The Future of Musculoskeletal Ultrasound in Sports Medicine

Ricardo E. Colberg, MD, RMSK
Andrews Sports Medicine and Orthopaedic Center
American Sports Medicine Institute

Disclaimer

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- I have no conflicts of interest with regards to this presentation
- This presentation includes procedures that are considered experimental and not the standard of care

Objectives

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- Role of ultrasound
- Diagnostics
- 1st generation procedures
- 2nd generation procedures
- 3rd generation procedures
- Introduction to MSK Ultrasound Course

Ultrasound Imaging

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- The use of ultrasound imaging in sports medicine has boomed in the last 20 years…
  - Diagnostic MSK US studies increased 717% from 2000 to 2009
  - Portable US machines have improved
    - Sideline and bedside evaluations are now possible
  - Second and third generation procedures have been developed
    - Tenotomy, tendon debridement, peripheral nerve entrapment release, carpal tunnel release, A1 pulley release, plantar fasciotomy, etc.

Ultrasound in Sports Medicine

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- Ultrasound imaging allows you to see structures up to five times larger than with MRI and diagnose pathology even in bones in half the times it takes for plain films.
  - It is a quick and accurate extension of your physical examination
  - Allows you to perform dynamic imaging
- This is the future = micro-invasive procedures
  - A paradigm shift is occurring similar to what happened with the introduction of arthroscopic procedures 50 years ago

Ultrasound image of sub-centimeter structures

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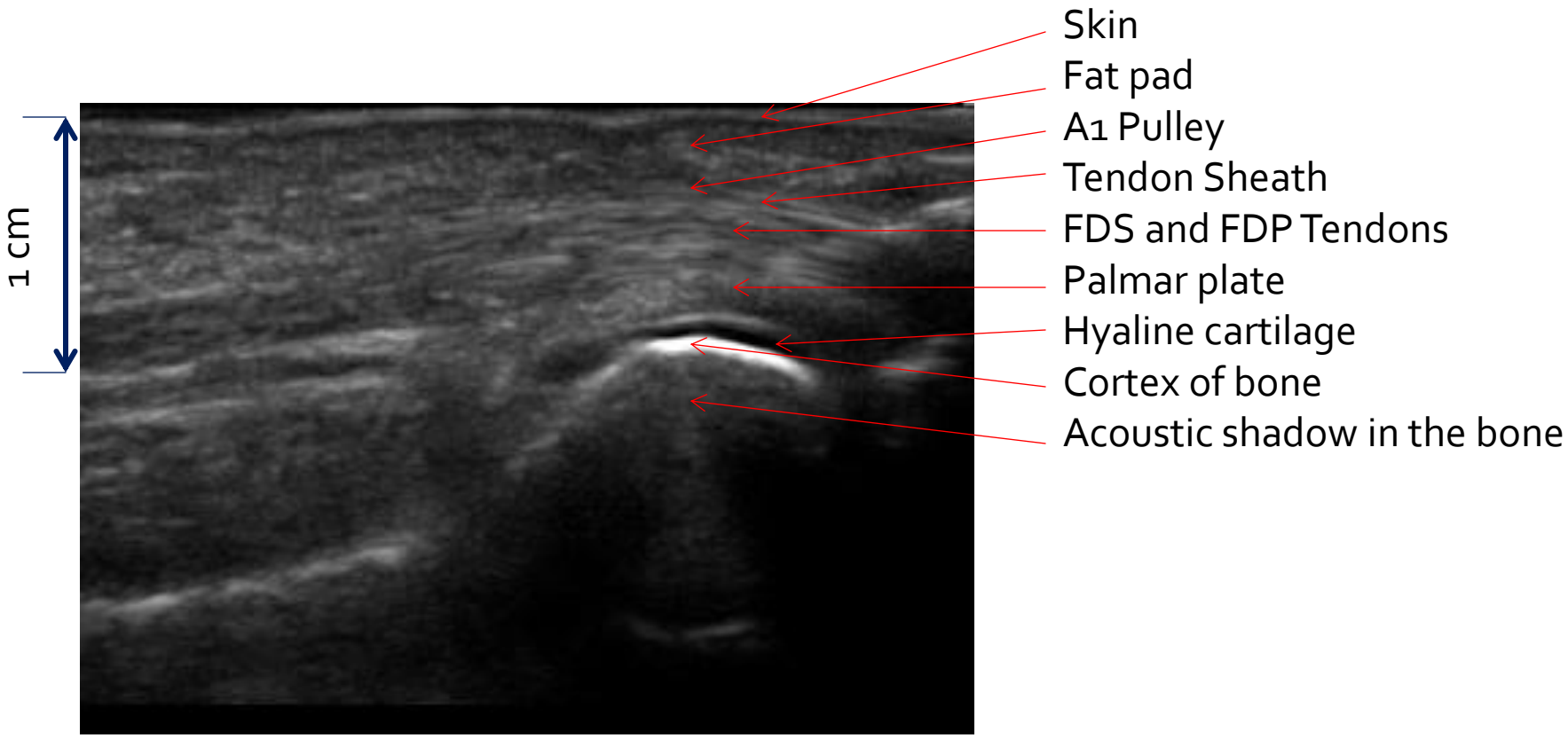

3rd metacarpal and metacarpophalangeal joint

Ultrasound in Sports Medicine

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- Diagnostic Imaging
  - Musculoskeletal evaluation
  - Neurovascular evaluation
  - Echocardiogram
- Sideline Injury Screening – Ex. FAST Protocol
  - At the point of injury – Tendon tear, fractures, pneumothorax, laceration of vital organs, etc.
- Interventional procedures
  - Joint and tendon injections, second and third generation procedures
- Rehabilitation Progress
  - Monitor the healing of an injury

Diagnostic Ultrasound imaging

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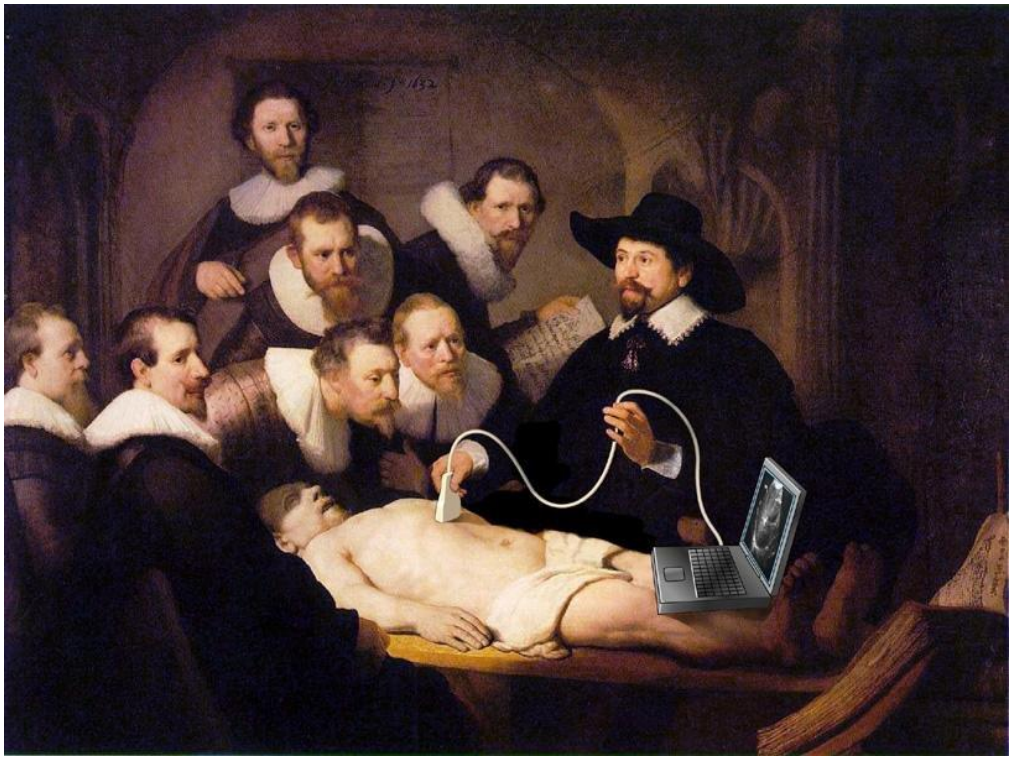

