



# RhAPP

RHEUMATOLOGY ADVANCED  
PRACTICE PROVIDERS

## Second Annual National Conference

September 30 – October 2, 2021  
Phoenix, AZ



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# **Ultrasound Boot Camp!!**

**Nate Mathews, RMSK**

**Kyle George, PA-C**

**McKenna Syphus, RMA**

# Disclaimer

## **Disclosure of Conflicts of Interest:**

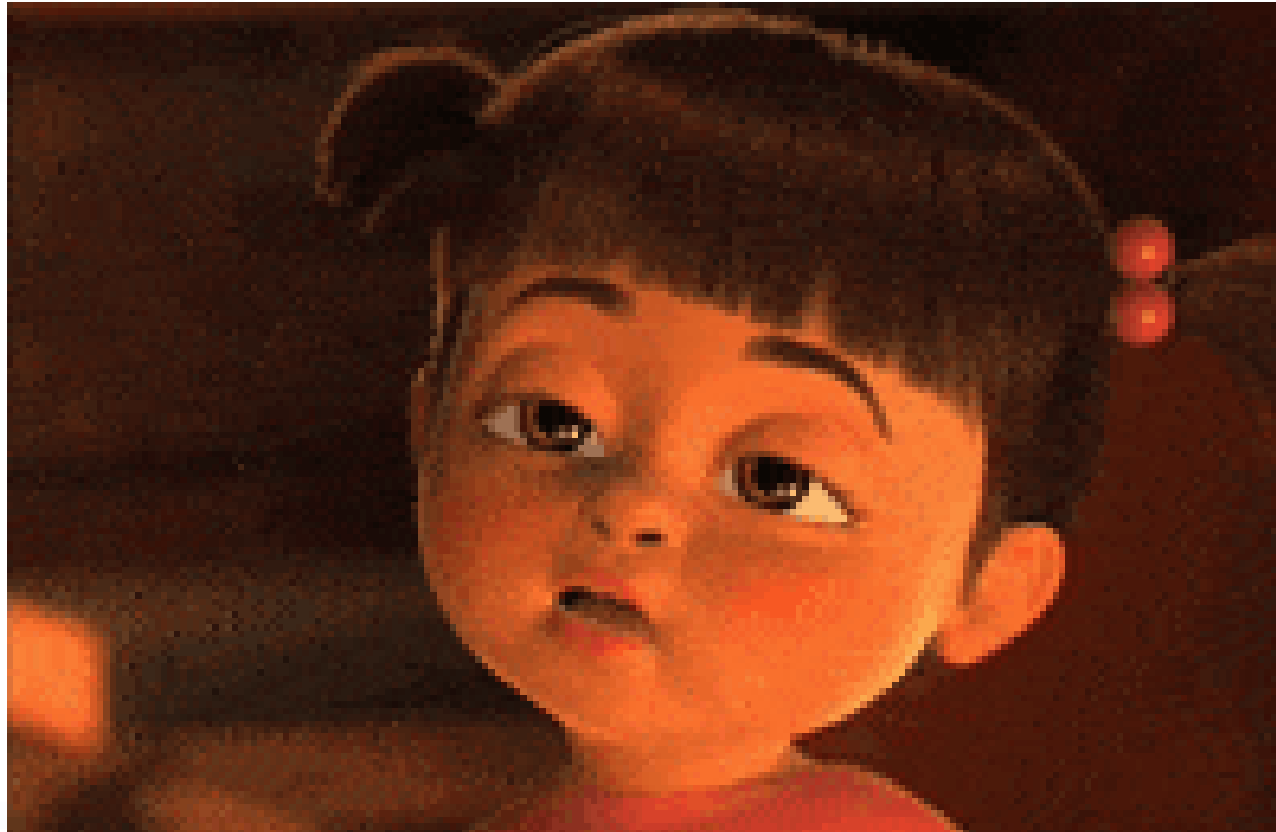
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# Disclosures

➤ None



**BORING!!!**

# Greetings, Everyone!!

Hi in English

hi

Hi in Mandarin



# About Me

Joseph "Nate" Mathews,  
RMSK

- Meridian, ID
- Certified in MSK US in 2012
- RMSK Pioneer
- Worked in Rheumatology for 21 years



The ARDMS proudly congratulates the Pioneer group of new RMSK Registrants.

LARISA LIKVER  
PATRICK LING  
LAUREN LOWN  
ROGER LOWN  
SYED MAHMOOD  
DANIEL MALONE  
JAMIE MALONEY  
SEAN MARTIN  
JOSEPH MATHEWS  
JASJIT MAVI  
MATTHEW MCELROY  
ROXANE MCGONIGAL  
WILLIAM MEDFORD  
VIJAY MEHTA  
PATRICK MEYERS  
JULIA MICHALEK  
ROBERT MONACO  
RANDY MOORE  
ARMOND MORADIAN  
MARK MUILENBURG  
SEAN MULVANEY  
THOMAS NABITY JR  
SHAZIA NASIM  
HO YIN NGAI  
JOHN NITSCH  
SHAHIDA PARVEEN  
LEONARDO PIRILLO  
PRESTON POLLOCK  
ADRIANA POP-MOODY  
NARAYANA PRASAD  
TIMOTHY PROVEDA  
JAMES PROVO  
MARTHA PYRON  
ALBERTO RAMOS CRUZ  
BLAKE RANGLES  
HALEEMA RAUF  
JEFFREY RAYBORN  
DAVID RILEY  
BRIAN ROBERTSON  
JAMES ROBLES

JACOB SELLON  
ROY SETTERGREN  
NOREEN SHUKH  
JOHN SIEVERS  
JAYASHREE SINHA  
DR JONAS SKARDIS  
STEVEN SKUROW  
JAY SMITH  
LISA SMITH  
WAYNE SMITH  
DAVID SOTO QUIJANO  
DAVID SPINNER  
HEINRICH STIENE  
RICHARD STRIANO  
ZANET SWART  
AASIM SYED  
RYAN SZEPIELA  
LIAQAT TALPUR  
JOHN TASSONE  
PHILIPPA TATGE  
HELEN TAYLOR  
SHAWN TIERNEY  
BRIAN TOLLEFSON  
PAUL TORTLAND  
MICHELE TRAVES  
LINDSEY UNDERWOOD  
JAMES VANHUYSEN  
CHRISTOPHER VISCO  
ANANDA WALALIYADDA  
RANMALI WALALIYADDA  
ERIC WATSON  
JOHN WATSON  
KIMBERLY WEEKS  
DAVID WESTERDAHL  
THOMAS WILKINS  
AMY WILKINSON  
AARON WILLIAMS  
WING KEUNG WU  
RALPH YACHOU

JAMIE MALONEY  
SEAN MARTIN  
JOSEPH MATHEWS  
JASJIT MAVI  
MATTHEW MCELROY

(Hey, that's Me!!)

