Ultrasound-guided Tendon Treatments

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Disclosures

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

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

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Outline

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

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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

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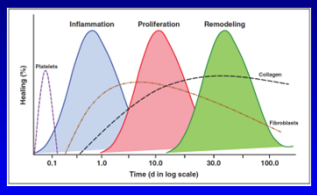
Tendon: healing

- 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

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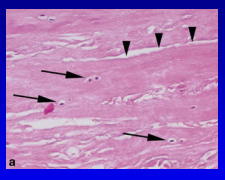
Tendinosis

- Histologic term used instead of tendinitis
- No acute inflammatory cells
  - Primarily mucoid degeneration
- Inflammatory mediators do exist[1]
  - Precise role unknown
- Tendinopathy: non-specific term
  - Any tendon pathology



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

[1]Mosca MJ et al. BMJ Open Sport Exerc Med 2018

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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

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Peritendon Steroid Injections

- Shoulder: minimal transient pain relief[1]
- Elbow: common extensor tendon
  - Pain returns worse than before injection[2]
- Gluteal:
  - 72% showed improvement at 1 month[3]
- Hamstring:
  - 24% had symptom relief beyond 6 months[4]

[1]Mohamadi A et al. Clin Orthop Relat Res 2017; 475:232
[2]Coombes BK et al. JAMA 2013; 309:461
[3]Labrosse JM et al. AJR 2010; 194:202
[4]Zissen MH et al. AJR 2010; 195:993

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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

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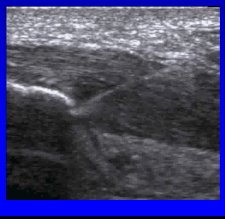
Fenestration: technique

- 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



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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

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Fenestration: technique

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

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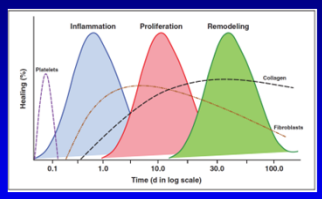
Post-procedure:

- No ice
- Achilles: walking boot
- Rest for 2 weeks
  - Daily activities okay
  - Gradual return to activities
- No NSAIDS: 2 weeks



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

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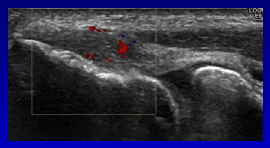
Common Extensor Tendon: elbow

- 58 patients[1]
- Outcome: average 28 months
  - 64% excellent, 16% good, 7% fair, 13% poor
- Follow-up study: 57 patients[2]
  - 93% excellent or good results
  - Corticosteroid injection not needed
- Metanalysis vs PRP: inconclusive[3]

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



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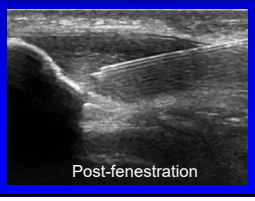
Patellar Tendon

- 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



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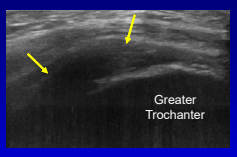
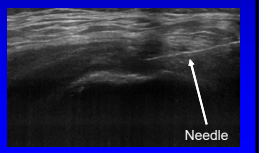
Gluteus Maximus and Minimus

- 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 groups[1]
- Two injections: more sustained response[2]

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





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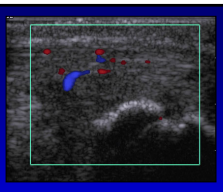
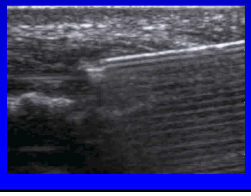
Achilles Tendon

- Randomized controlled: 54 patients
- PRP versus saline injection
- No significant difference in outcomes
  - At 24 weeks[1]
  - At 1 year[2]
  - *All had eccentric physical therapy

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





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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

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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

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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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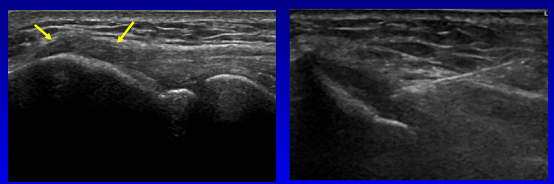
Whole Blood Injection: Common Extensor Tendon



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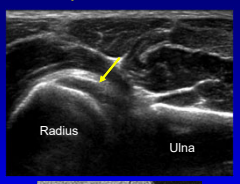
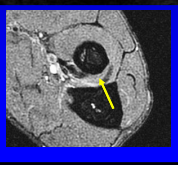
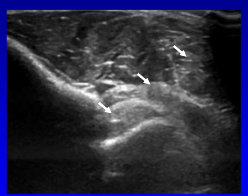
Biceps Brachii Tendon: whole blood injection







Whole Blood Injection + Fenestration

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Outline

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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

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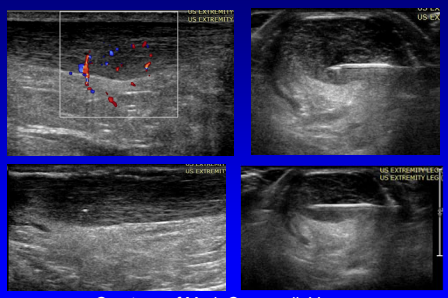
Achilles: hyperosmolar dextrose



