Tendon: injury
- Acute tensile overload
  - Usually underlying abnormal tendon
- Chronic overuse: repetitive excessive loading
  - Loss of normal tendon architecture
  - Change in tenocyte morphology
  - Altered collagen fibril distribution and neovascularity
  - Microtears
  - Resulting underuse may contribute

Tendon: healing
- Inflammatory phase
  - First week after injury
    - Fibrin clot
    - Cell migration, neovascularity
- Proliferation phase
  - 1 to 4 weeks
    - Fibroblasts synthesize collagen and extracellular proteins
- Remodeling phase
Tendinosis
• Terms used instead of tendinitis
• No acute inflammatory cells
  – Primarily mucoid degeneration
  – Chondroid metaplasia
• Ultrasound:
  – Hypoechoic tendon
  – Heterogeneous, ill-defined
  – Possible increased thickness


Tendinosis: supraspinatus tendon

Tendon Tear versus Tendinosis
*both may appear hypoechoic

<table>
<thead>
<tr>
<th>Tear</th>
<th>Tendinosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anechoic</td>
<td>Hypoechoic</td>
</tr>
<tr>
<td>Well-defined</td>
<td>Ill-defined</td>
</tr>
<tr>
<td>Homogeneous</td>
<td>Heterogeneous</td>
</tr>
<tr>
<td>Thinned</td>
<td>Swollen</td>
</tr>
<tr>
<td>Bone irregularity*</td>
<td>Smooth cortex</td>
</tr>
</tbody>
</table>

*At supraspinatus tendon footprint in patients over 40 years old

Degenerative Calcification

Calcific Tendinitis

Formative
Defined, shadow

Resorptive
Amorphous, little shadow
Calcific Tendinitis: lavage/aspiration

Common Extensor Tendon: tendinosis

Long Axis
Short Axis

Common Extensor Tendon: elbow
- Often called “tennis elbow” or “lateral epicondylitis” or “epicondylitis” or ……
- All terms are misnomers
- Those inflicted usually do not play tennis (professionally or correctly)
- It is not inflammatory
- It is not a primary problem of the epicondyle

Patellar Tendon: tendinosis

color Doppler
power Doppler

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

Peritendon Steroid Injections

- Shoulder: minimal transient pain relief
  - Pain returns worse than before injection
- Elbow: common extensor tendon
  - Pain returns worse than before injection
- Gluteal:
  - 72% showed improvement at 1 month
- Hamstring:
  - 24% had symptom relief beyond 6 months

Steroid Injection: plantar fascia

- Into fascia:
  - 2% risk of plantar fascia rupture
  - Temporary pain relief: 4 weeks
  - No difference at 8, 12 weeks compared to saline
- Deep to fascia: 1st branch of the lateral planter nerve (Baxter’s nerve)
- Superficial to fascia:
  - Risk of fat atrophy theoretical using US guidance

Steroid Injection: plantar fascia

- Transducer: short axis to plantar fascia
- Needle: in plane with transducer

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

Fenestration: technique

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

Post-procedure:

- No ice
- Rest for 2 weeks
  - Daily activities okay
  - Gradual return to activities
- Follow-up:
  - Referring physician, physical therapy
- No NSAIDS: 2 weeks

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

Fenestration: tendons

- Common extensor tendon: elbow
- Patellar tendon
- Gluteal tendons: great trochanter
- Achilles
- Other
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

- 58 patients
- 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
  - 93% excellent or good results
  - Corticosteroid injection not needed

1McShane JM et al. J Ultrasound Med 2006; 25:1281

Common Extensor Tendon: elbow

- Randomized controlled: 28 patients
- PRP + fenestration versus fenestration alone
- Trend for greater clinical improvement in PRP subjects at 2 months
- No difference in clinical outcome at 6 months

Stenhouse G et al. Skeletal Radiol 2013; 42:1515

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

**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


**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

Long Axis

Gluteus Maximus and Minimus
- 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\(^1\)
- Two injections: more sustained response\(^2\)

\(^1\)Jacobson JA et al. J Ultrasound Med 2016; 35:2413

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


Percutaneous Fenestration: Hamstring

Tensor Fascia Lata

Achilles tendon

Sagittal
Achilles Tendon

- Randomized controlled: 54 patients
- PRP versus saline injection
- No significant difference in outcomes
  - At 24 weeks\(^1\)
  - At 1 year\(^2\)
  - Both groups: eccentric physical therapy

\(^1\) de Vos RJ et al. JAMA 2010; 303:145

Outline

- Tendinopathy
  - Background
  - Ultrasound appearance
- Joint disease
  - Inflammatory
  - Degenerative

Arthritis: approach

- Inflammatory:
  - Synovial proliferation and erosions
  - Enthesitis
- Degenerative:
  - Osteophytes
  - Minimal if any synovial proliferation
- Radiographs: appearance, distribution
- Laboratory values and clinical information

Synovitis (Rheumatoid Arthritis): dorsal wrist

Synovitis: MCP joint

Synovitis: MCP joint

Sagittal Plane: Radiocarpal and Mid-carpal Joints

Sagittal Plane: 2\(^{nd}\) MCP Joint
Synovitis: color flow

RA Ankle
No flow

RA ankle
Positive flow

Joint Effusion vs Synovial Hypertrophy

- Anechoic: fluid
- Hypoechoic:
  - Effusion vs. synovial hypertrophy
  - Compressible: fluid
  - Internal hyperemia: synovitis
  - Flow may be absent

AJR 2000; 174: 1353

Rheumatoid Arthritis

Arthritis: bone

- Ultrasound not very good for erosions:
  - Better than radiographs
  - 40% sensitivity\(^1\), 29% false positives\(^2\):
    wrist/hand compared with CT
  - Very non-specific, time consuming
- Adjacent synovitis adds specificity
- Correlate with radiographs, labs, distribution

\(^1\)Dohn UF M, Arthritis Res Ther 2006; 8:1
\(^2\)Finzel S. et al. Arth Rheumatism 2011; 63:1231

Pseudoerosions

3rd MCP: sagittal
Lunate

3rd MCP; transverse
Ulna

Gout

Double Contour Sign

Tophus

Microtophi
First CMC joint: osteoarthritis

Note: osteophytes (arrow) and intra-articular body (open arrow)

Take Home Points

• Tendinosis
  – Degenerative process
  – Amenable to percutaneous treatments
• Joint disorders
  – Inflammatory: synovial hypertrophy
  – Degenerative: osteophytes

Syllabus on line and other educational material: www.jacobsonmskus.com

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