Diagnostic Ultrasound

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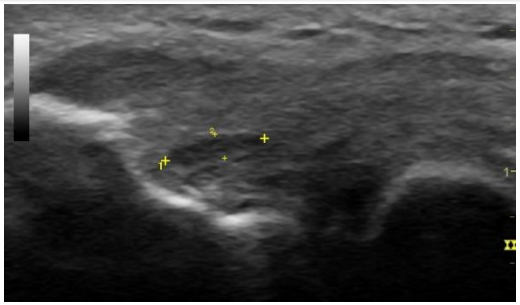
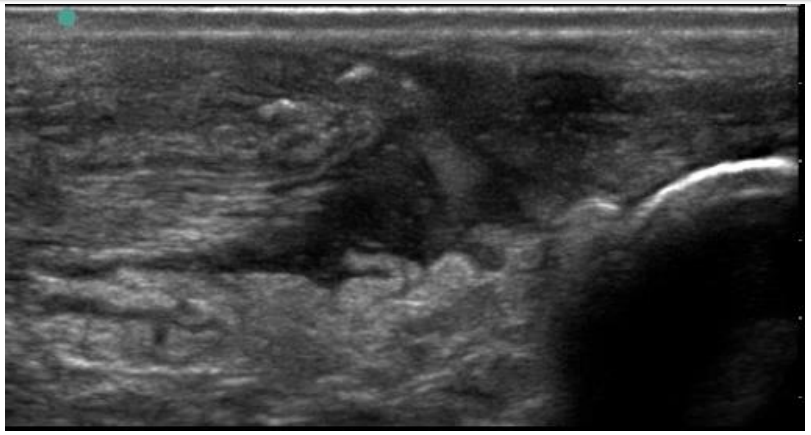
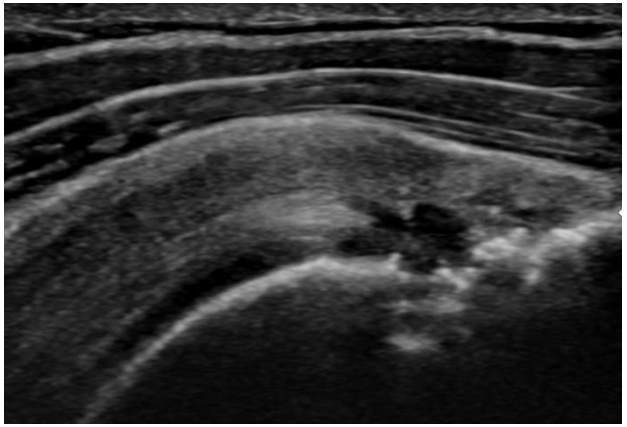


Interstitial degenerative tear of common extensor tendon



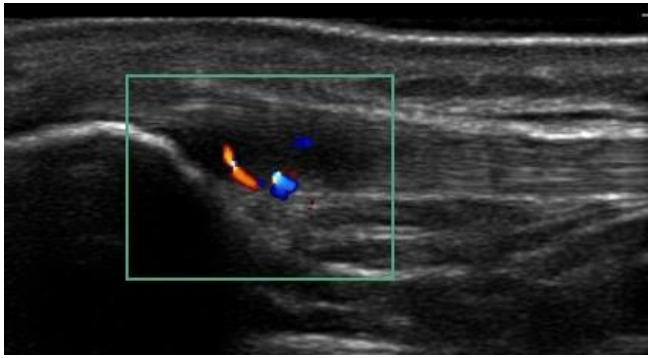
Achilles Tendon Rupture



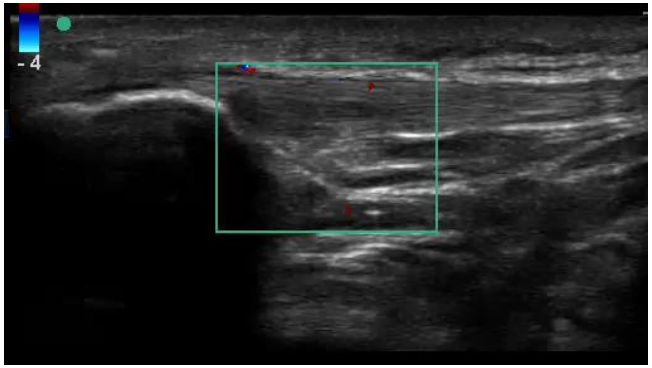
Partial supraspinatus tear, articular side

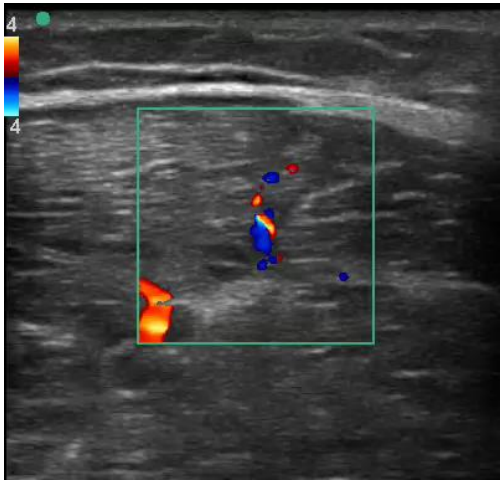
Intrasubstance Patella tendon
Tophaceus Cyst

Color flow images and video



Patella Tendinosis





Quad Contusion

Partial Quad tendon Degenerative tear

Tissue healing progress

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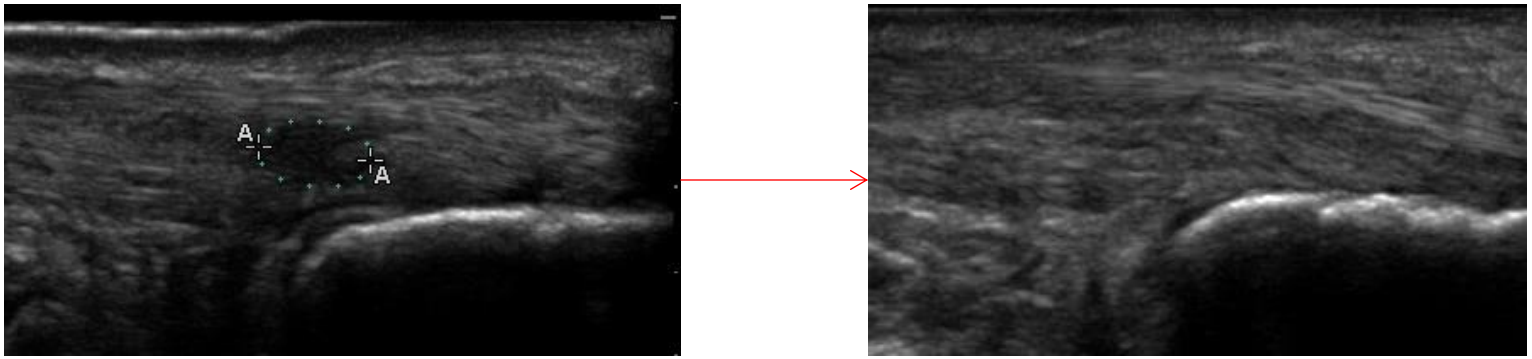
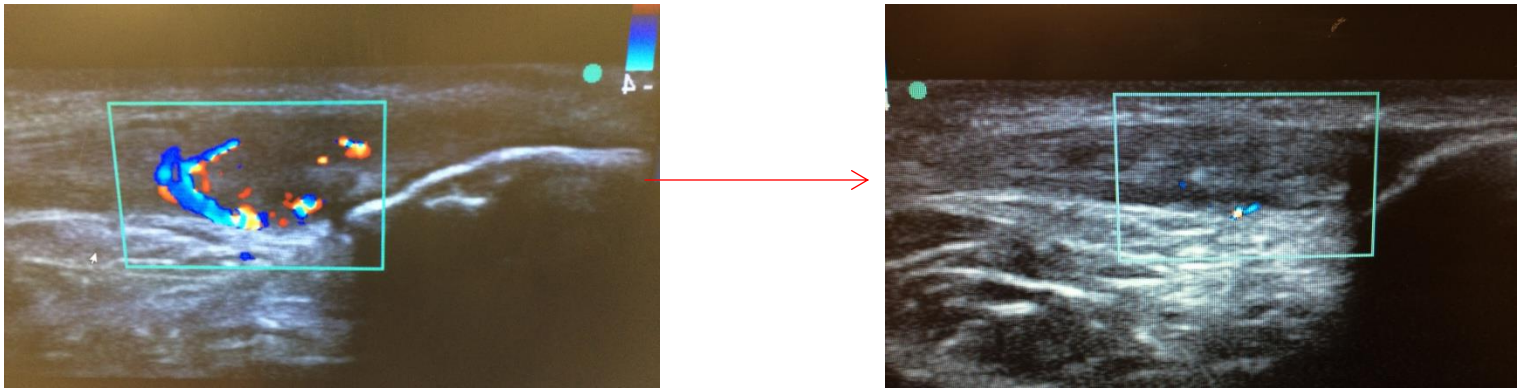
- This can be achieved by direct visualization of the tissue with ultrasound imaging during the rehabilitation process using:
  - Greyscale
  - Color flow
  - Sonoelastography
  - UTC imaging