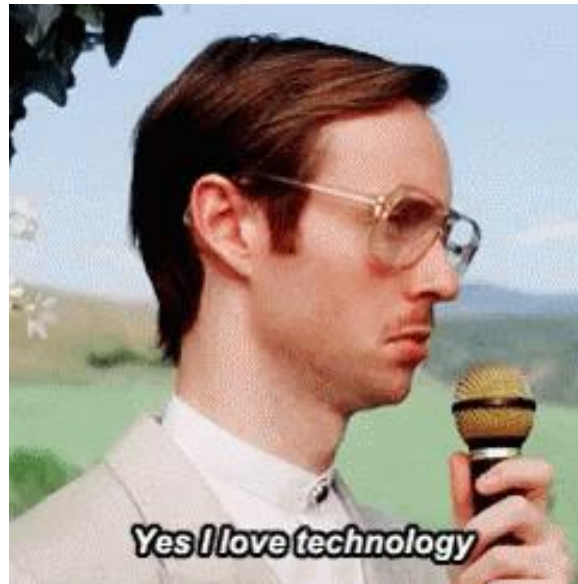
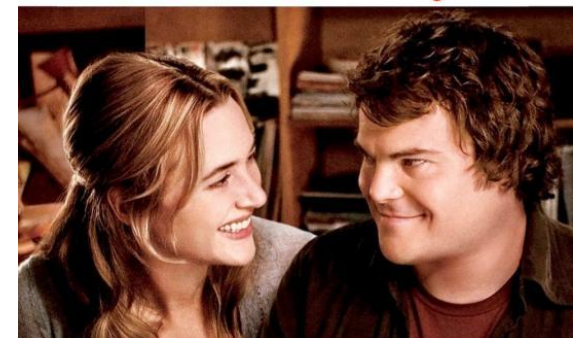


# About Me

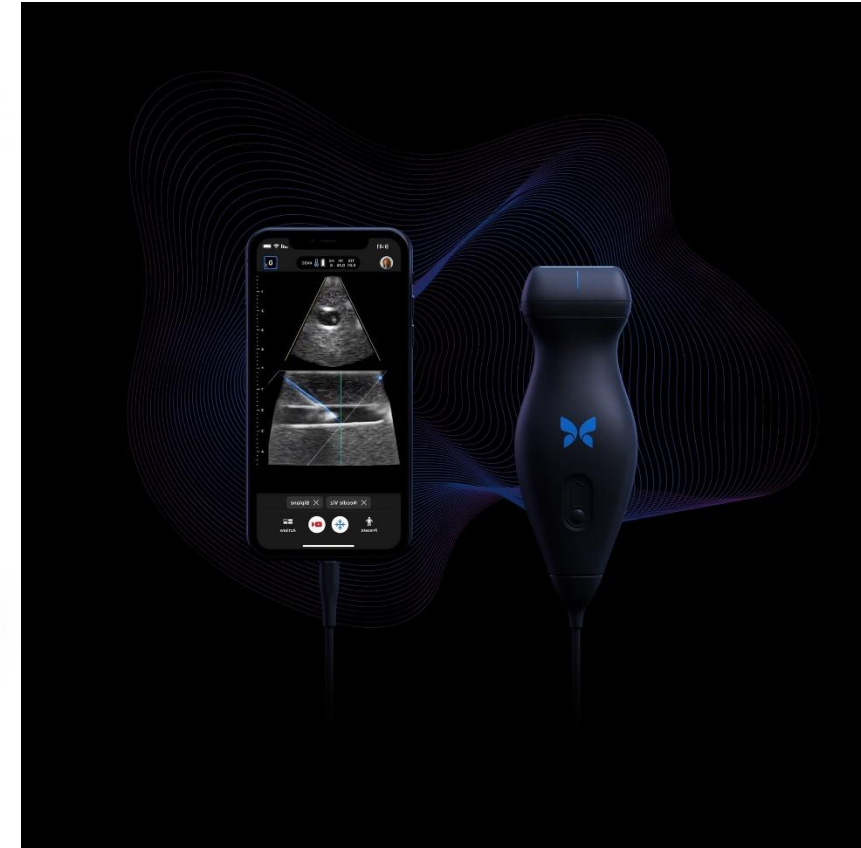
- 1 Wife
- 3 Kids
- 1 Pooch Named Finn
- I Love Technology
- The HOLIDAY (Really)  
Come at me, Bro...



the Holiday



# The MVP of this Presentation





# Musculoskeletal Ultrasound and You:

- What?
- Why?
- How?

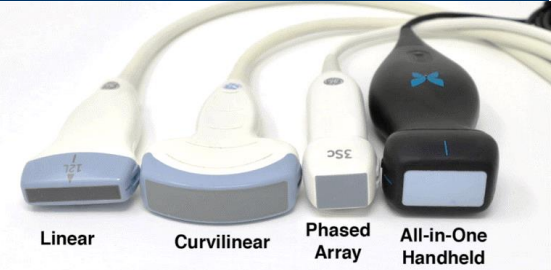
# Alright, What's All This Then?

Ultrasonography is a medical imaging technique that uses high frequency sound waves and their echoes. The technique is similar to the echolocation used by bats, whales and dolphins, as well as SONAR used by Submarines.

In a typical ultrasound, millions of pulses and echoes are sent and received each second. The probe can be moved along the surface of the body and angled to obtain various views.

# The Parts

- Central Processing Unit
- Transducer Probe
- Control Panel
- Display
- Ultrasound Transmission Gel (the goo)



#GelsCheap!!!!



