

Interventional MSK US: Tendon Treatments and PRP

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1

Disclosures:

- Consultant: Bioclinica
- Advisory Board: Philips
- Book Royalties: Elsevier
- Not relevant to this talk

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Fundamentals of Musculoskeletal Ultrasound are copyrighted
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2

Outline

- Tendon treatment overview
- Tendon fenestration / tenotomy
- Whole blood injection
- Prolotherapy
- Platelet-rich plasma

3

Tendon: injury

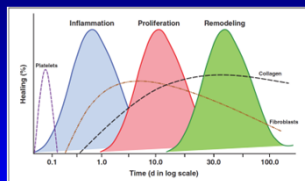
- Acute tensile overload
 - Usually underlying abnormal tendon
- Chronic overuse: repetitive excessive loading
 - Loss of normal tendon architecture
 - Change in tenocyte morphology
 - Altered collagen fibril distribution and neovascularity
 - Microtears
 - Resulting underuse may contribute

Galloway MT et al. JBJS 2013; 95:1620

4

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

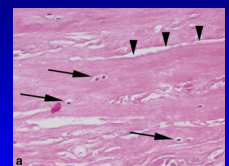


Galloway MT et al. JBJS 2013; 95:1620
Lee KS, et al. Am J Roentgenol 2011; 196:628

5

Tendinosis

- Histologic term used instead of tendinitis
- No acute inflammatory cells
 - Primarily mucoid degeneration
- Inflammatory mediators do exist!
 - Precise role unknown
- Tendinopathy: non-specific term
 - Any tendon pathology



From: Hodler J, et al. JMRI; 2010; 72:811

Mosca MJ et al. BMJ Open Sport Exerc Med 2018

6

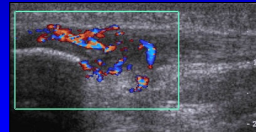
Tendinosis

- 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**

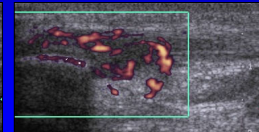
McShane et al. J Ultrasound Med 2006; 25:1281

7

Patellar Tendon: tendinosis



color Doppler



power Doppler

8

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

Lopez-Vidriero et al. Am J Sports Med 2010; 26:269

9

Peritendon Steroid Injections

- Shoulder: minimal transient pain relief¹
- Elbow: common extensor tendon
 - Pain returns worse than before injection²
- Gluteal:
 - 72% showed improvement at 1 month³
- Hamstring:
 - 24% had symptom relief beyond 6 months⁴

¹Mohamadi A et al. Clin Orthop Relat Res 2017; 475:232

²Coombes BK et al. JAMA 2013; 309:461

³Labrosse JM et al. AJR 2010; 194:202

⁴Zissen MH et al. AJR 2010; 195:993

10

Outline

- Tendon treatment overview
- **Tendon fenestration / tenotomy**
- Whole blood injection
- Prolotherapy
- Platelet-rich plasma

11

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

12

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



13

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

14

Fenestration: technique

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

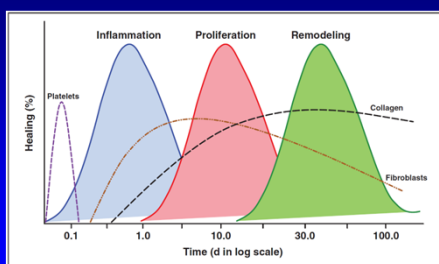
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Post-procedure:

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

16

Phases of Tissue Healing



From: Lee KS, et al. Am J Roentgenol 2011; 196:628

17

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

18

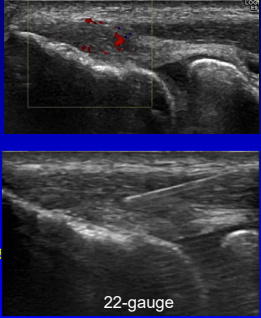
Fenestration: tendons

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

19

Common Extensor Tendon: elbow

- 58 patients¹
- Outcome: average 28 months
 - 64% excellent, 16% good, 7% fair, 13% poor
- Follow-up study: 57 patients²
 - 93% excellent or good results
 - Corticosteroid injection not needed
- Metanalysis vs PRP: inconclusive³