US pre and post-procedure



Achilles tendon interstitial tear pre and post (3ms) PRP injection (greyscale)



Patella tendon interstitial tear pre and post (3ms) PRP injection (color flow)

Dynamic Scanning

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- Useful for evaluation of:
  - Ligament instability
  - Ulnar nerve subluxation
  - Subacromial impingement
  - Entrapment pathologies (ex. Trigger finger)
  - Snapping tendons (ex. Iliopsoas, IT band)
  - Other mechanical pathologies

Dynamic Scanning

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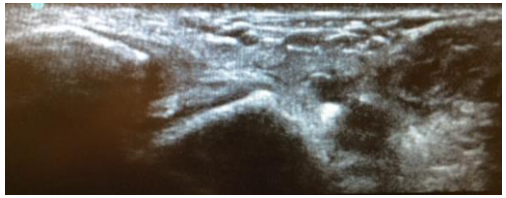
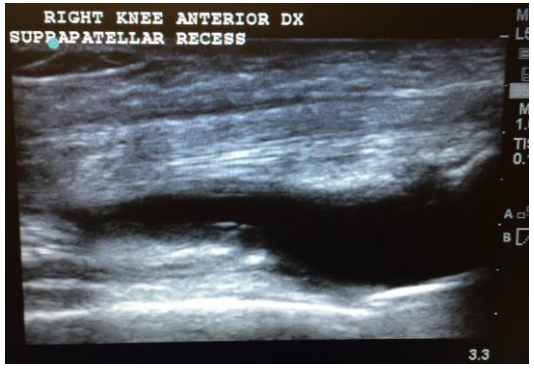
ATFL



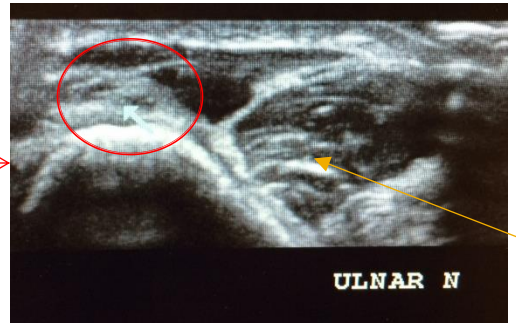
Positive Anterior Drawer



Prefemoral fat pad impingement

Ulnar neuropathy secondary to chronic subluxation

Elbow Extended



Elbow Flexed

Medial head of triceps

Dynamic Scanning - UCL

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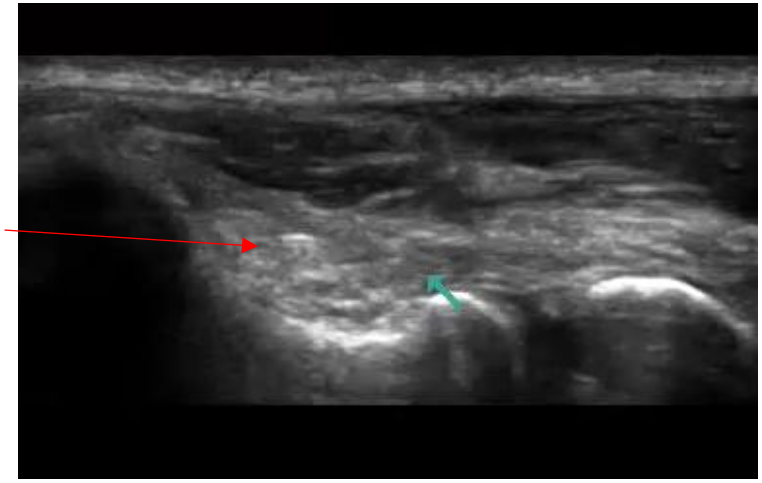
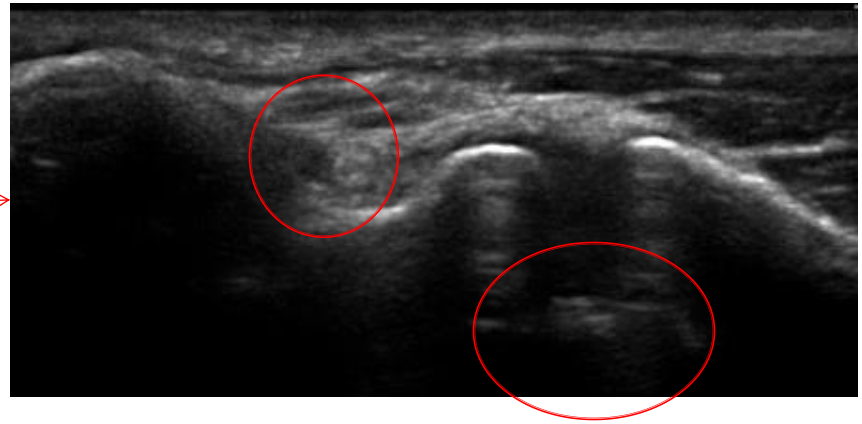
Partial UCL tear





Sideline US evaluation

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- Serves to identify injuries with absolute contraindications for return to play:
  - Fractures
  - Complete ligament tears
  - Tendon ruptures
  - Pneumothorax
  - Liver and spleen laceration
  - Renal and testicular fractures
  - Bladder rupture, etc.

Portable US devices for sideline evaluations

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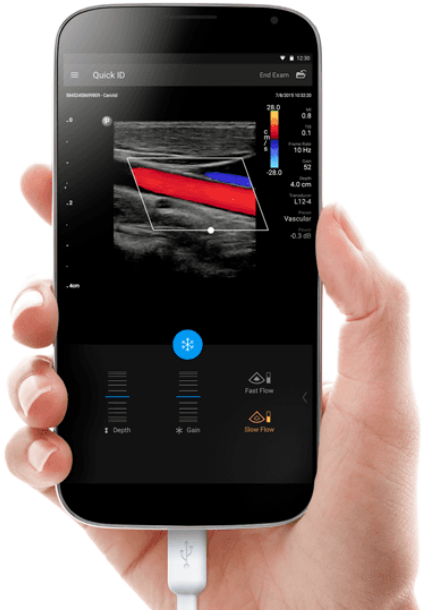

Ultra-high frequency US

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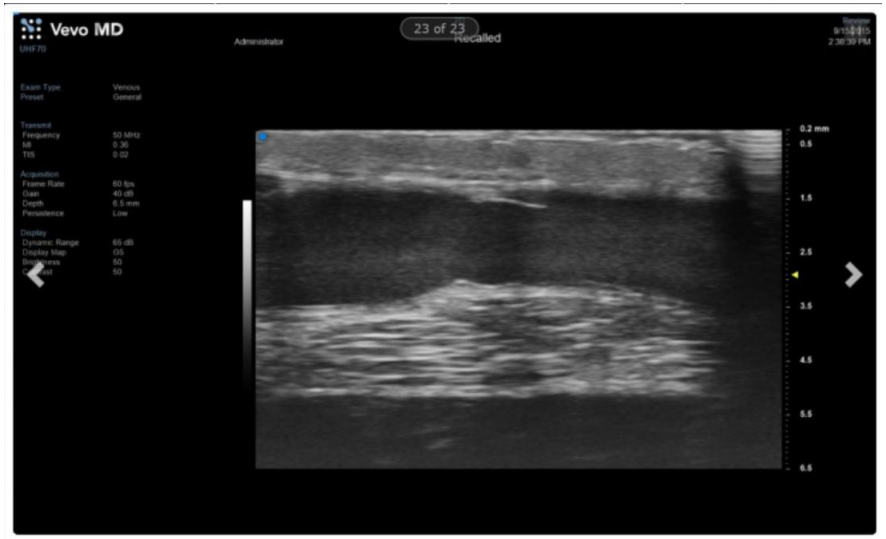
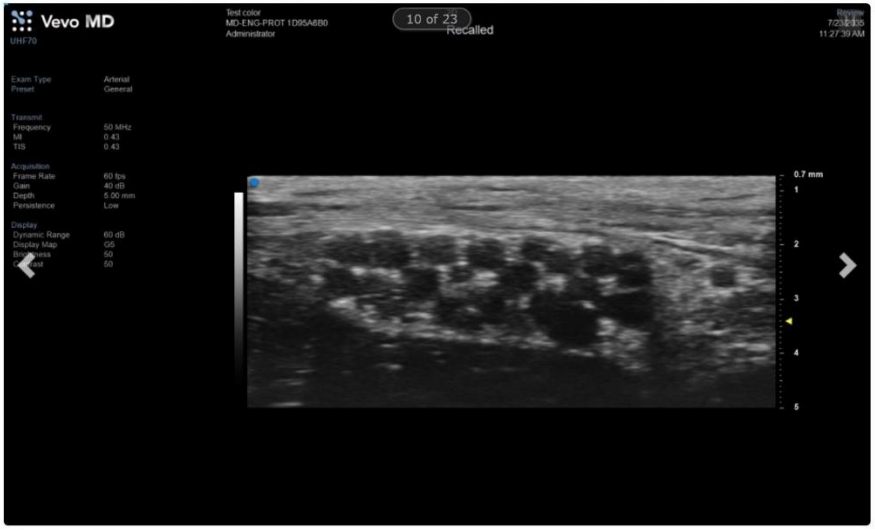
- VivoMD: 22, 48 & 70 MHz