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# The Bicameral Mind

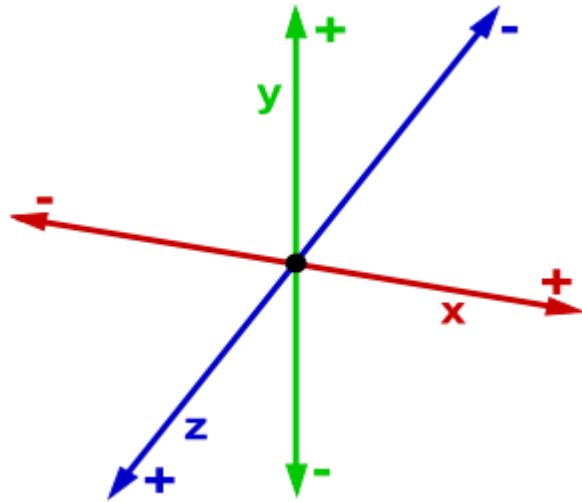




# A Bit About Axes (Because I Like Axes)



Not this kind



This Kind

BackGround

Subject

Foreground



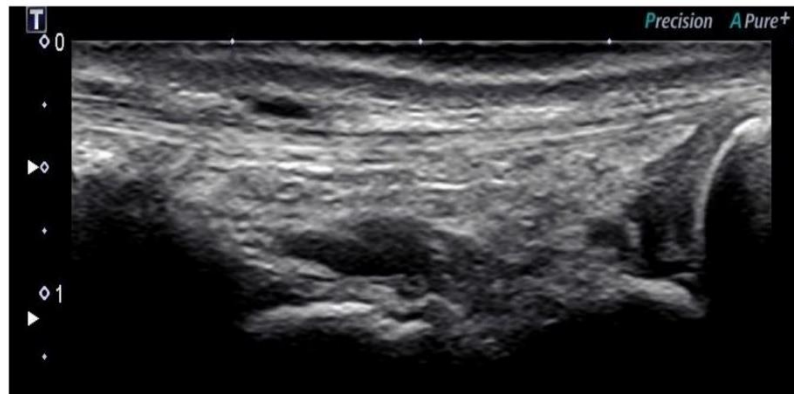




# RhAPP

## The Long and Short of it

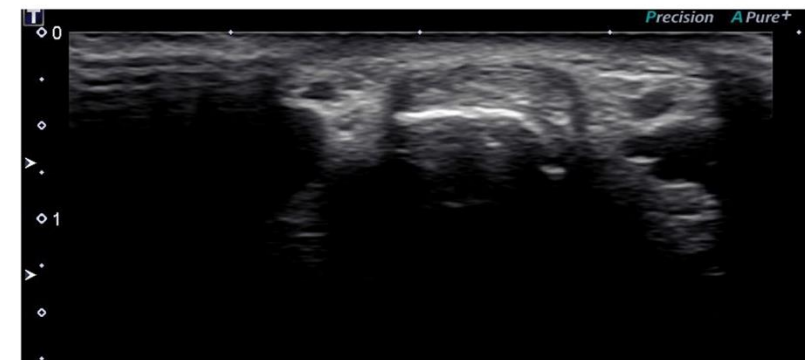
**DORSAL VIEW OF COMPARTMENT 1 LONG AXIS**



*Structures of interest:*

radius, scaphoid, trapezium, extensor pollicis brevis and abductor pollicis longus in view

**DORSAL VIEW OF COMPARTMENT 1 SHORT AXIS**



*Structures of interest:*

radius, scaphoid, trapezium, extensor pollicis brevis and abductor pollicis longus in view



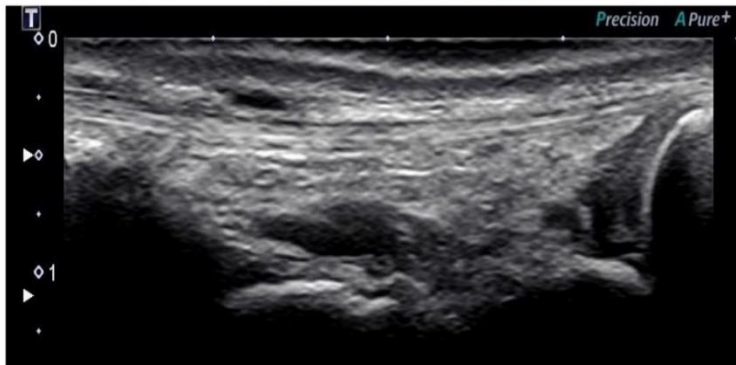
# RhAPP

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## The Long and Short of it



DORSAL VIEW OF COMPARTMENT 1 LONG AXIS

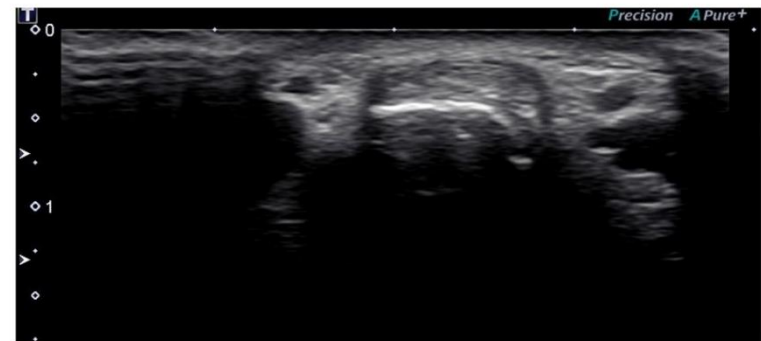


*Structures of interest:*

radius, scaphoid, trapezium, extensor pollicis brevis and abductor pollicis longus in view



DORSAL VIEW OF COMPARTMENT 1 SHORT AXIS



*Structures of interest:*

radius, scaphoid, trapezium, extensor pollicis brevis and abductor pollicis longus in view



# Terminology (Oh, EWWWW, DAVID!!)

- **Anisotropy** – an artifact seen when the beam is not perpendicular to the tissue surface. It is due to beam scattering and results in the tissue (usually tendons) appearing hyporeflexive or dark. BE CAREFUL!! This can simulate pathology
- **Refraction** – and artifact depicting real structures in incorrect positions (this occurs when the beam bends at the interface of two materials)
- **Attenuation** – the loss of energy as US wave propagates through a tissue
- **Reverberation** – occurs when the beam bounces between an object and the transducer causing repetition echoes below the object
- **Echogenicity** – the ability of an object to return as US pulse as and echo (how we describe the images seen on US)
  - **Hyperechoic** – appearing white
  - **Anechoic** – appearing black
  - **Hypoechoic** – appearing dark gray
  - **Midechoic** – appearing as varying shades of gray



# Echogenicity of Interesting Structures (Tissue Characteristics)

- Bone surface – Hyperechoic with Posterior Acoustic Shadowing
- Bursae – Hypoechoic or anechoic
- Cartilage –
  - Hyaline: Anechoic
  - Meniscal: Mildly Hyperechoic
  - Fibrocartilage: Mildly Hyperechoic
- Connective tissue – Midechoic and mildly irregular
- Ligaments – Hyperechoic with multidirectional fibrillar pattern

# Echogenicity of Interesting Structures (Tissue Characteristics)

- Muscles – midechoic with hyperechoic lines (fascial planes, septae, epimysium, paramysium)
- Nerves – mildly hyperechoic (“Honeycomb appearance” of fascicles)
- Subcutaneous fat (midechoic and irregular (globular appearance)
- Synovium – midechoic
- Synovial Fluid – as With any fluid seen with ultrasound it is anechoic, it will also be displaceable incompressible.
- Tendons – hyperechoic exhibiting indistinct parallel fibular pattern. A key tissue that displays the artifact known as anisotropy (which can be helpful and harmful)