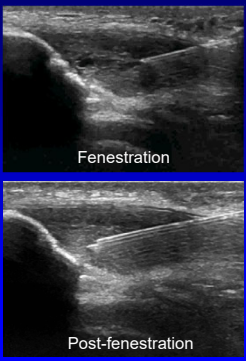


¹McShane JM et al. J Ultrasound Med 2006; 25:1281
²McShane JM et al. J Ultrasound Med 2008; 27:1137
³Kreigh, Am J Sports Med 2013; 41:1435

20

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

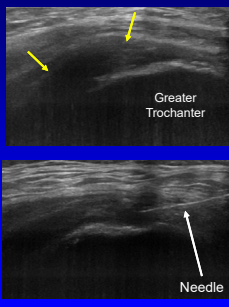


Dragoo JL et al. Am J Sports Med 2014; 42:610

21

Gluteus Maximus and Minimus

- Randomized controlled: 30 patients
 - PRP versus fenestration alone
 - Significant improvement at weeks 1 and 2
 - 80% had long term improvement: up to 1 year follow-up
 - No difference between treatment groups¹
- Two injections: more sustained response²

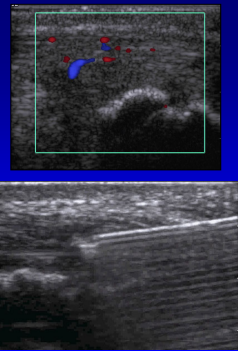


¹Jacobson JA et al. J Ultrasound Med 2016; 35:2413
²Fitzpatrick J et al. Am J Sports Med 2019; 47:1130

22

Achilles Tendon

- Randomized controlled: 54 patients
- PRP versus saline injection
- No significant difference in outcomes
 - At 24 weeks¹
 - At 1 year²
 - *All had eccentric physical therapy



¹de Vos RJ et al. JAMA 2010; 303:145
²de Jonge S. Am J Sports Med 2011; 39:1623

23

Discussion: tendon fenestration

- Studies are relatively limited to date
- Most common site:
 - Common extensor tendon (elbow)
 - Other sites have been attempted
- All studies show improvement
- Procedure well-tolerated
 - Potential risk of tendon tear

24

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 tenotomy¹
 - Risk of tendon rupture

¹McShane JM et al. J Ultrasound Med 2008; 27:1137

25

Ultrasonic Tenotomy (Tenex)

- Ultrasound phacoemulsification
 - Debride and aspirate necrotic tendon
- Irrigation
- Safe and effective
- No comparison studies
 - Outcomes, cost-effectiveness



Williams RC et al. PM R 2018; 2015; 10:313

26

Outline

- Tendon treatment overview
- Tendon fenestration / tenotomy
- Whole blood injection
- Prolotherapy
- Platelet-rich plasma

27

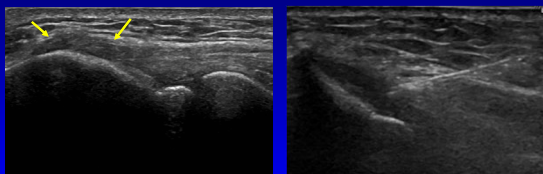
Whole Blood Injection

- 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

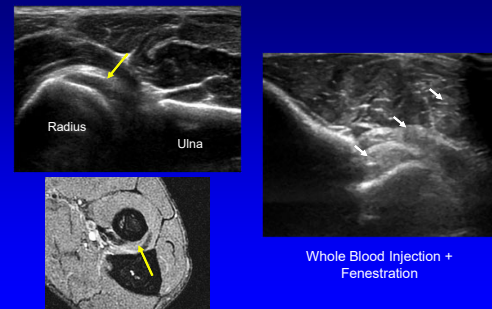
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Whole Blood Injection: Common Extensor Tendon



