Dry Needling for Tendinopathy?

Amy Wallace McDevitt PT, DPT, OCS FAAOMPT
Assistant Professor, Physical Therapy Program, University of Colorado, Anschutz Medical Campus

Paul Mintken PT, DPT, OCS FAAOMPT
Professor, Physical Therapy Program, University of Colorado, Anschutz Medical Campus

Session Learning Objectives

- Summarize the best available evidence supporting tendon needling as a potentially effective treatment for tendinopathy.
- Describe the histologic response of the tissue contributing to the theoretical remodeling of chronic pathologic tissue.
- Describe and demonstrate techniques and their proposed integration into the plan of care for the patient with tendinopathy.

Course Outline

- Background on tendinopathy
- Physical therapy examination, evaluation and treatment of tendinopathy
- Background on dry needling and tendon fenestration
- Video and live demonstration of tendon needling including ultrasonography
- Conclusion, discussion and future directions

Tendinopathy, tendinosis, tendinitis (what’s the difference?)

- Pre 1990s: the ‘tendinitis’ model
  - Inflammation was thought to be the driver
  - Treated with anti-inflammatory measures
- The move away from ‘tendinitis’: decade of the 1990s
  - Histological findings showed little inflammatory mediators in chronic tendons (neutrophils and macrophages)
  - In the late 1990s, Maffulli et al advocated a shift in clinical terminology from tendinitis to “tendinopathy”
- Degeneration w/o inflammation: Paradigm of 2000s
  - Continuum of tendon degeneration
  - “Degeneration” common in asymptomatic
  - Newer evidence indicates inflammation accompanies chronic tendon degeneration

The term ‘tendinopathy’ includes only those cases that are clinically diagnosed with tendon pain with or without pathology on imaging.


Disclosure

- No relevant financial relationships exist
Tendinopathy

- Affects professional and recreational athletes as well as people involved in repetitive work
- 30-50% of all sports injuries
- Significant morbidity and health care costs
- 28 million people in the United States develop tendon disorders per year
- Cost in the US estimated to be $30 billion/year

Tendinopathy

- Common sites:
  - Supraspinatus
  - Long head bicep
  - Common extensor tendon of the elbow
  - Proximal hamstring
  - Quadriceps tendon
  - Patellar tendon
  - Posterior tibial tendon
  - Achilles tendon

Tendon Disorders

- Types of Tendon Disorders
  - Tendon injuries
  - Tendinopathy

Painful Tendinopathy Incidence

- Achilles: 2.35/1,000
- Patellar: 1.6/1,000
- Adductor: 1.22/1,000
- Gluteal: 4.22/1,000
- Plantar Fascia: 2.44/1,000
- Elbow: 3/1,000
- Shoulder: 3/1,000

Prevalence Tendon Abnormalities on Imaging in Asymptomatic Individuals

- Achilles: 10–50%**
  - Ooi 2016
- Patellar tendon: 40-90% **
  - Pappas 2016, Simpson 2016
- Lateral Elbow: 10-40%**
  - Krog 2017
- Proximal Hamstrings: ~20%
  - Thompson 2017
- Shoulder: 25-39%
  - Girish 2011

Risk Factors

- Biggest Risk Factor: presence of a tendon abnormality
  - Intrinsic Factors
    - Age – ‘mature’ tissues are different and less efficiently
    - Chronic disease – diabetes, high cholesterol, menopause, connective tissue disease, seronegative disorders
    - Tendon load history
      - Tendon load across lifespan
      - Changes in tendon load
        - Injury, off season, etc
  - Extrinsic Factors
    - Environment
    - Repetitive activity in work, sport or leisure
    - Often a sudden burst of activities
    - Sport – an increase in training load

**Higher estimates are for athletes that use that body part.**
Can you Prevent Tendinopathy?

- Limited evidence for balance training
- Shock absorbing insoles could have a preventive effect on Achilles tendinopathy
- Hormone replacement therapy may reduce risk of tendinopathy in postmenopausal women
- NO evidence was found for stretching

Prophylactic Training in Asymptomatic Soccer Players With Ultrasonographic Abnormalities in Achilles and Patellar Tendons. The Danish Super League Study

- Prophylactic eccentric training & stretching reduces risk of developing patellar tendon imaging abnormalities
- No positive effects on risk of injury!
- In asymptomatic imaging abnormal patellar tendons, prophylactic eccentric training and stretching increased the injury risk
- No effect on the Achilles tendons

Histology of Tendinopathies

Normal Tendon

Tendinopathy

Pathophysiology

- Cell proliferation and activation produces large proteins (proteoglycans)
- Continued cell production in presence of proteoglycans changes cellular matrix
- If overload continues, cellular matrix continues to degrade
- Leads to neovascularization and modification of collagen structure
- Reduction of ability of the tendon to tolerate load

Normal vs. Excessive Loading

Normal

Tendinopathy

- Tendon cells spindle shaped
- Minimal ground substance
- Linear, tight bundled collagen
- Minimal innervation
- Minimal vascularity

- Rounded nuclei, fewer tenocytes
- Increased ground substance
- Disrupted collagen
- Ingrowth of nerves
- Prominent vessels

Is the problem pathology or pain or both?