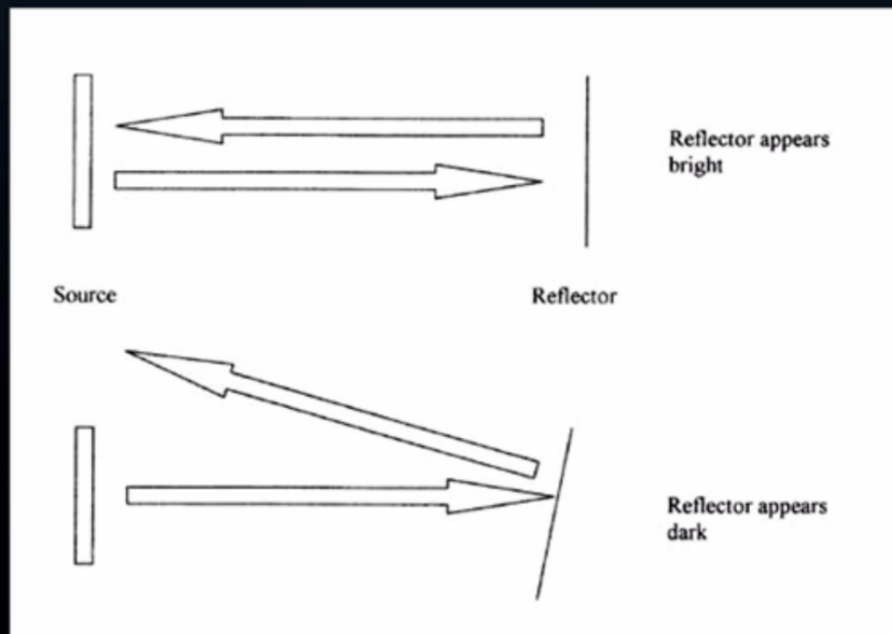
# Image Reflection



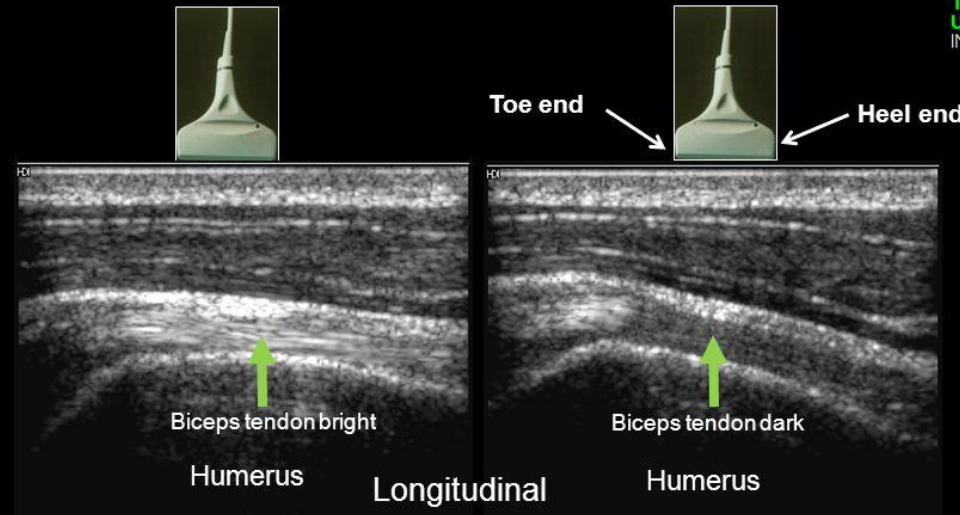
# Anisotropy

## ANISOTROPY

Tendon or Muscle



## ANISOTROPY: OBJECT NOT PERPENDICULAR



The probe should be maintained parallel to the tendon. In the event that the object (region of interest) is not perpendicular to the transducer, non uniform pressure can be applied—in this case, pressing down slightly harder at the heel end will ensure that the tendon is perpendicular.

# The Big Physics Takeaway!!!

(You, in the back, WAKE UP FOR THIS!!)

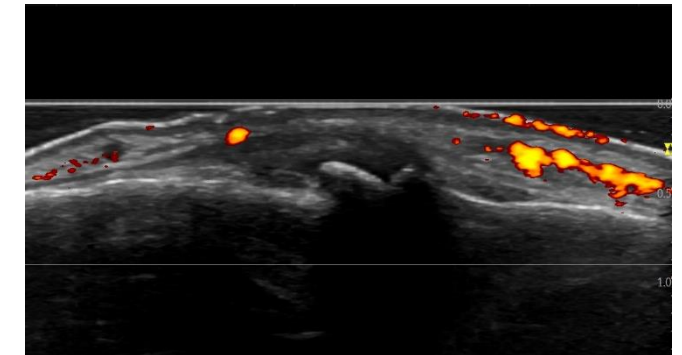
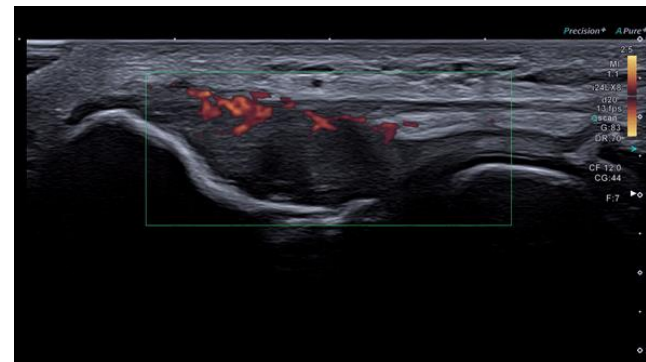
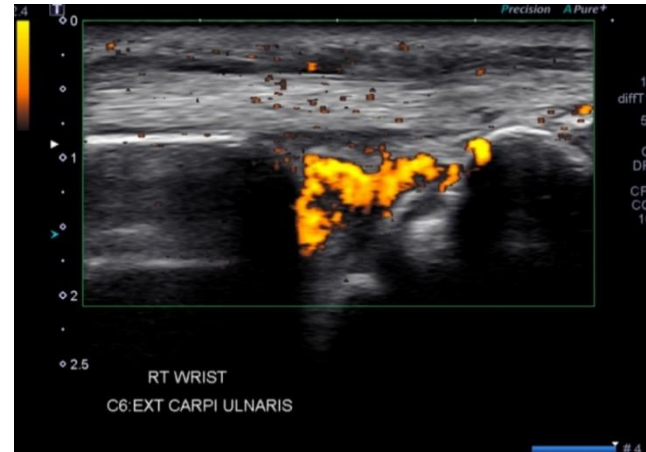
- Frequency – As frequency goes up, Resolution goes up, but Penetration (depth) decreases
- Depth – As Depth increases (goes deeper), Frequency and Resolution go down
- Resolution – Increases with frequency, Decreases with greater depth
- For Superficial Soft Tissue, High Frequency Results In Higher Resolution!!