29

Biceps Brachii Tendon: whole blood injection



30

Outline

- Tendon treatment overview
- Tendon fenestration / tenotomy
- Whole blood injection
- **Prolotherapy**
- Platelet-rich plasma

31

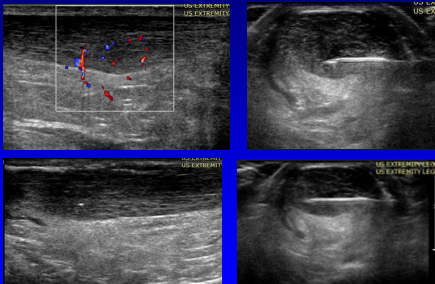
Prolotherapy

- 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

32

Achilles: hyperosmolar dextrose



Courtesy of Mark Cresswell, Vancouver

33

Prolotherapy

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

Maxwell et al. Am J Roentgenol 2007; 189:W215

34

Outline

- Tendon treatment overview
- Tendon fenestration / tenotomy
- Whole blood injection
- Prolotherapy
- **Platelet-rich plasma**

35

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

Giusti et al. BioMed Res International 2014; 26:269

36

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 healing²

¹Giusti et al. BioMed Res International 2014; 26:269
²McCarrel TM et al. JBJS 2012; 94:e143

37

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



38

PRP: how to inject

- No NSAIDS: 10 days before procedure
 - Inhibits platelet aggregation and activation
 - Platelet life span = 10 days
- Sterile technique
- 20 or 22-gauge needle
- Tendinosis: fenestrate during injection
- Tendon tear: target tendon defect

39

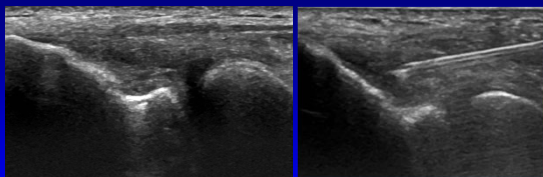
PRP: safety

- Pain: up to several days
- Risks:
 - Infection: PRP has antibacterial effects
 - Tumor:
 - Insulin-like growth factor (IGF) linked to cancer
 - IGF is not elevated in PRP preparations

Giusti I et al. Biomed Res Internat 2014

40

Common Extensor Tendon: PRP



- 22-gauge needle
- In plane with transducer and long axis to tendon
- Fenestrate prior to or during PRP injection
- Most common: one treatment

41

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

Mishra AK et al. Am J Sports Med 2013; 42:453

42

Common Extensor Tendon

- PRP vs fenestration: 230 subjects
 - 24 weeks: PRP higher success (84% vs 68%)
 - Mishra, Am J Sports Med 2013
- PRP, fenestration, steroid (in tendon):
 - No significant difference
 - Krogh, Am J Sports Med 2013; 41:625
- PRP vs whole blood: no difference
 - Thanasis, Am J Sports Med 2011; 39:3120

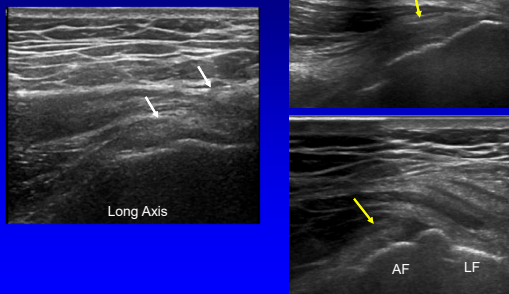
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Common Extensor Tendon