Courtesy of Mark Cresswell, Vancouver

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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

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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

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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]

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

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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

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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

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Pre- and post-procedure:

- No NSAIDS: 10 days after procedure
- No ice after procedure
- Initial rest: 2 weeks
- Gradual return to activities
- Begin with mild stretching
- Physical therapy (eccentric)

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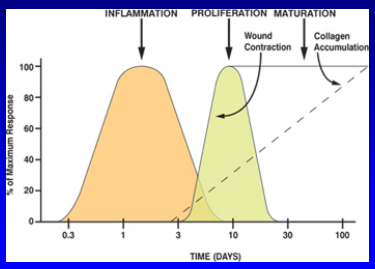
Phases of Tissue Healing



No non-steroidal anti-inflammatory drugs for 2 weeks

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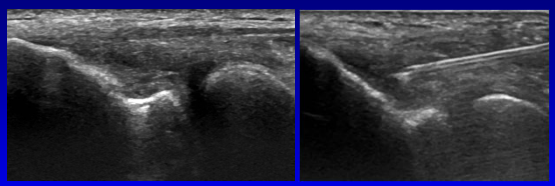
Common Extensor Tendon: PRP



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

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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*
  - Thanasas, 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

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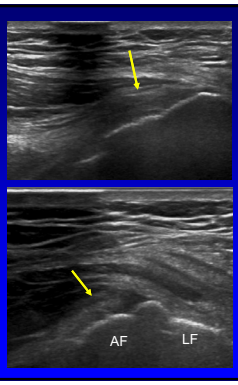
PRP: Gluteus Minimus



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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[1]
- Two injections: more sustained response[2]

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

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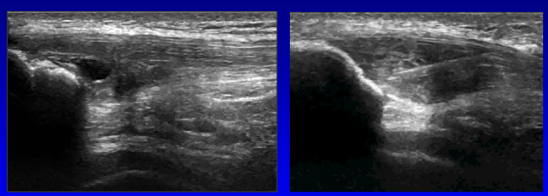
PRP: proximal patellar tendon



Pre-procedure PRP injection

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PRP and Tendon Injection

- Patellar tendon
  - Randomized controlled: 23 patients
  - PRP + fenestration versus fenestration alone
  - PRP better at 12 weeks, no different at 26 weeks[1]
  - PRP no better than saline[2]

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

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PRP and Tendon Injection

- Achilles tendon
  - Randomized controlled: 54 patients
  - PRP versus saline injection
  - No significant difference at 24 weeks[1] and1 year[2]
- Metaanalysis
  - PRP + eccentric physical therapy compared with saline
  - No difference in outcomes: clinical or ultrasound findings[3]

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

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PRP and Tendon Injection

- Rotator cuff
  - PRP not beneficial[1]
- Supraspinatus
  - Interstitial tear
  - No difference between PRP and saline[2]

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

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PRP and Muscle Injection

- Proximal hamstring
- PRP versus rehabilitation only
- Randomized controlled: 28 patients
- PRP group: full recovery earlier
  - 27 days versus 42 days (average)

Hamid MS et al. Am J Sports Med 2014; in print

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PRP and Muscle Injection

- Hamstring
- PRP versus rehabiliation alone
- 10 National Football League players
- Median time: return to play
  - PRP = 20 days vs. rehabilitation =17 days
- No significant difference between groups

Rettig AC et al. Orthopaedic J Sports Med 2013

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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

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PRP and Cartilage

- Meta-analysis: 21 papers
- Increased chondrocyte and mesenchymal stem cell proliferation
- Proteoglycan and Type II collagen deposition
- Increase chondrocyte viability
- Migration of stem cells
- Hyaline vs. fibrocartilage?

Smyth N. et al. Arthrosocpy 2013; in press.

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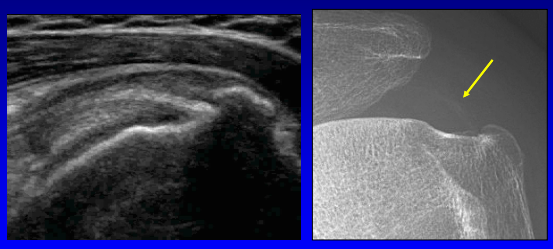
Degenerative Calcification



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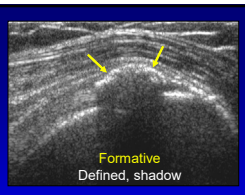
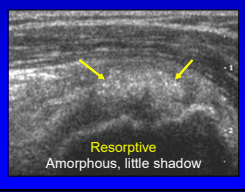
Calcific Tendinosis

- 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





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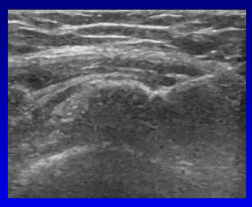
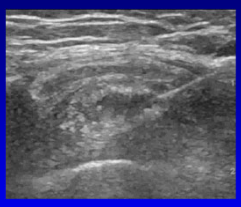
Calcific Tendinosis: lavage/aspiration