# Okay, Why? (2 Tool Boxes)



# Okay, Why?

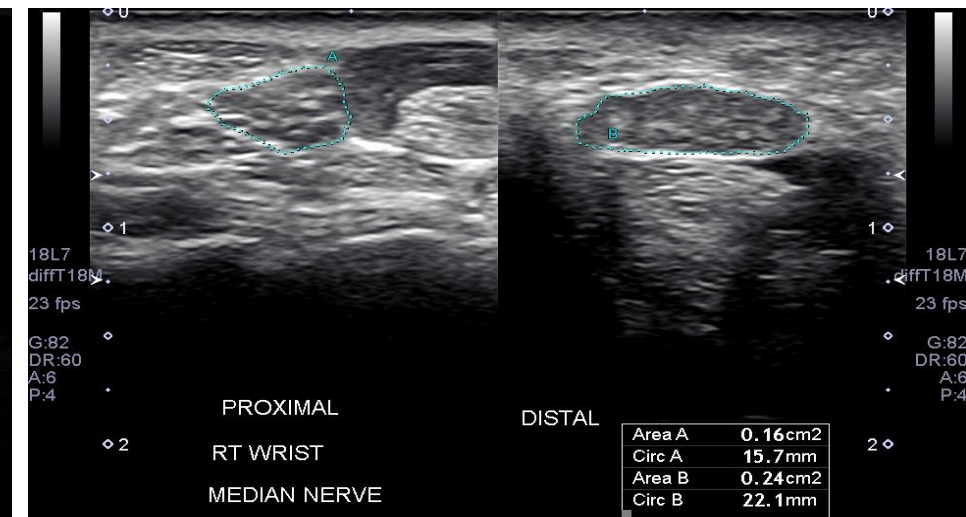
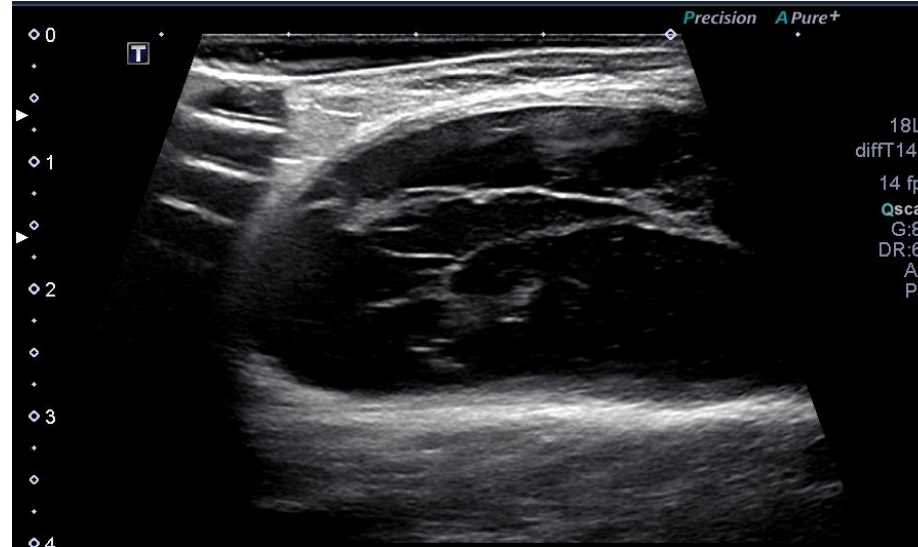
- Smoking gun?
  - Inflammation (Synovitis)
  - Erosive Damage (RA)
  - Enthesitis (PsA)
  - Osteophytosis (OA)





# Okay, Why?

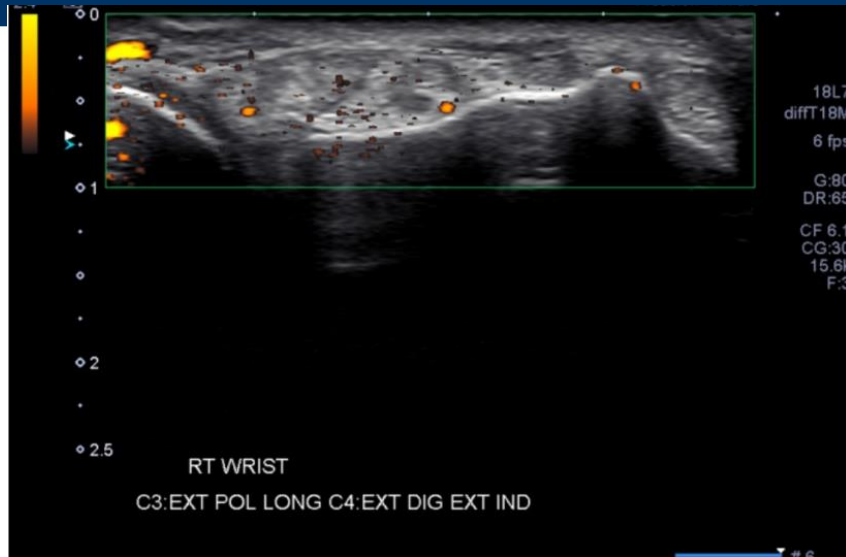
- Smoking gun?
  - Inflammation (Synovitis)
  - Erosive Damage (RA)
  - Enthesitis (PsA)
  - Osteophytosis (OA)
  - Effusion
  - Double Contour (Gout)
  - Chondrocalcinosis (Pseudogout)
  - Median Nerve Impingement (Carpal Tunnel Syndrome)



# Okay, Why?

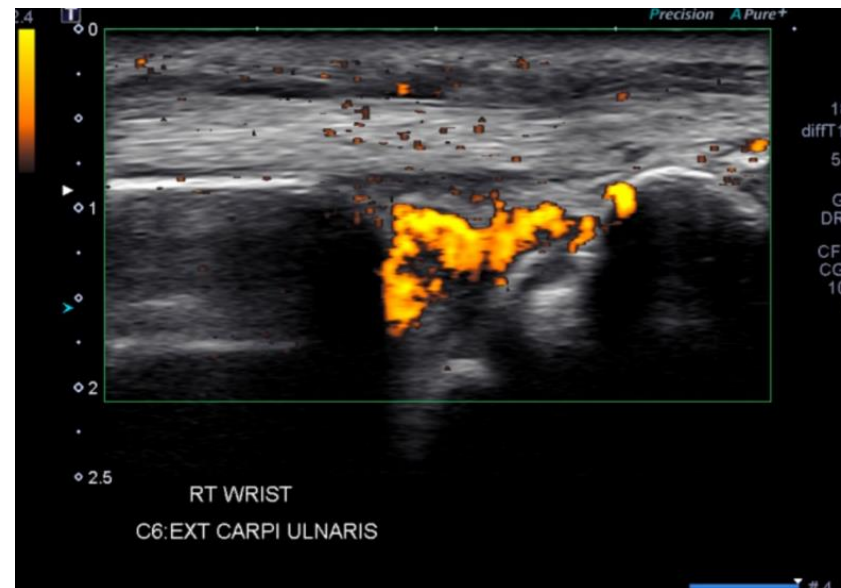
- Imaging Modalities
  - Ultrasound
  - X-Ray
  - MRI
  - CT
- Why US vs MRI, X-Ray, CT?
  - Oblique Angles
  - Dynamic Imagery
  - Doppler Signal (Active Inflammation)
  - Ability to Measure Erosive Damage

# Synovitis (Grade 1, 2 & 3)



Grade 1 (Single Vessel Signals)

Grade 2 (Confluent Vessel Signals)