Superficial Vein with Valves

Superficial Vein with Valves imaged using the Vevo MD UHF70 MHz



Median Nerve

Median Nerve imaged using the Vevo MD UHF70 MHz

Ultrasound-guided procedures

Ultrasound-guided procedures

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- 1st generation
  - Joints, tendon sheaths, nerves, aspirations, etc.
- 2nd generation
  - PRP injections, barbotage, tenograms, hydrodisections, etc.
- 3rd generation
  - A1 pulley release, bursectomy, ganglionectomy, Carpal Tunnel release, compartment release, etc.

1st generation Ultrasound-guided procedures

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- Indications
  - Avoid injuring neurovascular structures
  - Inject deep structures that are difficult to access
  - Severe osteoarthritis
  - Morbid obesity BMI >35
  - Failed attempt to inject by palpation in order to confirm placement for diagnostic and therapeutic purpose

Joint Injections

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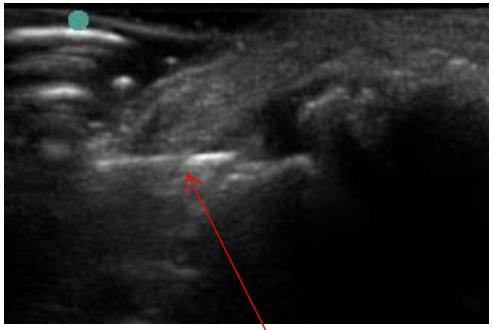
1st CMC joint CSI



Needle

Hip joint CSI

Subtalar joint Injection

Aspiration

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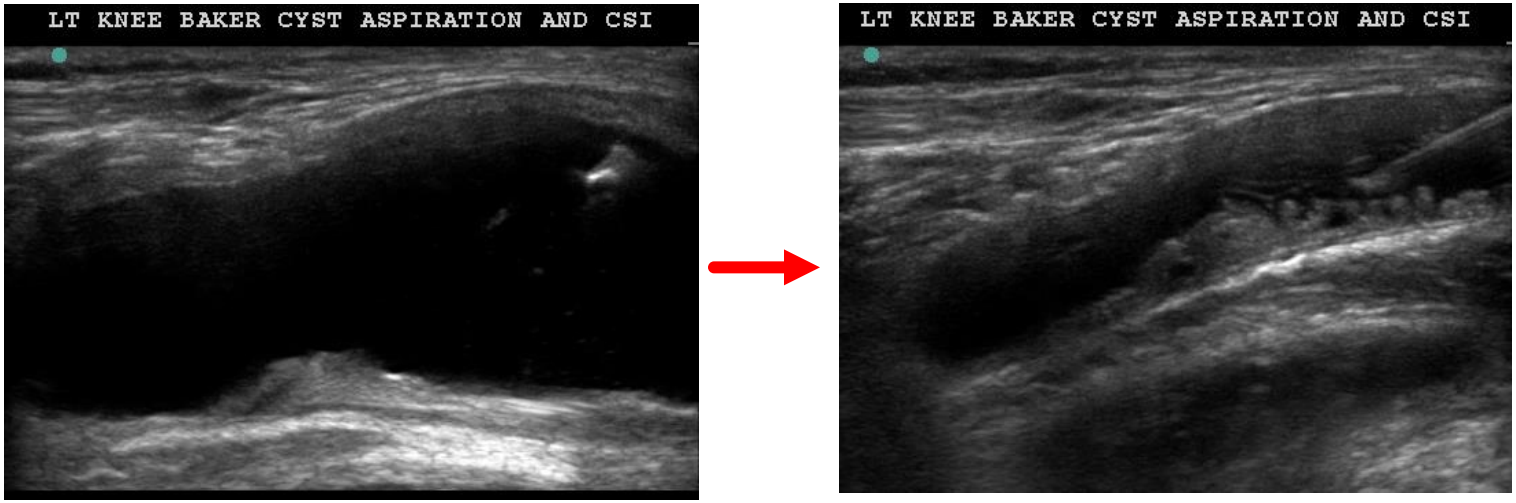
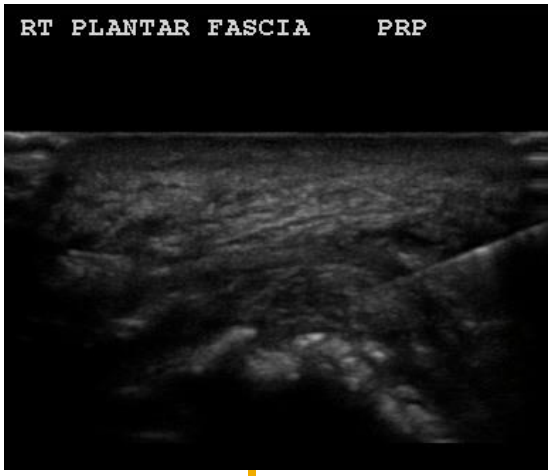
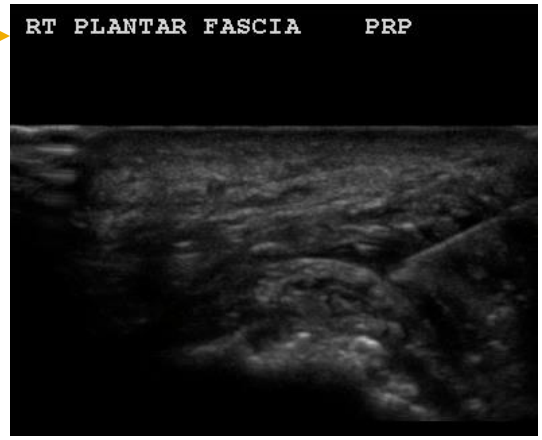
- Baker's Cyst aspiration