- Pain & pathology are unrelated
- Mainly pain
  - Stops function, stops performance
  - May/may not have pathology on imaging
- Pathology
  - Tendons rupture if not enough intact tendon to take load
  - Quantity of intact tendon is key factor
  - Can be painfree prior to rupture

Main Theories of Tendonopathy

- Mechanical Damage Theory
  - Too much load over too much time
  - Changes in Nociceceptor substance
- Compression theory
  - Impingement/Compression of the tendon between adjacent structures
- Other Considerations
  - Genetics
  - Hypoxia

Tendon cell undergoing (A,B) shear and (C) compression during a tendon-loading cycle.

Is tendon pathology a continuum? A pathology model to explain the clinical presentation of load-induced tendinopathy

- Propose tendon pathology continuum with three stages:
  - Reactive tendinopathy
  - Tendon dysrepair (failed healing)
  - Degenerative tendinopathy
- May be painful or pain-free anywhere in continuum

Tendinopathy Continuum

- Reactive Tendinopathy
  - Tensile / compressive overload (acute)
  - Repair proteins, proteoglycans prominent
- Tendon Dysrepair
  - Myofibroblasts present
  - Disorganization starting: collagen separation
- Degenerative Tendinopathy
  - Absent cell nuclei, little collagen
  - Heterogeneous signal on MRI, US

Is tendon pathology a continuum? A pathology model to explain the clinical presentation of load-induced tendinopathy

- Adding/removing load is the stimulus that drives the tendon forward or back along the continuum
  - Reducing load may allow the tendon to return to a previous level of structure and capacity within the continuum
Stages

- Stages can occur in combination

- Poorly understood (Pathology common without pain)
- Local nociceptive driver
  - Signaling substances to local nerves and tenocytes (Substance P, glutamate)
  - Biomechanical irritants (chondroitin sulphate)
  - Changes to tendon pH
- Central mechanisms: decreased cortical excitability
- Pain linked to neovascularization and neural growth

Origin of Pain

- Failed healing response?
  - Neovascularity and nerve proliferation

Why is there pain?

- Recommended when:
  - Case is complicated/complex and long-standing
  - Appropriate rehabilitation program has failed
  - Thorough clinical examination has identified differential diagnoses in need of exclusion
  - Not usually required to make diagnosis
  - Ultrasound – preferred option
  - Partial tears are common, even in asymptomatic tendons
Mid-portion Achilles tendinopathy (red brackets); retrocalcaneal bursitis (yellow arrow); insertional achilles tendinopathy and superficial bursitis (blue arrow). MRI sagittal view. Achilles tendon enlargement and signal changings (*)

**Imaging Features**

- With MRI, low signal intensity tendon appears as increased signal intensity approximately equal to muscle with tendon swelling
- On US, the normally hyperechoic and fibrillar tendon appears hypoechoic and thickened with loss of the normal fibrillar pattern

---

Ultrasound image of a thickened patellar tendon with intact collagen fascicles

(Tennis Elbow Ultrasound)

Hypo-echoic
Extensor tendon origin
Radial head
Joint space

(Tennis Elbow Ultrasound with color doppler)

(Tennis Elbow Ultrasound)

(Dysrepair)

(Ultrasound of a normal right and tendon degeneration left patellar tendon)

(Degenerative)
Ultrasonic tissue characterization

(A) Normal patellar tendon appearance
(B) Mild patellar tendon disorganization
(C) Severe patellar tendon disorganization.

US of degenerative patellar tendon structure

(A) Degenerative progressing to a reactive on degenerative patellar tendon structure (B). Note the increase in blue pixilation in what was previously normal (green) tendon structure.

Tendinopathy Differential Diagnosis

<table>
<thead>
<tr>
<th>Region</th>
<th>Differential diagnosis to consider</th>
<th>Keys to correct diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achilles</td>
<td>Posterior impingement, bursitis, referred pain (lax condition)</td>
<td>Careful palpation, positive plantarflexion test for posterior impingement</td>
</tr>
<tr>
<td>Patellar</td>
<td>Patellar bursitis</td>
<td>Careful palpation</td>
</tr>
<tr>
<td>Lateral elbow</td>
<td>Referral pain from the cervical spine (tenosynovitis), nerve entrapments in the forearm</td>
<td>Careful examination of the cervical spine, awareness of forearm nerve entrapments, Examination of the AC joint, assessment for instability, and lateral tests</td>
</tr>
<tr>
<td>Rotator cuff</td>
<td>AC joint pain and osteoarthritis of the acromioclavicular, shoulder instability, and glenohumeral tears</td>
<td>Careful palpation – PHL, tendinopathy is generally at the tunnel; thumbs posterior tendinopathy is generally at the navicular insertion</td>
</tr>
<tr>
<td>Tibialis posterior – medial ankle</td>
<td>Flexor hallucis longus tendinopathy</td>
<td></td>
</tr>
</tbody>
</table>

Patient presentation

- **Reactive:** Acute overload
  - Usually trauma or a burst of unaccustomed physical activity in a younger person, swelling
- **Dysrepair:** Chronically overloaded tendon
  - Thickened tendon (can be young or older)
- **Degenerative:**
  - Primarily older individuals or younger athletes with a chronically overloaded tendon

https://www.physio-pedia.com/Tendinopathy

https://twitter.com/NSurdykaPhysio

Clinical Examination

  - Injury most likely when CHANGE occurs (intensity, frequency, duration)
  - Movement analysis of physical demands!
- You need to assess function and tolerance to load
  - Energy storage and release loads
  - Look for relationship between increasing the load on the tendon and pain
  - Achilles (heel raise), Patellar (decline squat)
- Palpation: Moderate tenderness in normal!
  - Palpation and results of imaging are generally not useful...
- Strength and endurance base

