectus femoris, hamstring, common extensor tendon


**Common Extensor Tendon (Elbow)**

*22-gauge*
Common Extensor Tendon: elbow

- 58 patients\(^1\)
- Outcome: average 28 months
  - Pain level and difficulties with related activities
    - 64% excellent, 16% good, 7% fair, 13% poor
  - No adverse effects
- Follow-up study: 57 patients\(^2\)
  - 93% excellent or good results
  - Corticosteroid injection not needed

\(^1\)McShane JM et al. J Ultrasound Med 2006; 25:1281
\(^2\)McShane JM et al. J Ultrasound Med 2008; 27:1137

Patellar Tendon

- 45 tendons
- 76% improved at 4 weeks, 24% no change
- Improved outcome at 4 weeks if:
  - Less pain prior to procedure
  - Well-defined area of tendinosis at US
  - No correlation with other ultrasound findings (color, size, location, etc.)


Gluteus Medius

- 22 tendons in 21 patients
- Gluteus medius (11), hamstring (8),
gluteus minimus (2), tensor fascia lata (1)
- Marked or some improvement: 82%


Fenestration: pelvis
**Whole Blood Injection**

- Autologous whole venous blood
- Injected into abnormal tendon during fenestration
- Release of growth factors that will promote healing
- Refractory tendinopathy may be helped
  - Additional studies are needed

Kampa RJ et al. Int J Clinical Practice 2010; 64:1813

**Outline:**

- Calcific tendinosis
- Tendon fenestration
- Tendon injections and PRP
Platelet-Rich Plasma

• Autologous venous blood
• Centrifuged
• Concentrated platelet sample
• Platelets degranulate:
  – Alpha granules: contain 95% of growth factors
  – Secrete additional growth factors (7 days)
  – Bind to cell membrane receptors: healing


Platelets: growth factors

• PDGF: platelet-derived growth factor
• VEGF: vascular endothelial growth factor
• TGF: transforming growth factor b-1
• IGF: insulin-like growth factor
• EGF: epidermal growth factor
• FGF: fibroblast growth factor
• TNF: tumor necrosis factor
• WTF: what’s that factor?

Platelet-Rich Plasma: who cares?

• Many high-profile athletes claim effectiveness
• Patients are requesting this treatment
• Everyone is doing it
• It works, but may not be best treatment

PRP: what’s in the mix

• Platelet count:
  – 500K ideal (in vitro)\(^1\)
  – Tenocyte proliferation, migrations, collagen type I production
  – Less effectiveness if higher, even cell death
• White blood cells:
  – Leukocyte poor or rich concentrations
  – Poor: less catabolic cytokines, more healing\(^2\)

\(^2\)McCarrel TM et al. JBJS 2012; 94:e143

PRP: Arthrex

• One of many available systems
• Double syringe system
• Leukocyte poor
• No anticoagulant needed
• Venous draw: 15 ml
• Place directly in centrifuge: 5 min
• 2 - 5 ml PRP
• Platelet concentration: 200 – 500K

PRP and Tendon Injection

• Common extensor tendon: elbow
  – Randomized controlled: 230 patients
  – PRP + fenestration versus fenestration alone
  – No difference in outcomes at 12 weeks
  – Significant difference in pain scores at 24 weeks: PRP group had less pain

**Common Extensor Tendon**

- PRP (72%) vs fenestration (56%)
  - *Both improved*
- PRP, fenestration, steroid (in tendon):
  - *No significant difference*
- PRP vs whole blood: *no difference*

**Common Extensor Tendon:**

- PRP vs steroid (+fenestration)
  - *PRP significantly better at 2 years*
- Metanalysis: *inconclusive*

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**PRP and Tendon Injection**

- Gluteal Tendons: greater trochanter
  - Randomized controlled: 30 patients
  - PRP versus fenestration alone
  - Significant improvement at weeks 1 and 2
  - Approximately 80% had long term improvement: up to 1 year follow-up
  - No difference between treatment groups

- Patellar tendon
  - Randomized controlled: 23 patients
  - PRP + fenestration versus fenestration alone
  - PRP outcomes better at 12 weeks
  - No significant difference in outcomes when greater than 26 weeks

- Achilles tendon
  - Randomized controlled: 54 patients
  - PRP versus saline injection
  - No significant difference in outcomes
    - At 24 weeks
    - At 1 year
  - de Vos RJ et al. JAMA 2010; 303:145

**PRP and Tendon Injection**

- PRP injection
  - Pre-procedure
  - PRP injection
PRP and Knee Osteoarthritis

- Several studies evaluating PRP, knee OA
- PRP may be slightly better than hyaluronic acid
- Benefits may decrease after 1 year
- Mild OA responds better
- No anatomic information
- Leukocyte-poor preparation is best

Discussion: other treatments

- Fenestration is often combined with other treatments:
  - Platelet-rich plasma or whole blood injection
  - Hyperosmolar dextrose or prolotherapy
- Common extensor tendon (elbow):
  - There is no benefit of injecting steroids during tenotomy\(^1\)
  - Risk of tendon rupture

\(^1\)McShane JM et al. J Ultrasound Med 2008; 27:1137

Syllabus on line and other educational material:
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