- PRP vs steroid (+fenestration)
 - PRP significantly better at 2 years
 - Gosens, Am J Sports Med 2013; 39:1200
- Metanalysis: inconclusive
 - Krogh, Am J Sports Med 2013; 41:1435
- PRP is superior to steroids
 - Xu G, Int J Surg 2019; 67:37
- PRP is equal to lidocaine
 - Martin GI, J Ortho Surg Res 2019; 23:14

44

PRP: Gluteus Minimus



45

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 groups¹
- Two injections: more sustained response²

¹Jacobson JA et al. J Ultrasound Med 2016; 35:2413
²Fitzpatrick J et al. Am J Sports Med 2019; 47:1130

46

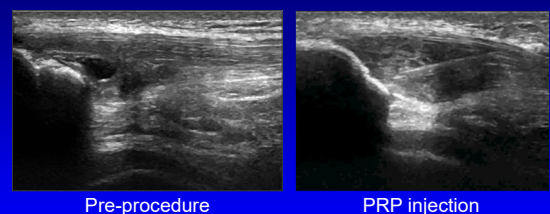
PRP and Tendon Injection

- Gluteal Tendons: greater trochanter
 - Randomized controlled: 80 patients
 - PRP versus steroid injection
 - Ultrasound-guided: 5 – 6 needle passes
- Patients with > 4 months of symptoms had greater clinical improvement with PRP at 12 weeks

Fitzpatrick J et al. Am J Sports Med 2018; 46:933.

47

PRP: proximal patellar tendon



48

PRP and Tendon Injection

- **Patellar tendon**
 - Randomized controlled: 23 patients
 - PRP + fenestration versus fenestration alone
 - PRP better at 12 weeks, no different at 26 weeks¹
 - PRP no better than saline²

¹Dragoo JL et al. Am J Sports Med 2014; 42:610
²Scott A et al. Am J Sports Med 2019; 47:1654

49

PRP and Tendon Injection

- **Achilles tendon**
 - Randomized controlled: 54 patients
 - PRP versus saline injection
 - No significant difference at 24 weeks¹ and 1 year²
- **Metaanalysis**
 - PRP + eccentric physical therapy compared with saline
 - No difference in outcomes: clinical or ultrasound findings³

¹de Vos RJ et al. JAMA 2010; 303:145
²de Jonge S. Am J Sports Med 2011; 39:1623
³Zhang YJ. Clin Orthop Relat Res 2018; 39:1623

50

PRP and Tendon Injection

- **Rotator cuff**
 - PRP not beneficial¹
- **Supraspinatus**
 - Interstitial tear
 - No difference between PRP and saline²

¹Hurley ET et al. Arthroscopy 2019; 35:1584
²Schwitzgubel AJ et al. Am J Sports Med 2019; ahead of epub

51

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
- Cartilage did not increase in thickness

52

PRP: where are we today?

- Promotes healing, does not cause harm
- Need: randomized controlled trials
- Meta-analysis:
 - No conclusive evidence to support PRP use¹
 - Supports ultrasound-guided leukocyte-rich PRP for tendinopathy (still controversial)²
 - Supports use for knee osteoarthritis³
- Accuracy? What about cost effectiveness

¹Sheth U. et al. JBJS 2012; 94:298
²Fitzpatrick J. et al. AJSM 2017; 45:226
³Wang D. et al. JBJS Reviews 2017; 5:1

53

Take Home Points

- Fenestration / tenotomy:
 - Proven effective at many sites
- Other tendon treatments: same
- Platelet-rich plasma
 - Tendon: not proven better than other treatments
 - Osteoarthritis: promising
 - What about cost effectiveness?

54



Syllabus on line and other educational material:
www.jacobsonmskus.com
Twitter handle: @jjacobsn

The image is a blue rectangular banner. On the left, there is an aerial photograph of a city campus with various buildings and green spaces. On the right, there is a photograph of a city skyline at sunset, with buildings illuminated and a bridge over a river. A small logo with a red 'C' and 'M' is visible in the bottom right corner of the left image. Below the images, there is a white text box containing the website URL and Twitter handle.