Clinical Classification

- Reactive/early tendon dysrepair
  - Young athlete after acute overload with a fusiform swelling of the tendon
- Late tendon dysrepair/degenerative
  - Older person with a thick nodular tendon
- Management optimized by tailoring interventions to stage of pathology
  - Target the primary driver (cell activation) and inter-related alterations in matrix integrity

Evidence based intervention for the treatment of tendinopathies

<table>
<thead>
<tr>
<th>Stage</th>
<th>Pharmacological management</th>
<th>Physical management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reactive/early tendon dysrepair</td>
<td>Tenocyte inhibitors (Ibuprofen, celecoxib, corticosteroid), aggrecan inhibitors (Ibuprofen, naproxen sodium, indomethacin)</td>
<td>Load management, Reduction in frequency intensity of tendon load isometrics?</td>
</tr>
<tr>
<td>Late tendon dysrepair/degeneration</td>
<td>Prolotherapy (including blood), sprotin, sclerosing therapy, glyceryl trinitrate</td>
<td>Exercise with eccentric component, ESWT, frictions, ultrasound</td>
</tr>
<tr>
<td>ESWT, extracorporeal shock wave therapy</td>
<td></td>
<td>Heavy slow resistance?</td>
</tr>
</tbody>
</table>

Clinical examination

- History: Mainly only see the “reactive” tendons
- Amount of overload (acute vs. history of tendon problems)
- Age (older vs. younger)
- Post menopausal women
- True reactive: very painful, younger, abusive overload, swollen and sore tendon, takes 4-8 weeks to settle
- Reactive on degenerative: usually older, history of load and/or tendon problems, settle 5-10 days
- Pure degenerative tendons don’t present because they are not painful, may have lumpy bumpy tendons, remaining tendon is doing pretty well

Inflamed?


Transverse Friction Massage

- Insufficient evidence to determine the effects of deep transverse friction on pain, improvement in strength, and functional status for patients with elbow or knee tendinopathy
- No evidence of clinically important benefits was found

Management
Reactive/Early Tendon Dysrepair
- Management of load, reduce impact of offending activities
  - Assessment/modification of intensity, duration, frequency, type
- Tendons need 1-2 days between high or very high tendon loads
  - Type 1 collagen precursors peaks 3 days after intense exercise
- Tendon load without energy storage/release (cycling, weights)
- Avoid high load elastic or eccentric loading with little recovery time
- High-load isometrics (70-80% MVC) relieve pain and change central activation
- Avoid positions that compress tendon

(Cook & Purdam 2009; Vicenzino 2015, Rio et al. 2015)

Reducing Compression
- Important for insertional tendinopathies
- Change training strategies
- Reduce stretching
- Offload tissue (heel lift, brace)
- Complete rest contraindicated
  - Decreases mechanical strength of the tendon
  - Induce tendinopathic changes secondary to lack of mechanical stimulus

Reducing Compression

Management
Late Dysrepair/Degenerative
- Chronically overloaded athletes and older people with stiff and nodular tendons
- Treatments to stimulate cell activity and protein production (collagen/ground substance) and restructure the matrix
- Transverse frictions and extracorporeal shock wave therapy less effective than exercise and not superior to placebo
- Eccentric exercises
  - Improves tendon structure and pain in both the short and long term
  - Decreases tendon neovascularization
  - Improves pain within 4-6 weeks
- Heavy slow resistance exercises also reduce pain and thickness and neovascularization


Structure, Pain, and Function

Unloaded tendon with low capacity (e.g. older persons, post-injury), susceptible to overload resulting in pathology and pain

Pathology and pain with loss of function (reactive, reactive on degenerative)

Degenerative non-painful tendon with poor function, can rupture

Degenerative non-painful tendon with good function, can rupture

Pain

Pathology

Management

Tendon dysrepair
- Intervention addressing core function and load intensity
- Interactions directed at core tendon function and load intensity
- Degenerative tendinopathy
- Intervention directed at core tendon function and load intensity
- Limited ability to remodel tendon attachments
Management

Suggested rehabilitation progression for patellar tendinopathy.

<table>
<thead>
<tr>
<th>Phase of rehabilitation</th>
<th>Aim of treatment</th>
<th>Interventions</th>
<th>Example exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tissue management</td>
<td>Reduce pain</td>
<td>Isometric exercise to maintain an enhanced, flexible, and painless knee flexor mechanism.</td>
<td>Squat exercises on low resistance.</td>
</tr>
<tr>
<td>Strength progression</td>
<td>Improve strength</td>
<td>Progressive overload program, increasing the number of repetitions.</td>
<td>Split squats, faster stairs, skipping exercises.</td>
</tr>
<tr>
<td>Functional training</td>
<td>Increase power</td>
<td>Isometric exercises, addressing power, strength, and endurance training.</td>
<td>Jumping, deceleration and change of direction tasks.</td>
</tr>
<tr>
<td>Energy storage</td>
<td>Development</td>
<td>Isometric exercises, focusing on muscle endurance.</td>
<td>Exercises for continuous leg extension strength, isometric squats.</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Prevention</td>
<td>Isometric exercises, focusing on muscle endurance.</td>
<td>Education, exercise, and prevention of flare-ups.</td>
</tr>
</tbody>
</table>


EdUREP model

Educational intervention (Ed), Unloading of the tendon (U), Gradual Reloading of the tendon (Re), and Prevention of tendon pain recurrence (P).