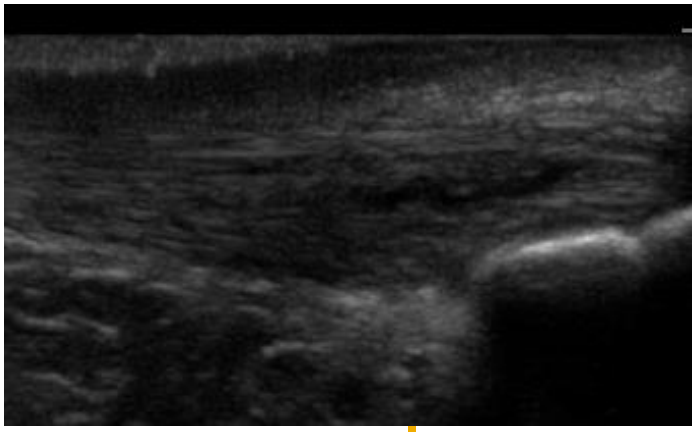


2nd generation procedures

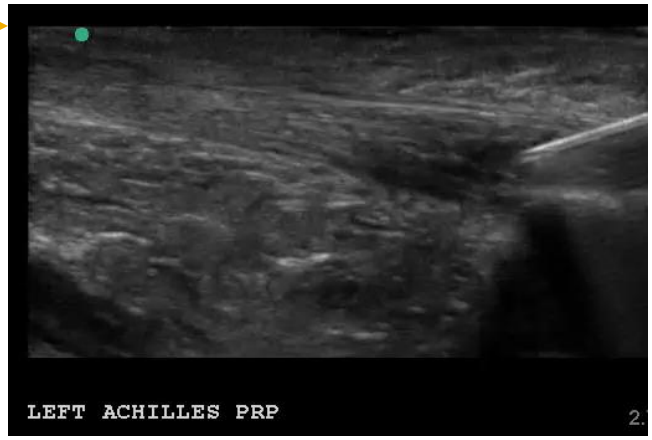


PRP injections





Tenogram of Achilles tendon interstitial tear



PRP for malunion apophyseal fracture

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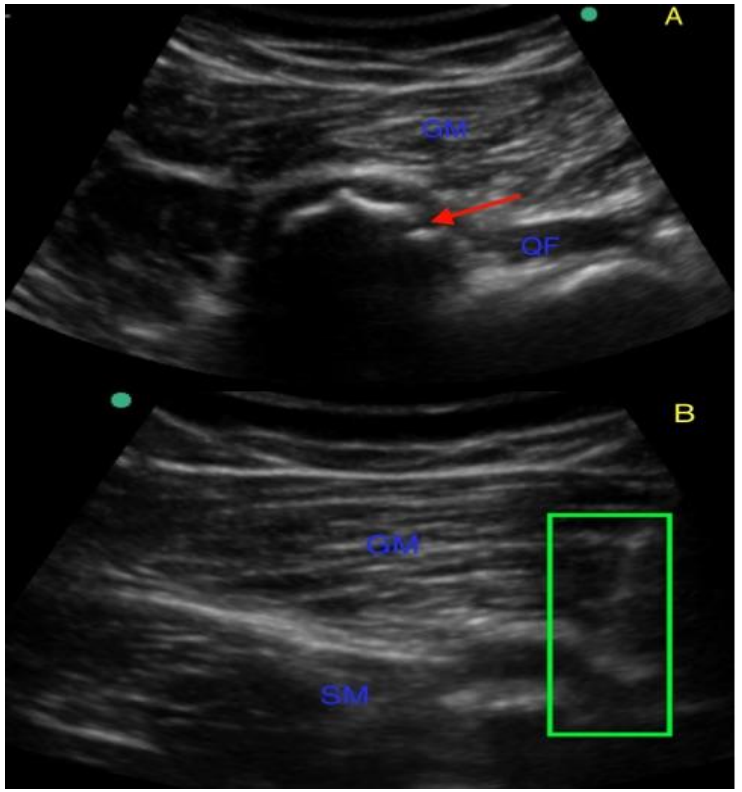
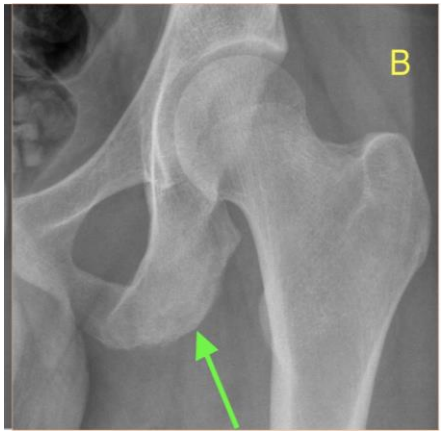
Stafford C, Colberg RE. "When it is more than just a hamstring strain". Podium presentation at the 25th AMSSM Annual Meeting, April 15-20,2018.



3 months after



Tenogram

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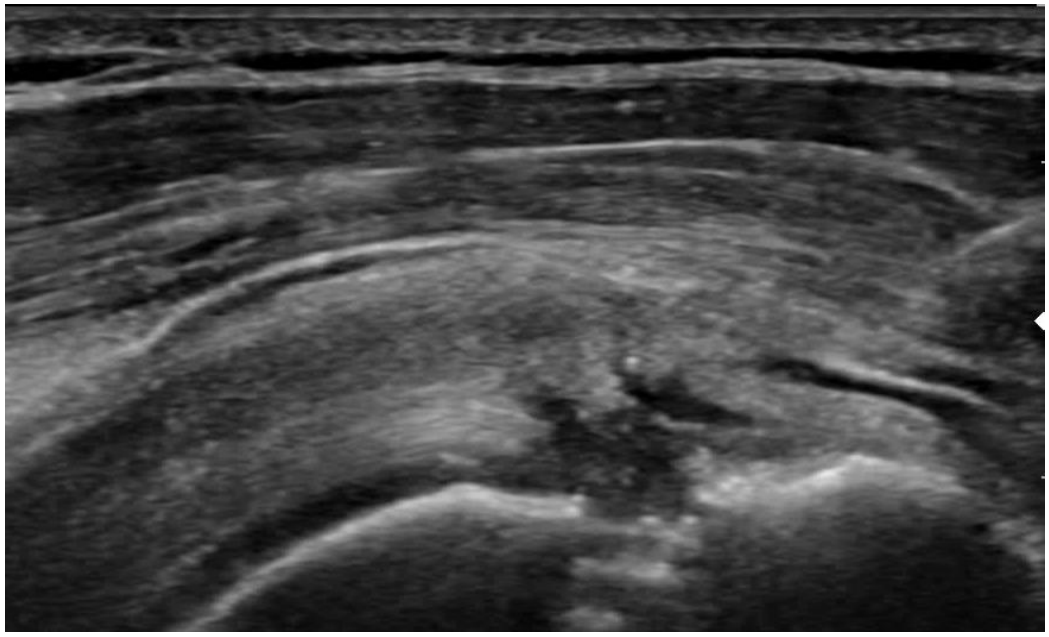
- MRI reported a partial supraspinatus tendon tear.
- The ultrasound tenography confirmed that it was a full thickness supraspinatus tendon tear with fluid extending from the articular surface to the bursa.



Tissue Hydrodissection

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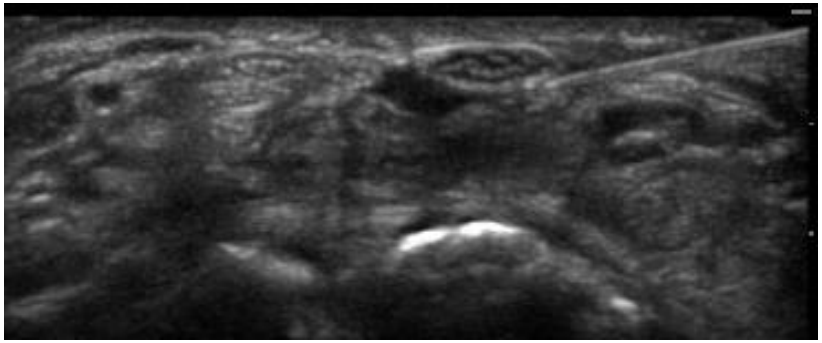
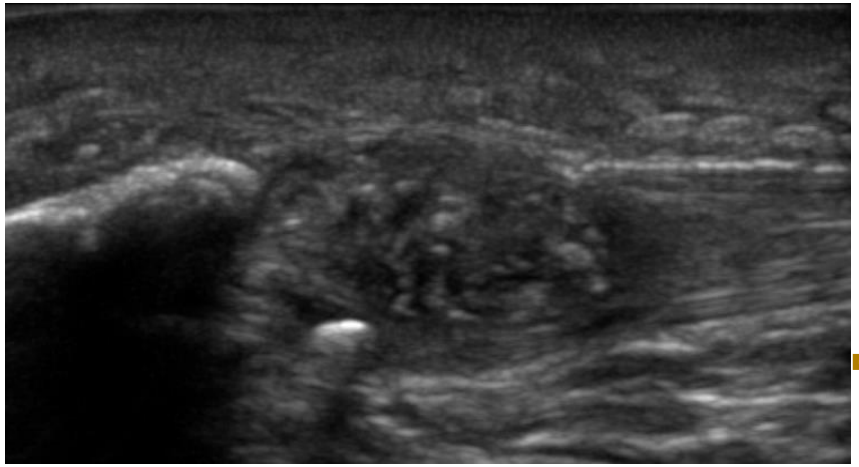
Carpal Tunnel Injections



Tendon Sheath Injection

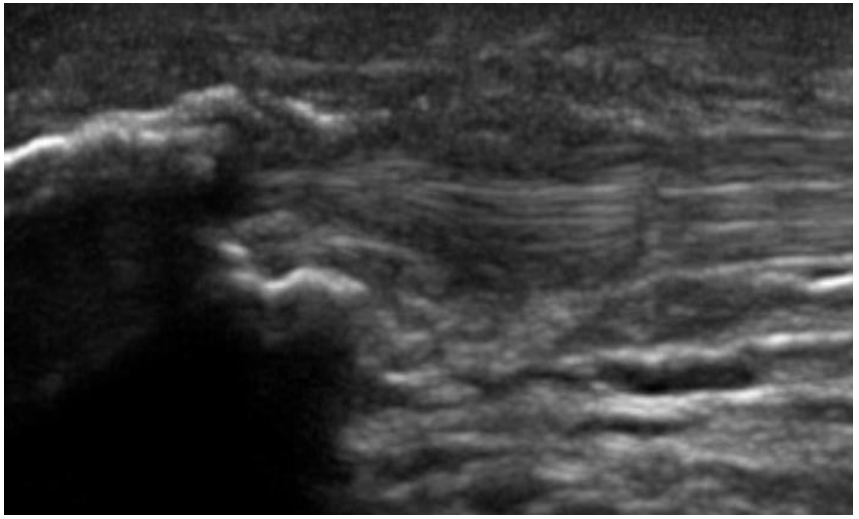
Barbotage

Colberg RE, Henderson RG. Diagnosis and Treatment of Gouty Tophi in the Patellar Tendon Using Ultrasound-Guided Needle Barbotage: A Case Presentation. PM&R. 2017 Sep 1;9(9):938-42.