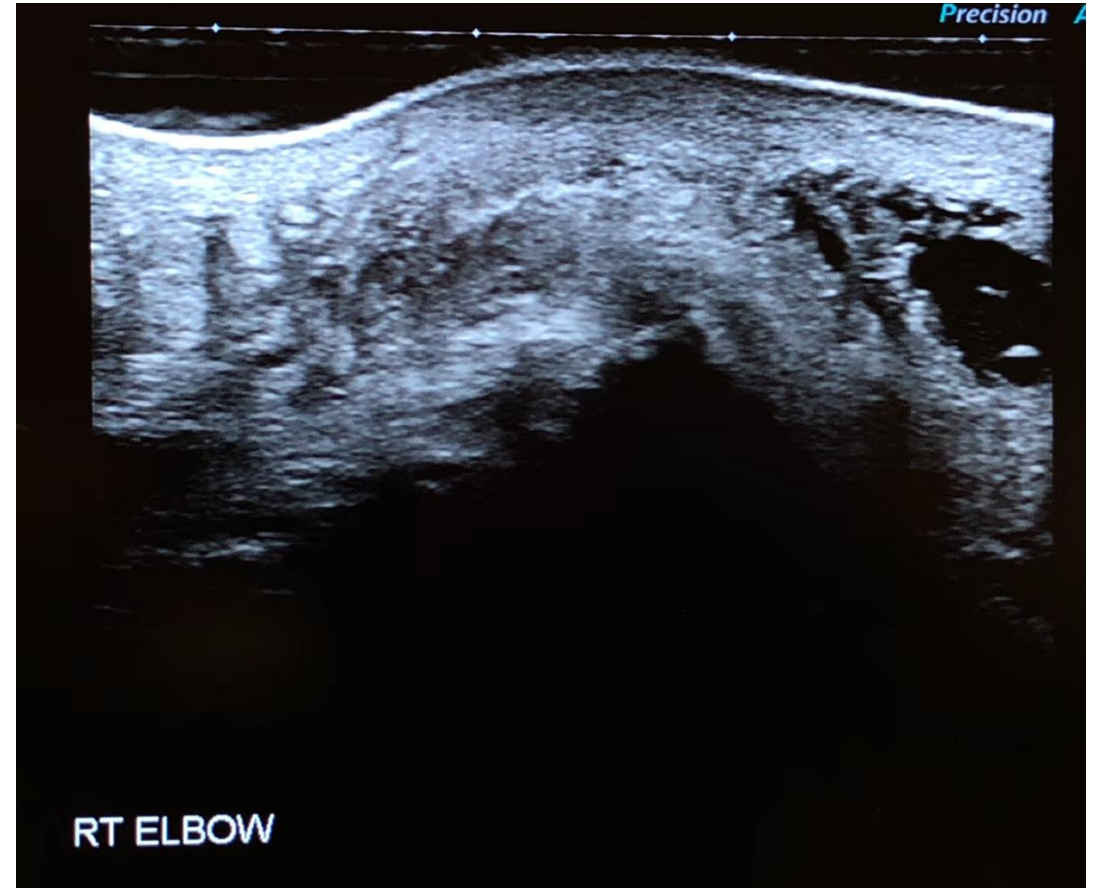
Grade 3 (>50% of synovium covered with vessel signals)

# Okay, Why?

- Ways MSK Ultrasound adds value to your practice
  - **High-definition ultrasound imaging narrows the differential**
  - **Real-Time Ultrasound Takes Away the Guesswork**
  - **A Confident Diagnosis Directs the Most Effective Treatment**
  - **Capturing Ultrasound Images Documents Actual Progress**
    - Progression of disease
      - Quantification of active synovitis
      - Accurate Measurement of erosive damage
    - Improvement or remission of disease
      - Efficacy of treatment

# Okay, Why ELSE?

- Interventional Medicine
  - Confident assessment of problem area
    - Simple Injection
    - Aspiration
  - Accurate Placement of Needle
  - Shortest, most concise path to affected area

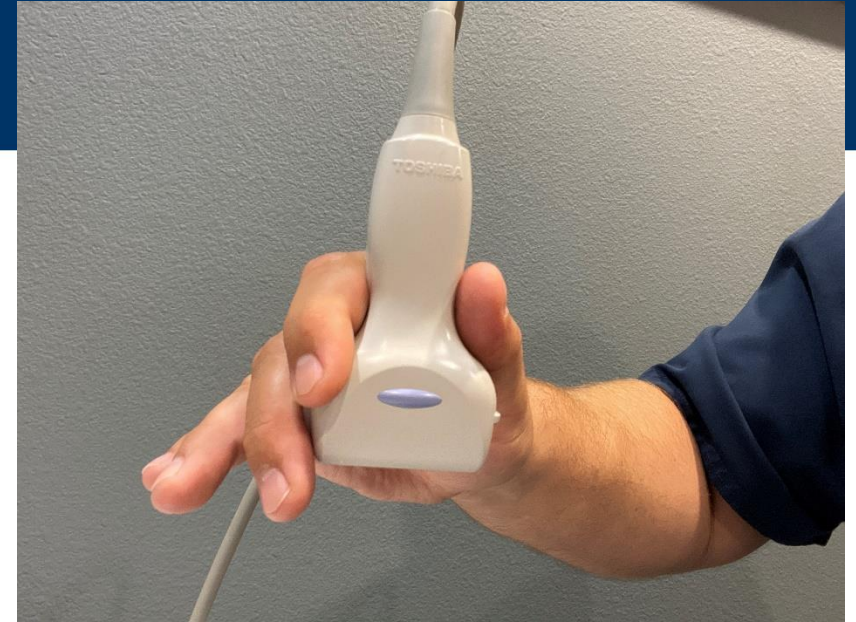




# Okay, Smarty Pants...

## How?

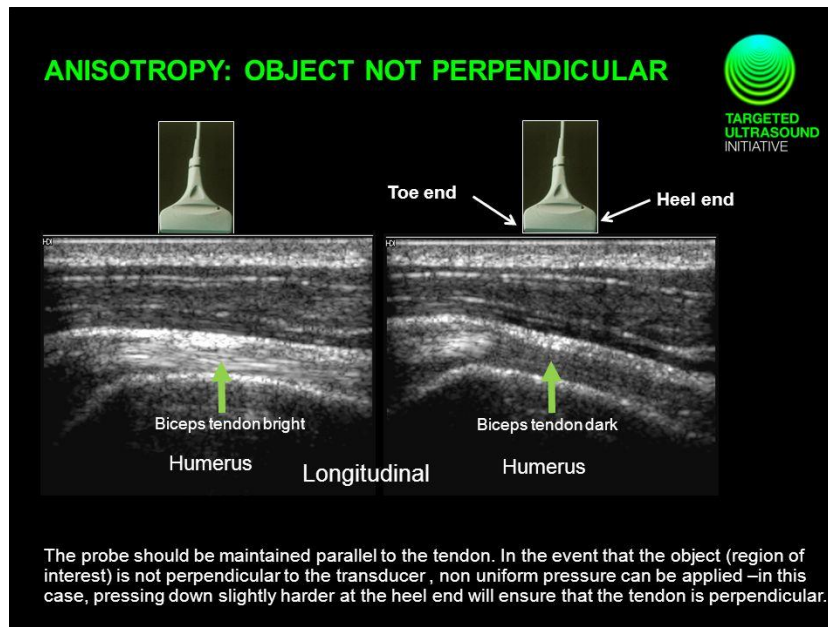
- Light Touch
- Move Slowly
- LOTS OF GEL  
#GELISCHEAP
- Relaxed Grip