Davenport PTJ. 2005

Isometrics for Pain?

- Compared isotonics to isometrics for pain relief

<table>
<thead>
<tr>
<th>Table 2</th>
<th>Loading protocols in the study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apparatus</td>
<td>Prescription</td>
</tr>
<tr>
<td>Isometric</td>
<td>Biodex Pro</td>
</tr>
<tr>
<td>Isometric</td>
<td>Leg extension machine</td>
</tr>
<tr>
<td>Isometric</td>
<td>3 concentric phase</td>
</tr>
</tbody>
</table>


Isometrics for Pain?

- Athletes were advised to complete 5 repetitions of a 30-second double-leg squat using the rigid belt

Rio et al. Can J Sport Med. 2017

Eccentric Exercise

- Conservative approach
- Low-cost
- No equipment
- Self-management
- Effective

Mechanism?

Mechanical sclerosing
Collagen remodelling
Prescription of Eccentric Exercise

First Use:
- **Alfredson’s Heel-Drop Protocol for Achilles Tendinopathy**
  - 3x15 reps knee straight & bent
  - Performed 2x/day for 12 weeks
  - 180 reps per day
  - Overload theory
  - Pain allowed up to 5/10
  - Add weight (up to 50kg)

Achilles Tendinopathy

- Compared Eccentric Protocol to conventional management in 30 middle aged runners with chronic Achilles tendinopathy
  - 3x15 reps knee straight & bent
    - Performed 2x/day for 12 weeks
  - All 15 in eccentric group returned to running vs. all 15 in conventional group had surgery.

Does it have to be PURELY eccentric exercise?

- Eccentric training better results than concentric
  - Achilles (Mafi et al. 2001)
  - Patellar (Jonsson and Alfredson 2005)
  - Tennis elbow (Peterson et al. 2014).
- No strong evidence that eccentric training is superior to isotonic
  - (Couppe et al. 2015; Mallias et al. 2013)
- Heavy Slow Resistance Training (HSRT) has similar or better outcomes compared to eccentric training
  - (Beyer et al. 2015, Kongsgaard et al. 2009, Frohm et al. 2007)

Heavy slow resistance training (HSR)

- Compared eccentrics to HSR
- 3 times per week for 12 weeks
  - 3x15 rep max week 1
  - 3x12 rep max weeks 2-3
  - 4x10 rep max weeks 4-5
  - 4x8 rep max weeks 6-8
  - 4x8 rep max weeks 9-12
- Both groups had similar outcomes out to 1 year
- Exercise does not need to be eccentric only

The Big Question:
Can a Degenerative Tendon Heal?

- Many authors say changes are irreversible

Is it reversible or irreversible change?

[Image of toasting bread]

Irreversible
Mechanotransduction
Process by which “mechanical loading” creates a cellular response
- Mechanical trigger (mechanocoupling)
  - Can be in just isolated region
  - Shear or compression
- Cell to cell communication
  - “signaling proteins” (Ca and inositol triphosphate)
- Effector cell response
  - Tissue repair & remodeling

Can Exercise Change Tendon Histology?


- The evidence suggests that tendon needling improves patient-reported outcome measures in patients with tendinopathy
- There is a trend that shows that the addition of autologous blood products may further improve theses outcomes

Conclusions
- Pain has little linking with pathology
- Tendon pathology exists in asymptomatic persons
- Recovery can occur without reversal of imaging-identified tendon pathology
- No identifiable pathology in some cases
- Tendon pain has transient on/off nature closely linked to loading and excessive energy storage and release in tendon
- Evidence of cortical changes (activation) and central sensitization
- Tendon pain is often persistent
Review of Needle Based Interventions for Tendinopathy

- Cortisone
- Prolotherapy
- Autologous Blood
- PRP
- Dry Needle

Corticosteroids

- US guided corticosteroid injection commonly used
  - Effects are short term, long term outcomes questionable
- Common extensor tendon of the elbow:
  - Short-term symptom relief (<8 weeks)
  - Negative outcomes at 6 months and 1 year
- Rotator cuff: conflicting evidence of any real short-term improvement
- Hamstring tendinosis:
  - 50% of patients improved at 1 month
  - Only 24% of patients >6 months after injection
- Gluteal tendons: Improves symptoms in < 55%

Corticosteroid Disadvantages

- Underlying tendon abnormality is not directly treated
- Temporary symptom relief not completely understood
  - Altered release of toxins as well as inhibition of collagen, extracellular matrix molecules, and granulation tissue
- Use as an anti-inflammatory is questionable
- Injection of corticosteroids directly into a tendon has been shown to weaken tendon and predispose to rupture
- Other potential complications
  - Fat necrosis
  - Depigmentation
  - Suppression of adrenocorticotropic hormone
  - Increased blood glucose levels in patients with diabetes