- Single puncture: 20 gauge needle
- Lavage: three 10ml syringes: lidocaine
- Shoulder: inject steroids in bursa
- Amorphous type: easier

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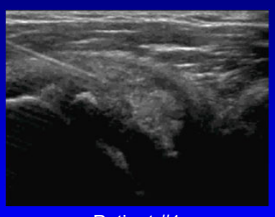
Calcific Tendinosis: lavage/aspiration



Patient #1

Patient #2

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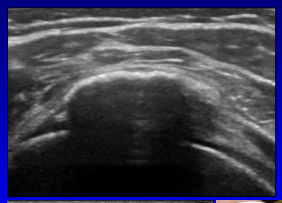
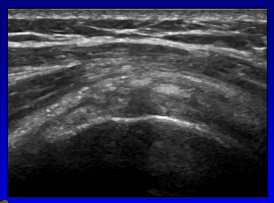
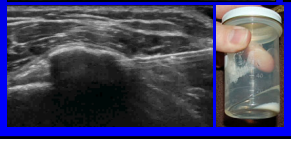
Calcific Tendinosis







3 weeks after lavage and aspiration

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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?

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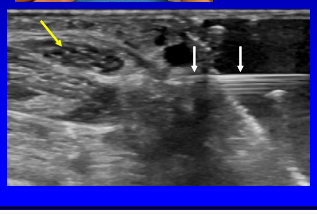
Carpal Tunnel Injection

- Axial plane: ulnar to radial
- Sterile gel stand-off
- Begin over ulnar nerve and stay superficial
- Inject adjacent to median nerve
- Cross-sectional area may decrease within 1 week after steroid injection[1]

[1]Cartwright MS et al. Muscle Nerve 2011; 44:25.

From: Smith J. et al. JUM 2008; 27:1485



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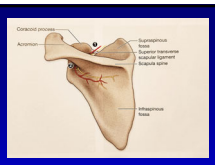
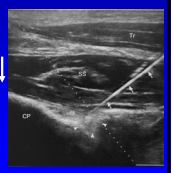
Suprascapular Nerve

- Place transducer on scapular spine
- Move transducer superiorly over supraspinatus fossa
- 22-gauge needle
- Medial to lateral
- 3 ml anesthetic, 1 ml corticosteroid
- Diagnostic or therapeutic





From: Atlas of Ultrasound-guided Musculoskeletal Injections (Malanga and Mautner)

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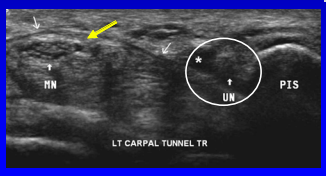
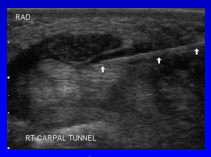
Carpal Tunnel Injection

- In plane
- Transverse plane
- Ulnar to radial





From: Smith J. et al. JUM 2008; 27:1485

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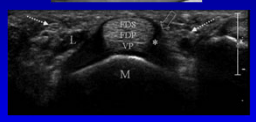
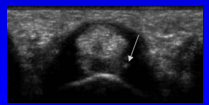
A1 Pulley Injection

- In or out of plane
- 10 mg triamcinolone, 2% lidocaine
- 90% success rate: 1 year





From: Bodor M. et al. JUM 2009; 28:737

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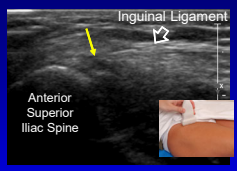
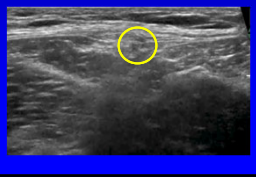
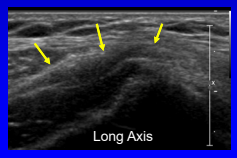
Meralgia Paresthetica

- Sensory: anterolateral thigh
- Hypoechoic enlargement
- Ultrasound-guided steroid injection







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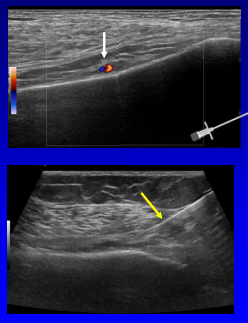
Genicular Nerves

- Located adjacent to genicular vessels
- Metaphysis of femur and medial tibia
- In or out of plane
- 3 ml anesthetic
- Inject adjacent to vessels



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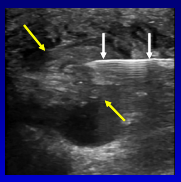
Morton Neuroma

- Steroid injection[1]
  - 3 month: pain relief
- Alcohol injection[2]
  - Symptoms return at 5 yrs
- Radiofrequency ablation[3]
  - 85% effective at 6 months

[1]Thomson CE JBJS 2014; 96A:334
[2]Gurdezi S Foot Ank Int 2013; 34:1064
[3]Chuter GSJ Skeletal Radiol 2013; 42:107



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Thank you!

Syllabus on line and other educational material:
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