Tophaceus cyst before barbotage

Tendon 3 months after barbotage



3rd generation procedures

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"Who would have thought 50 years ago that we would be repairing torn meniscus and rotator cuff tendons through the arthroscope."

- Bursectomies
- Ligamentous releases (i.e. A1 pulley, deQuervain, carpal tunnel, etc)
- Tendon debridement
- Plantar Fasciectomy and Fasciotomy
- Compartment releases
- Ganglionectomy

Superficial Achilles bursectomy

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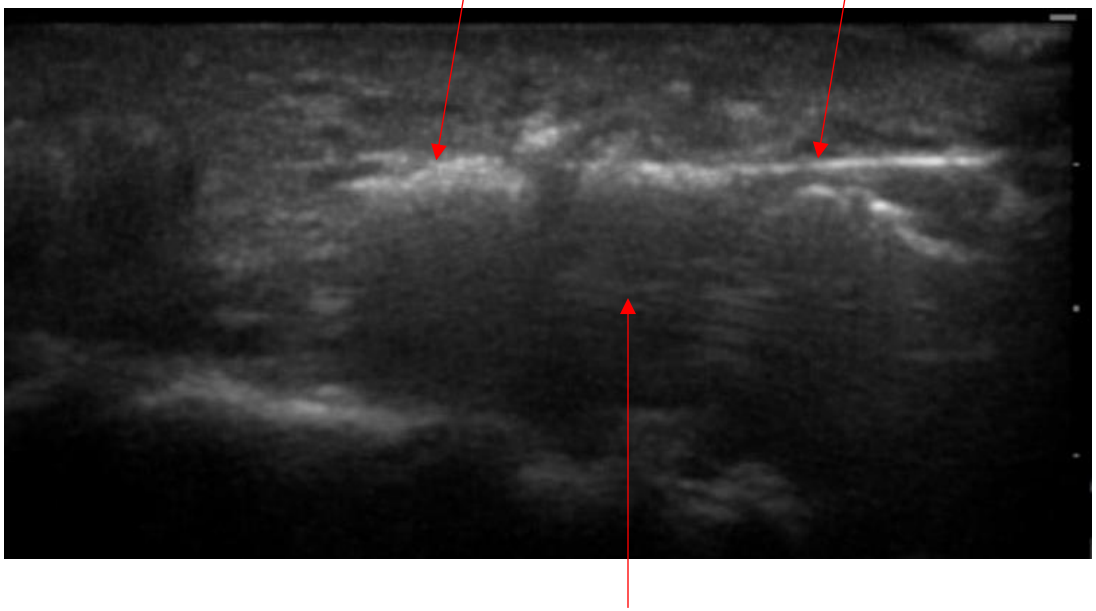
Umarvardia J, Colberg RE. "Chronic superficial achilles bursitis and achilles peritendinitis treated with percutaneous bursectomy and peritendinous debridement: A case report". Poster presentation at the AMSSM Annual Meeting, May 8-13, 2017



Pre and Post-Procedure

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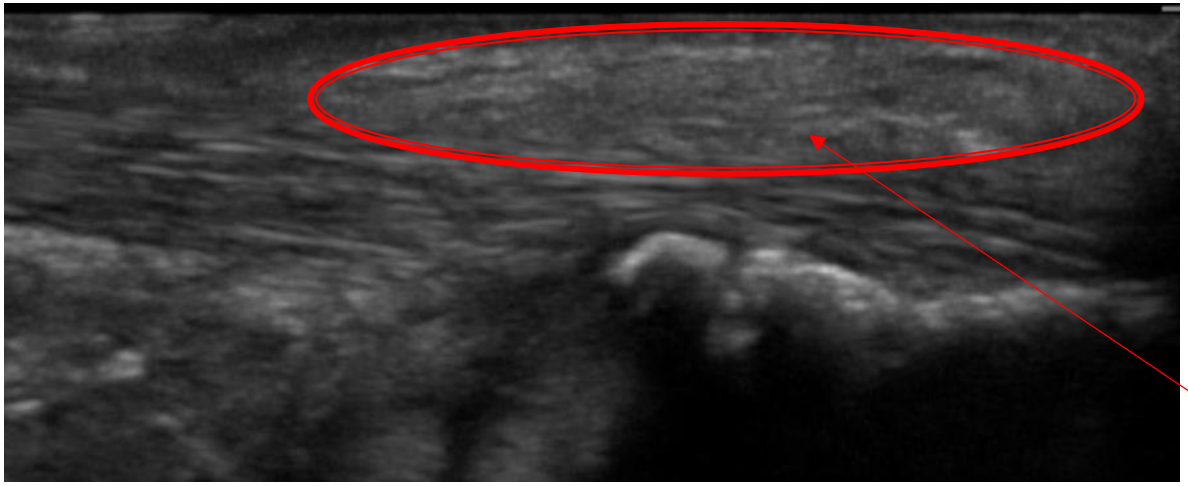
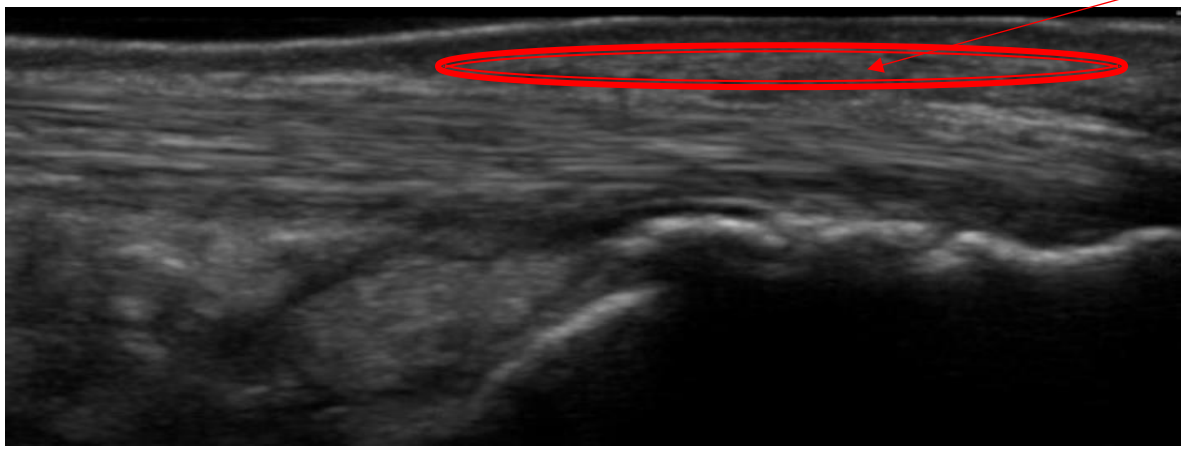
Before



8 weeks after



Resolution of the chronic superficial Achilles bursitis

US-assisted arthroscopic tendon debridement

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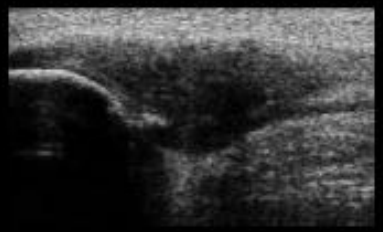
Proximal patellar Tendinopathy

US+Doppler-arthroscopic shaving

Sterile ultrasound gel
Two monitors
Greyscale ultrasound - cross section



Alfredson, Hakan. The Umea Model – Targeting Treatment Outside the Tendon. Presented April 17, 2016 at the 25th Annual AMSSM Meeting.