Prolotherapy

- Involves injection of an irritant, such as hyperosmolar dextrose, into the area of tendinosis
- Thought to improve symptoms by:
  - Causing inflammation, which introduces growth factors that promote healing OR
  - Acts as a vascular sclerosing agent

Prolotherapy Effectiveness and Safety

- Limited evidence to support prolotherapy being safe and effective for treatment of Achilles tendinopathy, plantar fasciopathy and Osgood-Schlatter disease
- Sclerotherapy and prolotherapy may be effective treatments for Achilles tendinopathy and are considered safe
Platelet-rich Plasma (PRP) 
Autologous Whole Blood

**Autologous Blood Injection**

- Peripheral blood is drawn from the patient's arm and re-injected into the pathologic tendon using ultrasound guidance
- Thought to increase concentration of growth factors to the region and promote healing
- With centrifuge, the platelet component of the patient's blood (PRP) can be isolated, concentrated, and then re-injected into area of tendinosis
- Rationale for use of PRP over whole blood
- More concentrated platelets lead to a better clinical response.
- Both types of injections are often combined with tendon fenestration

---

**Platelet Rich Plasma Biology**

Growth Factors increase linearly with platelet concentration

<table>
<thead>
<tr>
<th>Platelet Concentration (thousands/mL)</th>
<th>TGF-β (ng/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000</td>
<td>100</td>
</tr>
<tr>
<td>2,000</td>
<td>200</td>
</tr>
<tr>
<td>3,000</td>
<td>300</td>
</tr>
<tr>
<td>4,000</td>
<td>400</td>
</tr>
<tr>
<td>5,000</td>
<td>500</td>
</tr>
<tr>
<td>6,000</td>
<td>600</td>
</tr>
<tr>
<td>7,000</td>
<td>700</td>
</tr>
<tr>
<td>8,000</td>
<td>800</td>
</tr>
<tr>
<td>9,000</td>
<td>900</td>
</tr>
<tr>
<td>10,000</td>
<td>1,000</td>
</tr>
</tbody>
</table>

---

**PRP vs DN in Rotator Cuff Disease**

- 39 patients with supraspinatus tendinosis or partial tear < 1.0cm
- 2 DN (control) or 2 PRP injections
- Outcomes: SPADI, PROM shoulder, physician global rating at 6-month
- PRP superior to DN 6 weeks to 6 months post injection
- However!!! There is variability in the use of the term DN in the literature; it does not indicate tendon perforation but could entail a single injection to the subacromial space with a dry needle

---

**Cochrane Library**

**Platelet-rich therapies for musculoskeletal soft tissue injuries (Review)**

- 19 studies (RTC repair, shoulder impingement, lateral epicondylitis, knee ligament reconstruction, patellar tendinopathy, Achilles tendinopathy, Achilles tendon rupture)
- Very low quality evidence for slight benefit of PRT in short-term pain (<3 months)
- PRP does not make a difference in function in short, medium or long-term
- Insufficient evidence to support PRP for soft tissue injuries

---

**Autologous Growth Factor Injections in Chronic Tendinopathy**

Michelle A. Sandrey, PhD, ATC

- Wrist flexor and extensor tendinopathy, plantar fasciopathy, patellar tendinopathy
- PRP or autologous white blood cells
- Very low quality evidence for slight benefit of PRT in short-term pain (<3 months)
- PRP does not make a difference in function in short, medium or long-term
- Insufficient evidence to support PRP for soft tissue injuries
- Studies methodologically flawed, autologous whole blood and PRP injection treatments are not standardized
Results of Multiple Systematics Reviews

- RCTs of PRP injection and non-randomized studies: overall low quality (Sheth et al)
- RCTs and non-randomized clinical trials: evidence for autologous injections for plantar fasciopathy were of low quality (Taylor et al)
- More low quality versus high quality studies evaluating autologous injection and PRP
- Studies do not account for differences in healing in load bearing vs non-load bearing tendons; results of one region are not generalizable to another (Combs et al)
- Great variability exists in how treatments are performed and lack of standardized methods: frequency, preparation, concentration (leukocytes, platelets, growth factors)


- Comparison of PRP to placebo/dry needling
- Primary outcome was pain intensity; 2 or 3, 6 months
- Secondary outcome functional disability; 3 months
- Statistically significant difference in favor of PRP
  - Pain intensity at 2-3 months
  - Functional disability at 3 months

In the beginning...

Dr. Janet Travell, left, and Dr. David Simons

Dr. Karl Lewit

History of Dry Needling

- Travell described using hypodermic needles to inject trigger points for injection therapy (local anesthetic) and also dry (mechanical)
  - 22, 25 and 27 gauge needles
- Chang-Zern Hong described trigger point injection "Lidocaine Injection Versus Dry Needling to Myofascial Trigger Point"
  

What is Dry Needling?

Dry needling (DN) is a skilled intervention used by physical therapists that uses a thin filiform needle to penetrate the skin and stimulate underlying myofascial trigger points, muscular, and connective tissues for the management of neuromusculoskeletal pain and movement impairments.

- Solid filiform needle is regulated by FDA as Class II medical device
- FDA definition includes how the needles can be used to pierce the skin
Dry needling is a neurophysiological evidence-based treatment technique that requires effective manual assessment of the neuromuscular system. Physical therapists are well trained to utilize dry needling in conjunction with manual physical therapy interventions. Research supports that dry needling improves pain control, reduces muscle tension, normalizes biochemical and electrical dysfunction of motor end plates, and facilitates an accelerated return to active rehabilitation.

Dry needling is a technique used to treat dysfunctions in skeletal muscle, fascia, and connective tissue, and, diminish persistent peripheral nociceptive input, and reduce or restore impairments of body structure and function leading to improved activity and participation.

TrPs are physiological contractures characterized by local ischemia and hypoxia, a significantly lowered pH (active TRPs only), a chemically altered milieu (active TRPs only), local and referred pain, and altered muscle activation patterns.

Dry needling of myofascial trigger points (TrP) has a different physiological basis versus treatment of connective tissue, fascia etc.

**Description of Dry Needling in Clinical Practice: An Educational Resource Paper, APTA 2013**

- Not intended to be a stand alone procedure
- Therapeutic exercise, neuromuscular re-education and functional training
- Patient education on self-care
- Part of progression to restore movement, return to activity and participation

**The effect of dry needling in the treatment of myofascial pain syndrome: a randomized double-blinded placebo-controlled trial**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Study Details</th>
</tr>
</thead>
</table>

- 39 patients analyzed
- Inclusion: Age 24-65, Symptoms >6 mo. Active TrP in the upper thoracic region
- 22 received TDN, 17 received placebo

**Table:**

<table>
<thead>
<tr>
<th>TrP Location</th>
<th>VAS Scores</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper thoracic</td>
<td>23.4</td>
<td>0.000</td>
</tr>
<tr>
<td>Lower thoracic</td>
<td>15.6</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**Graph:**

- **Before**
- **After treatment**
- **Placebo**
- **Dry needling**

- **VAS Scores**
  - 10
  - 6
  - 0
  - 4
  - 2
  - 1

- **P=0.000**
**Upper-Quarter Myofascial Pain**
Systematic review and Meta-analysis

- 12 RCT analyzed
- Heterogeneous upper quarter pain syndromes
- Dry Needling vs. control/sham
- Dry Needling vs. other interventions (injections, laser, acupuncture and standard rehab)

**Dry Needling vs. Sham**

Immediate (3 RCTs)

Immediate (3 RCTs)

4 Weeks (2 RCTs)

4 Weeks (2 RCTs)

- Recommend dry needleing compared to sham or placebo for immediate reduction of pain (grade A)
- Cautiously recommend dry needleling compared to sham or placebo at 4 weeks (grade A)
- More research needed to establish efficacy of TDN to other interventions for upper quarter pain

**What About Tendon Needling?**

- Deep DN
  - Chemical milieu and pH of skeletal muscle
  - Restores local circulation
  - Local and referred pain
  - Improve ROM
  - Decrease TP irritability

- Superficial DN
  - Mechanoreceptors to slow unmyelinated C fiber afferent
  - Stimulates A Delta fibers
  - Local and referred pain
  - Improve ROM

- Fascia/Connective Tissue DN
  - Influence fibroblast matrix
  - Collagen synthesis and cell proliferation
  - Activation of fibroblasts
  - Mechanotransduction
  - Pain neuromodulation

- Description of Dry Needling in Clinical Practice: An Educational Resource Paper, APTA 2013

**Research Report**
The Effectiveness of Trigger Point Dry Needling for Musculoskeletal Conditions by Physical Therapists: A Systematic Review and Meta-analysis

- Dry needling when compared to control/sham had a statistically significant effect on functional outcomes but not compared to other treatments
- Low to moderate evidence that dry needling is more effective than no treatment
- No difference in functional outcomes when compared to other PT treatment

**Research Report**
Contribution of Dry Needling to Individualized Physical Therapy Treatment of Shoulder Pain: A Randomized Clinical Trial

- 120 individuals with nonspecific shoulder pain were randomized to 1) personalized, evidence based physical therapy 2) trigger point dry needling + personalized, evidence based physical therapy
- Individuals were assessed at baseline, after treatment and 3 months
- Outcomes were pain (VAS), ROM limitations, Constant-Murley score for pain and function and the number of active myofascial trigger points
- Dry needling did not offer benefit in addition to personalized, evidence based physical therapy in individuals with shoulder pain

**APTA- Resource Paper**

- Dry Needling when compared to control/sham had a statistically significant effect on functional outcomes but not compared to other treatments
- Low to moderate evidence that dry needling is more effective than no treatment
- No difference in functional outcomes when compared to other PT treatment

- Deep DN
  - Chemical milieu and pH of skeletal muscle
  - Restores local circulation
  - Local and referred pain
  - Improve ROM
  - Decrease TP irritability

- Superficial DN
  - Mechanoreceptors to slow unmyelinated C fiber afferent
  - Stimulates A Delta fibers
  - Local and referred pain
  - Improve ROM

- Fascia/Connective Tissue DN
  - Influence fibroblast matrix
  - Collagen synthesis and cell proliferation
  - Activation of fibroblasts
  - Mechanotransduction
  - Pain neuromodulation
DN of Fascia and Connective Tissue