Intra-patellar tendon debridement

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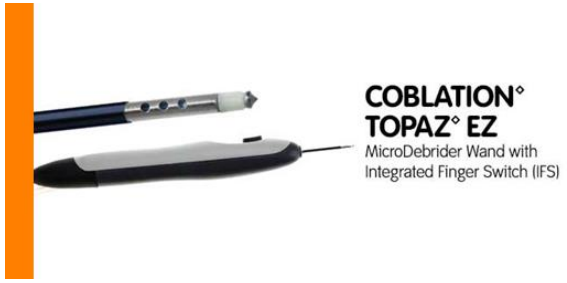
- Instruments used:
  - Supersonic saline debridement
    - Tenex
    - TenJet
  - Plasma field coablation debridement
    - Topaz EZ microdebrider



Intra-patellar tendon debridement

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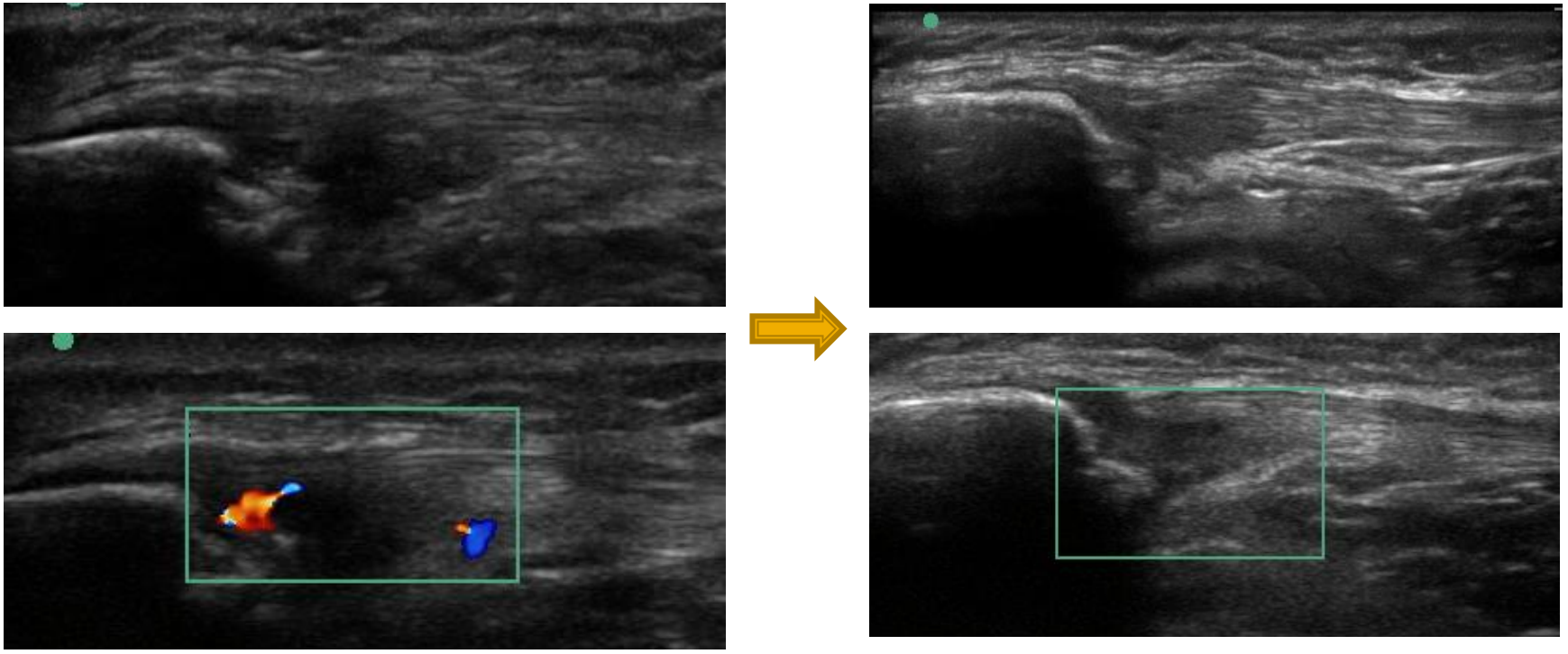
Javer A, Colberg, RE. "13 years old gymnast with chronic knee pain". Poster presentation at the AMSSM Annual Meeting, April 25 – 29, 2018.

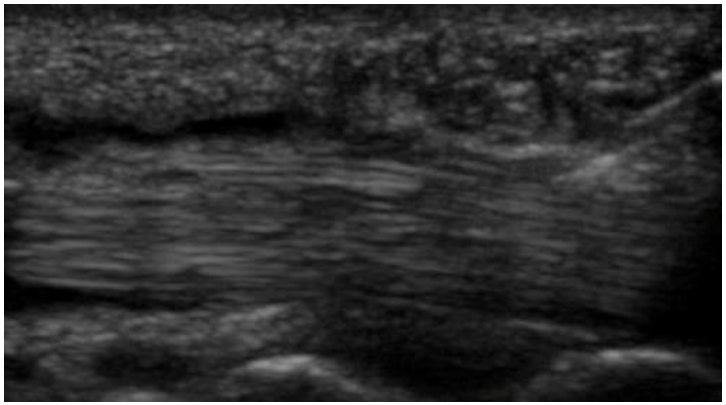


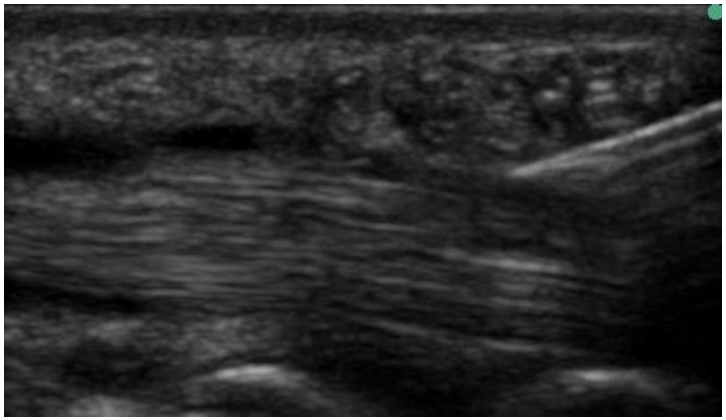
Pre-procedure

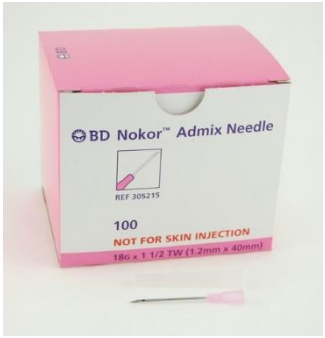
10 weeks after procedure

(using Topaz EZ microdebrider)

A1 pulley and DeQuervain releases







Lapègue F, André A, Pasquier Bernachot E, Akakpo EJ, Laumonerie P, Chiavassa-Gandois H, Lasfar O, Borel C, Brunet M, Constans O, Basselerie H, Sans N, Faruch-Bilfeld M. US-guided percutaneous release of the first extensor tendon compartment using a 21-gauge needle in de Quervain's disease: a prospective study of 35 cases. Eur Radiol. 2018 Apr 4.

A1 pulley release

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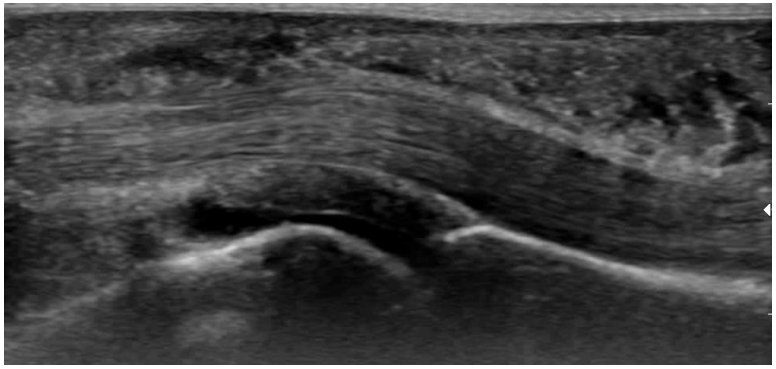
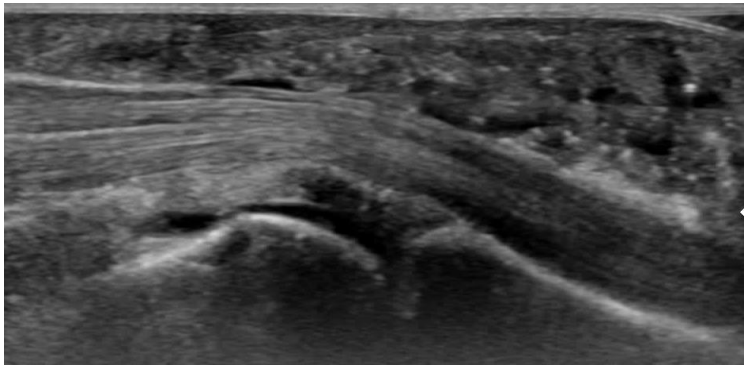
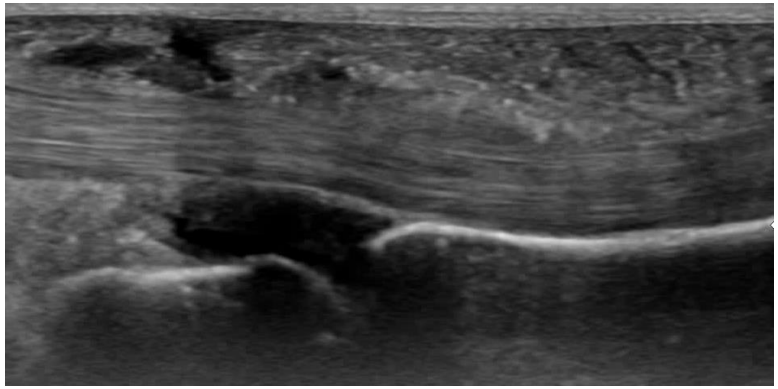
Tendon catching at A1 pulley