- Similar in approach to TrPs
- Palpation of the tissue for adhesion and movement restriction
- Needle directed superficially into adhesion
- Functional reassessment

Tendon Fenestration/Dry Needling

- Use of a needle to treat tendinosis; has been used for decades
- Interventional radiologists use US to ensure accurate placement of the needle into the tendon, avoid other structures, and reduce complications
- Repetitively passing the needle through area of tendinosis:
  - Disrupts the chronic degenerative process
  - Causes bleeding and inflammation
  - Increases local growth factors and other substances that promote healing

Tendon Fenestration Procedure

- US confirms presence of tendinosis
- Skin is scrubbed with cleansing agent and US probe placed in a sterile probe cover with gel
- Local anesthetic with 25-gauge needle
- Needle is inserted along the long axis of the tendon, parallel to the transducer
- 20-gauge needle for
  - Shoulder
  - Hip
  - Knee
- 22-gauge needle for smaller tendons

Technical Aspects

- Needle is passed into the area of tendinosis
- Needle is withdrawn out of the tendon and redirected to cover the area of tendinosis
- If the abnormality is adjacent to bone, needle is advanced to make contact with the bone
- 15 to 30 passes are typically used
- As the needle passes through the abnormal tendon, the tendon tends to soften
- Procedure terminated when area of tendinosis is treated and feels soft during needle advancement.
Pre-procedural Instructions

- Prior to the fenestration procedure, patient is instructed to avoid NSAIDs for 2 weeks before and after the procedure
- NSAIDs alter inflammation, growth factors, and the healing cascade

Post-procedure Considerations

- Avoid NSAIDs for 2 weeks
- Ice is avoided as it may dampen the induced inflammation
- For weight bearing tendons, precautions should be considered to enhance healing and tendon tears
  - Achilles tendon: Walking boot is often used
  - Patellar tendon: Knee brace is used
  - Bracing is not used in the upper extremity or hip region
- Timing of stretching and PT after tendon fenestration is variable in the literature
  - Many authors advocate waiting 2 weeks

Can Outcome Be Predicted?

- According to Jacobson et al. there were no clinical variables (age, sex, tendon, chronicity of symptoms, prior physical therapy, prior corticosteroid injection) that were significantly different between those with a positive vs negative outcome
- Kanaan et al. found that well defined tendon abnormality, based on US was predictive of positive outcome following tendon fenestration

Contraindications

- Bleeding disorders
- Anticoagulated patients
- Presence of local infection
- Presence of underlying tendon tear is a precaution
  - Rupture as a complication of fenestration is thought to increase with the degree of a preexisting tendon tear
  - Must weigh potential risk versus benefit
  - Many authors consider fenestration with tendinosis, interstitial tearing, or partial-thickness tearing up to 50% of tendon thickness

Can We Provide a Similar Intervention with a Smaller Needle??
How do we know if we’re on the target tendon?

- Knowledge of anatomy and ability to palpate target tissue
- Palpation of thickened areas of tendon
- Reproduction of patient’s familiar symptoms

Treatment of 2 Patients with Chronic Infraspinatus Tendinopathy with Dry Needling and Eccentric Exercise

Paul Mintken PT, DPT, OCS, FAAOMPT

University of Colorado
Anschutz Medical Campus

- 30 yo male swimmer 18 month history of posterior shoulder pain
- MRI + for Infraspinatus tendinopathy
- NPRS 6/10 with ER
- QuickDASH 38.6%
- PSFS: 7
  - Swimming
  - Washing hair
  - Shoulder ER

- 34 yo male tennis player with 5 year history of posterior shoulder pain
- US + for Infraspinatus tendinopathy
- NPRS 6/10 with ER
- QuickDASH 27.3%
- PSFS: 6
  - Tennis backhand
  - Reaching behind car seat
  - Reaching across body

Examination

- Painful AROM ER
- Limited and painful shoulder IR and adduction
- Pain with resisted shoulder ER
- Pain to palpation infraspinatus
- Negative ERLS

Intervention

- 3 sessions of dry needling to infraspinatus tendon, most tender areas based on palpation and pt report
- Patient positioned in prone, shoulder flexed to 90 degrees and slight ER

http://nursing-skills.blogspot.com/2014/01/infraspinatus-
Eccentric Exercise Program

- Phase 1: Sidelying ER
- Phase 2: Prone ER at 90 deg flexion
- Exercises were performed 3x15 reps, twice a day, 7 days per week, for up to 12 weeks.
- Load was increased until acceptable pain (<5/10) was experienced.

Outcomes

- 3 sessions of DN and Eccentrics over 3 weeks
- Eccentrics continued for 6 weeks
- Outcomes at 6 weeks
  - NPRS at ret: Patient 1 0/10, Patient 2 1/10
  - QuickDASH: Patient 1 6.8%, Patient 2 11.4%
  - Global rating of change (GROC): Patient 1 +6, Patient 2 +5
  - PSFS: Patient 1 1.33, Patient 2 2.33
- No pain with resisted ER
- Minimal pain (<2/10) with swimming and tennis

Treatment of Patients with Chronic Bicipital Tendinopathy with Dry Needling and Eccentric Exercise: A Case Series