A1 pulley after release





Tendon gliding after A1 pulley release

FHL ganglion cyst ganglionectomy

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Lancaster J, Colberg RE. "Not your typical ultrasound guided procedure of the foot". Poster presentation at the AMSSM Annual Meeting, April 25-29, 2018

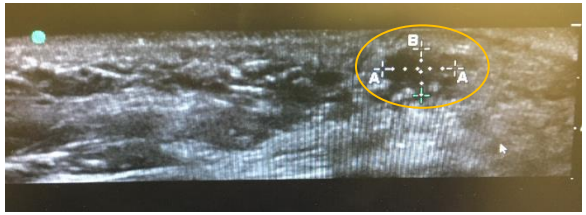
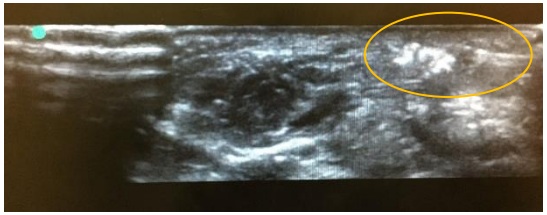


Image 1 (Left): Limited Diagnostic Ultrasound, LAX

Images 2a: Cyst with Wand next to it prior to Ultrasound Guided Debridement, SAX



Images 2b: Cyst after Ultrasound Guided Debridement, SAX

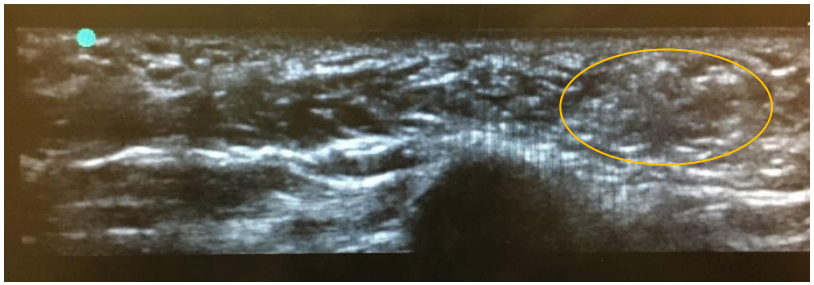


Image 3: Limited Diagnostic Ultrasound on Follow-up, SAX

Carpal Tunnel Release

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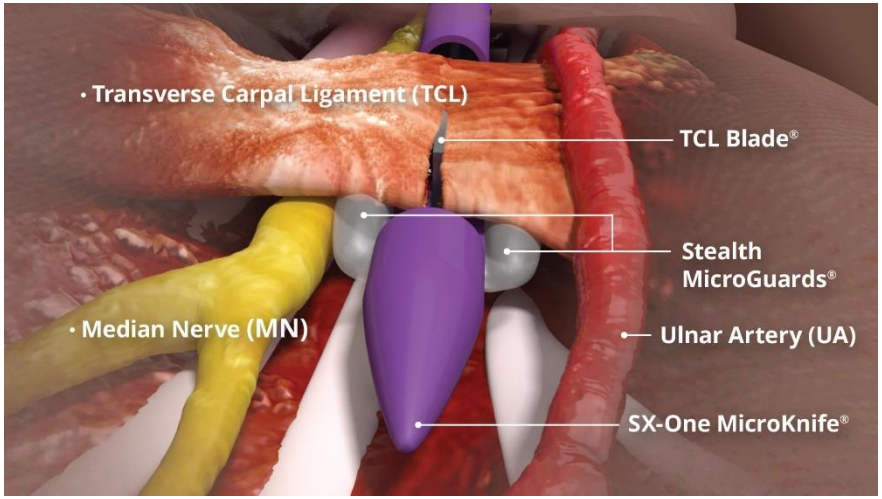
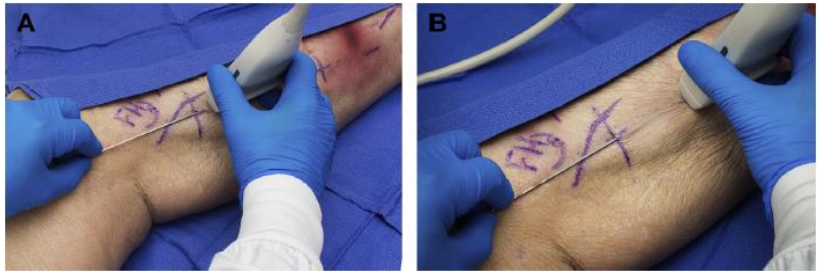
- Sonex Sx-One Microknife



Rojo-Manaute JM, Capa-Grasa A, et al. Ultra-minimally invasive sonographically guided carpal tunnel release: a randomized clinical trial. *J Ultrasound Med.* 2016;37:e37-45.

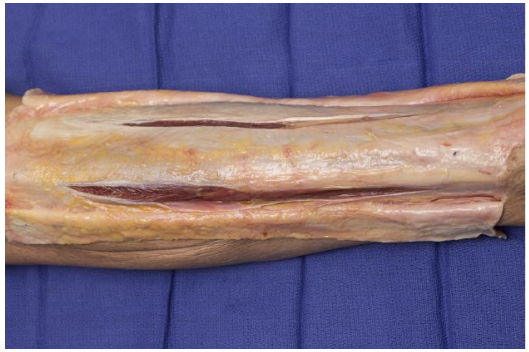
Compartment release

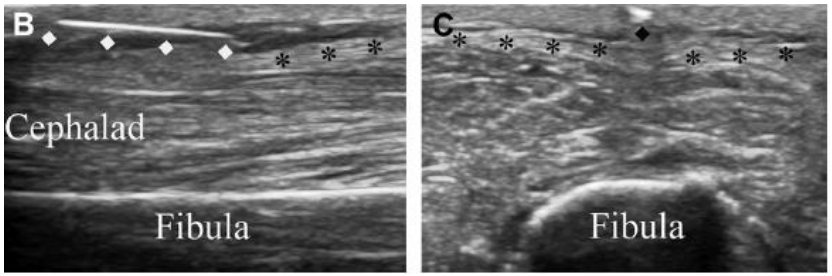
Lueders DR, Sellon JL, Smith J, Finnoff JT. Ultrasound-guided fasciotomy for chronic exertional compartment syndrome: a cadaveric investigation. PM&R. 2017 Jul 1;9(7):683-90.



Landmarks

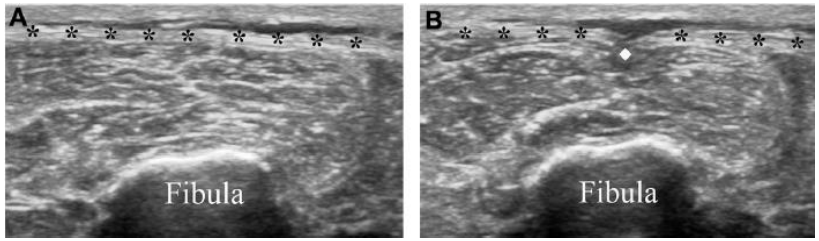
Post-procedure disection





Long and short axis images of release

Images short axis pre and post release



"get your feet wet"

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This lecture

MSK US Course

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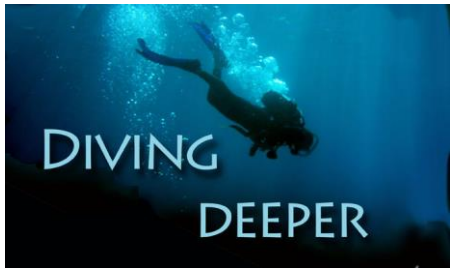

Formal Musculoskeletal Ultrasound Course

Thank you!

Questions?

Ricardo E. Colberg, MD, RMSK
Andrews Sports Medicine and Orthopaedic Center
American Sports Medicine Institute
805 St. Vincent's Dr., Suite 100, Birmingham, AL
205-939-3699
ricardo.colberg@andrewssm.com