Paul Mintken PT, DPT, OCS, FAAOMPT
Amy McDevitt PT, DPT, OCS, FAAOMPT

University of Colorado Anschutz Medical Campus

Patients

- 3 patients with chronic anterior shoulder pain
- Symptoms > 6 months
- Failed previous course of PT
- Positive examination findings
  - Speed’s test
  - Yergason’s
  - Pain with palpation LHBT
  - Painful flexion AROM

Intervention/Dry Needling

- Insert needles into most painful and/or thickened areas of the tendon up to 3 areas
- “Pepper” the most painful areas 20-30 times
  - Housner et al 2009

Eccentrics: Shoulder flexion with elbow extended; 3 sets of 15 reps twice daily
Eccentrics: Elbow flexion with shoulder extended; 3 sets of 15 reps twice daily

Stretching

- Palm facing up
  - Place on file cabinet or something higher than waist height
- Extend shoulder until tendon pain
  - Hold 30 seconds, 2 times
  - 2-3x/day

Results

- Total visits
  - 5-8 visits
  - 3-6 weeks
- GROC
  - Patient 1 (+6)
  - Patient 2 (+7)
  - Patient 3 (+5)

Outcomes

- Volleyball player (18 months pain)
  - 8 sessions
  - QuickDASH 11%
  - GROC +5
- Rock climber (7 months pain)
  - 5 sessions
  - QuickDASH 0%
  - GROC +7
- Rock climber (12 months pain)
  - 6 sessions
  - QuickDASH 7%
  - GROC +6

Treatment of Patient with Chronic Hamstring Tendinopathy with Dry Needling and Eccentric Exercise

Amy McDevitt PT, DPT, OCS, FAAOMPT

University of Colorado Anschutz Medical Campus

Patient

- 40 yo female, 5 month history of R proximal hamstring insertion pain; pt c/o pain with running and sitting
- NPRS 5
- LEFS 68
- Patient Specific Functional Scale (PSFS) 5.3
  - Running, yoga and LE exercise
Examination

- R gluteus medius, gluteus maximus and ERs weakness
- Myotomal weakness noted on R (L5)
- Single leg stance time decreased on R with decreased lumbopelvic stability and control
- Lateral abdominal endurance test-62 sec
- Tenderness to palpation
  + Bent knee stretch test and modified BKST

Intervention

- 4 sessions of dry needling to R proximal hamstring attachment, most tender areas based on palpation and pt report
- Patient positioned in supine with maximal hip flexion (knee to chest) for dry needling

Eccentric Exercise Program (Jayaseelan et al. JOSPT March 2014)

- Phase 1: Leg curl machine, single leg dead lift, single leg stance stability, supine bridge walk outs; lumbopelvic stabilization (plank, side plank, sidelying hip abduction)
- Phase 2: Phase 1 exercises with increased reps and/or weight; single leg windmills, standing hip hikes, lunges; retro treadmill
- All exercises performed 3 sets of 10-15 repetitions based on form fatigue; pain to be present but not disabling

Outcomes

- 4 sessions of DN and Eccentrics over 3 weeks
- NPRS 1
- LEFS 80
- Global rating of change (GROC) +4 after 1st visit and at 4th
- PSFS 8.3 (running, yoga, biking)
- Improved glut med, glut max strength and lateral abdominal endurance
- Minimal pain with running that resolved within 24 hours of activity

Patients

- Hx chronic anterior shoulder pain (N=10)
- Symptoms > 3 months
- Failed previous course of PT (8/10)
- Positive examination findings
  - Speed’s test
  - Hawkins Kennedy
  - Yergason’s test
  - Pain with palpation LHBT
  - Painful AROM flexion
Treatment Protocol

Dry needling:
- Painful/thickened areas of tendon
- Pepper thickened and painful areas 20-30 times (Housner et al 2009)

Exercise:
- Concentric/Eccentric shoulder flexion with elbow extended 3x15 1X daily
- Concentric/Eccentric elbow flexion with shoulder extended 3x15 1X daily
- Biceps stretch: extend shoulder to tendon pain 2x30 sec 2X day

Results

Total visits
- 3-8 visits
- 2-6 weeks

GROC
- Change of 5-4

Discussion
- DN and EE may be a compliment treatment to manual therapy and strengthening of the rotator cuff and scapular muscles
- Further implications may include avoidance of more invasive techniques such as injection and surgery

Change of 5.4
DN and EE may be a compliment therapy to manual therapy and strengthening of the rotator cuff and scapular muscles.

Further implications may include avoidance of more invasive techniques such as injection and surgery.
Tendon Needling Demonstration

- Video examples of ultrasonography taken during needling of various regions/tendons
- Video demonstration of tendon needling in various regions/tendons
- Reassessment strategies after needling
Achilles Tendon

Future Directions

- Potential positive effects of ultrasound-guided tendon fenestration.
- It is unknown which factors influence the outcome of the procedure.
- Does increased vascularity, echogenicity, or size of the tendon abnormality at ultrasound influence results?
- Chronicity: It is unknown whether chronicity of the symptoms, prior treatments, and patient variables such as age or smoking affects outcome.
- Technique: It is unknown whether needle choice or number of needle passes through the tendon has an effect. Lastly, because other percutaneous ultrasound-guided tendon injections such as hyperosmolar dextrose, autologous whole blood, and PRP also involve tendon fenestration during the procedure, does tendon fenestration alone produce similar results compared with these tendon injections?

References