# 5 Motions For Success



1. Rock
2. Heel-Toe
3. Fan



# 5 Motions For Success

1. Rock
2. Heel-Toe
3. Fan
4. Slide (Sweep)
5. Compress



# Major Pathology

## ➤ Synovitis

- Grade 0 (No Signal)
- Grade 1 (Single Vessel Signals)
- Grade 2 (Confluent Vessel Signals)
- Grade 3 (>50% of synovium covered with vessel signals)

## ➤ Enthesitis

## ➤ Osteophytosis

## ➤ Erosion ( $\geq 1$ mm on 2 axes)

## ➤ Effusion

## ➤ Rotator Cuff Rupture

- Partial-Thickness
- Intrastance
- Full-Thickness
- Complete



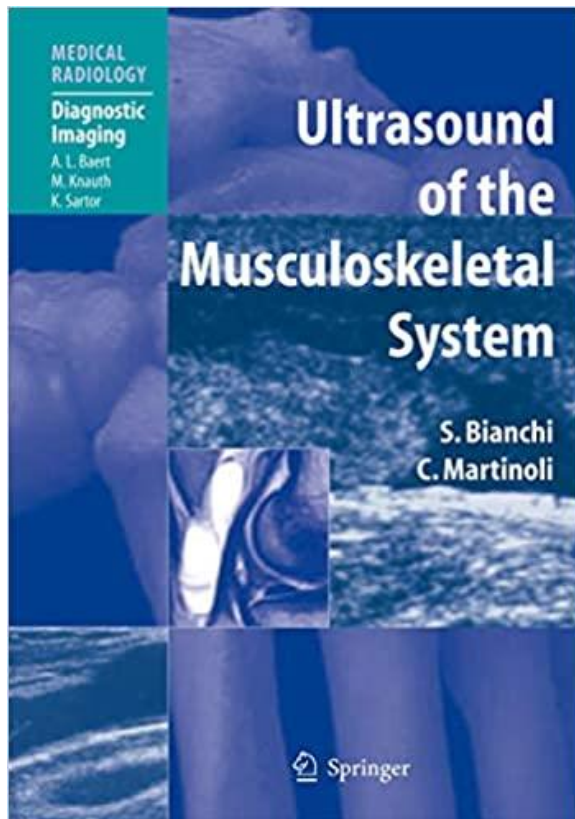
# Minor Pathology

- Synovial Hypertrophy
- Synovial Proliferation
- Tenosynovitis (active)
  - Preclinical RA
  - Peritendinous fluid/tissue thickening
- Early Erosive Damage
  - <1 mm
  - Early RA
- Joint Space Narrowing
  - Mild
  - Moderate
  - Significant

# Resources (These are a few of my favorite things)

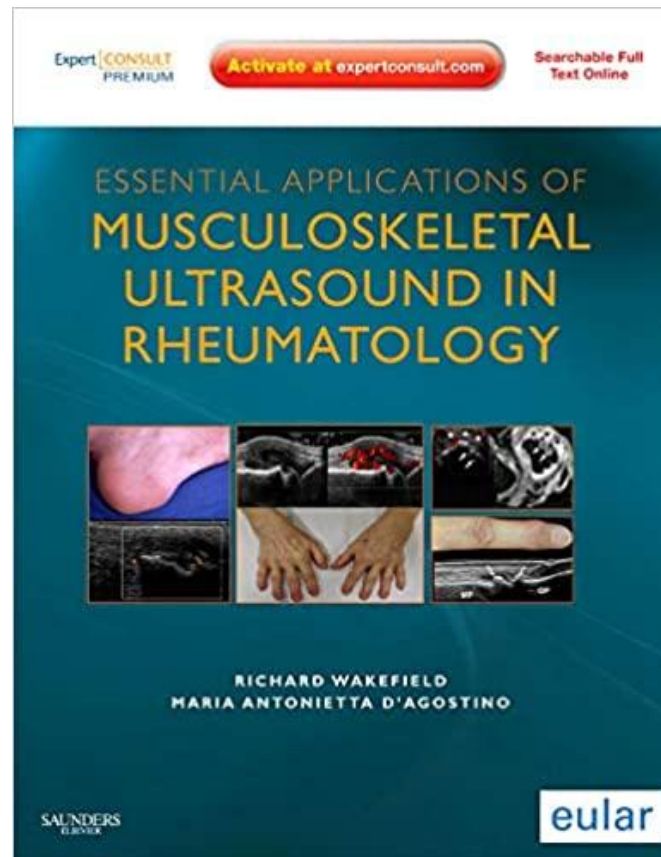
## Ultrasound of the Musculoskeletal System

by Bianchi & Martinoli



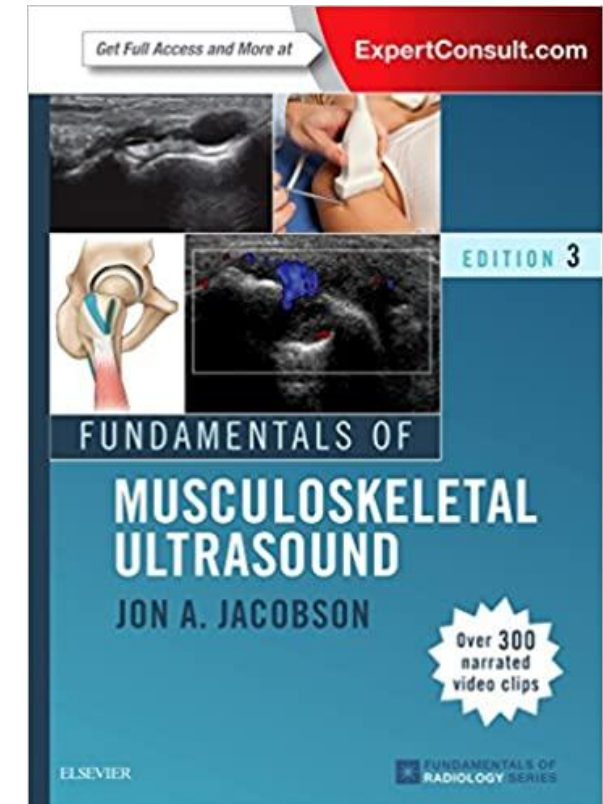
## Essential Applications of Musculoskeletal Ultrasound in Rheumatology

By Richard Wakefield



## Fundamentals of Musculoskeletal Ultrasound

By Jon A. Jacobson



# Thank you



Me too chair, me too



My  
LinkedIn



1920s: In 100 years we will have flying cars

2020s:





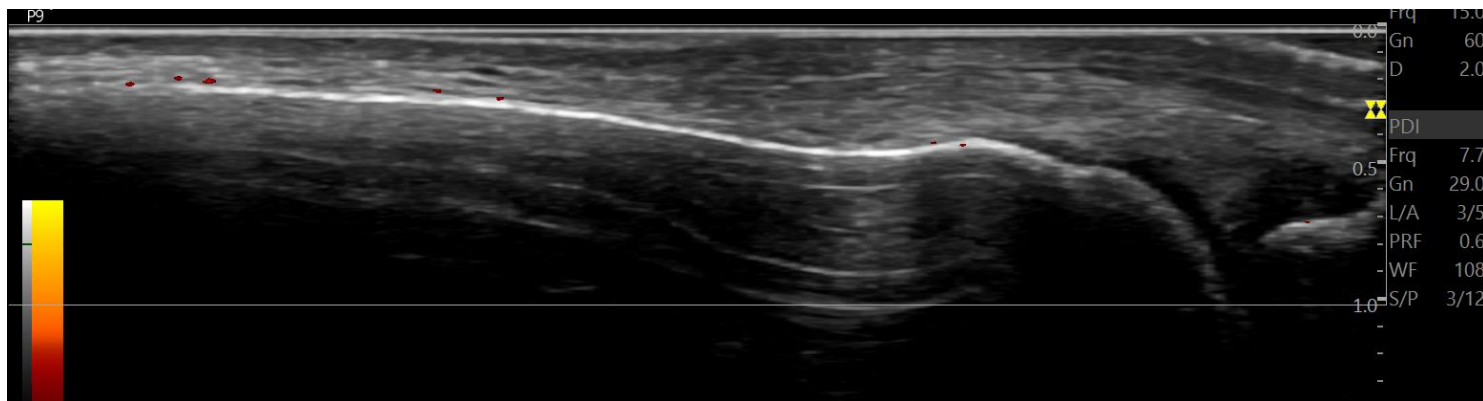
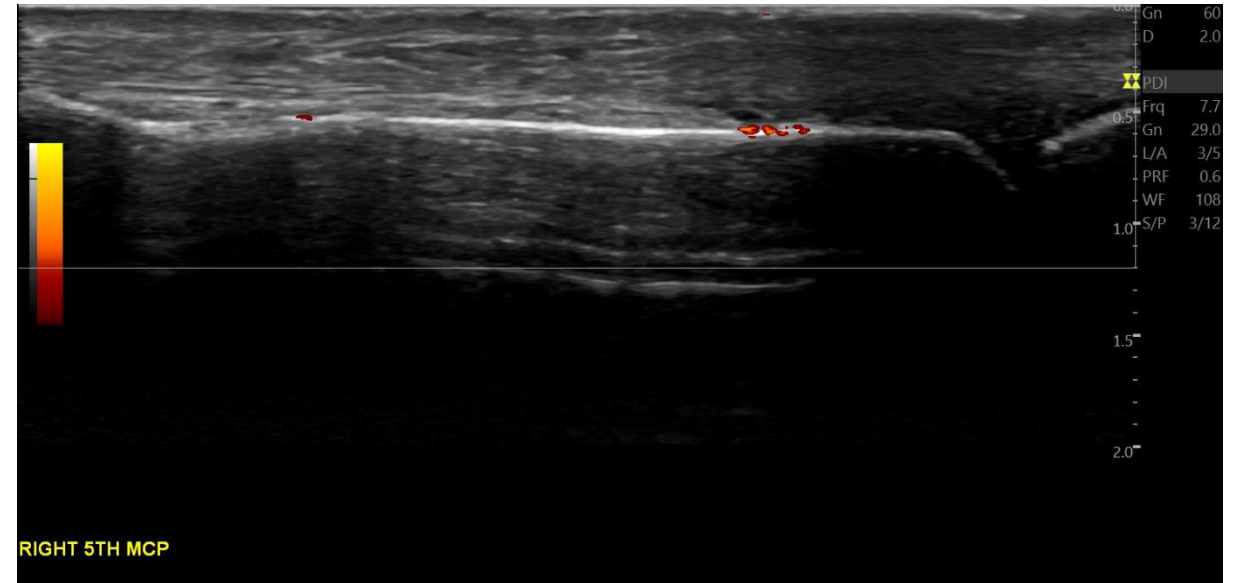
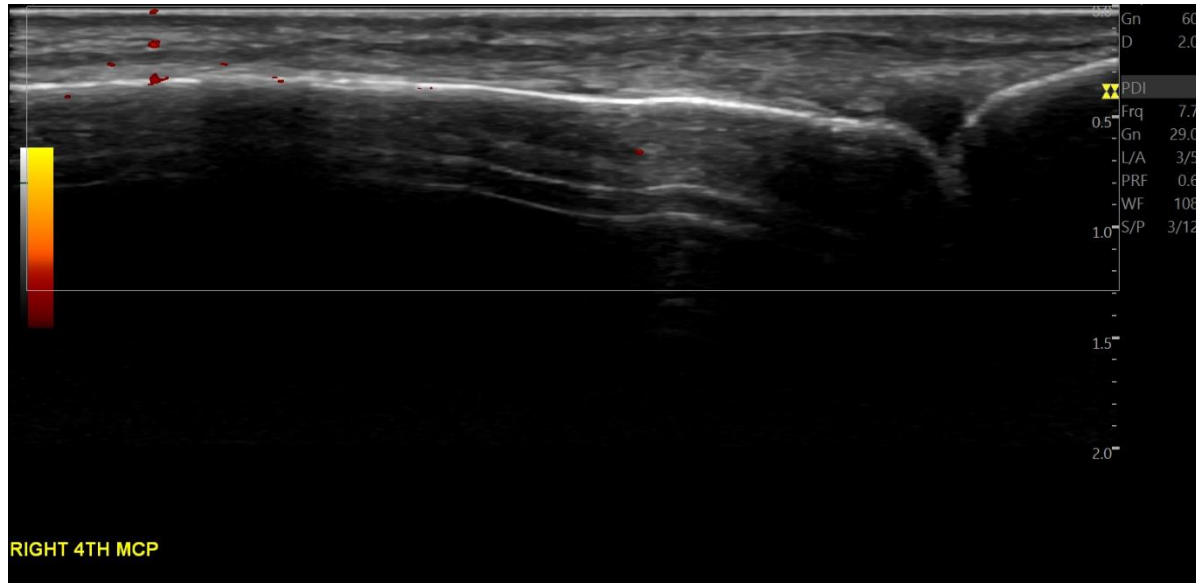
# Sources

- <https://us.medical.canon/products/ultrasound/aplio-i-series/>
- <https://www.pocus101.com/ultrasound-machine-basics-knobology-probes-and-modes/>
- <https://www.ultrasoundcases.info/cases/musculo-skeletal-joints-and-tendons/shoulder/biceps-tendon-rupture/>
- <https://www.essr.org/subcommittees/ultrasound/>
- <https://www.jacobsonmskus.com/video-links>
- <https://www.ultrasoundcases.info/enthesopathy-6328/>
- <https://www.pocus101.com/ultrasound-machine-basics-knobology-probes-and-modes/>

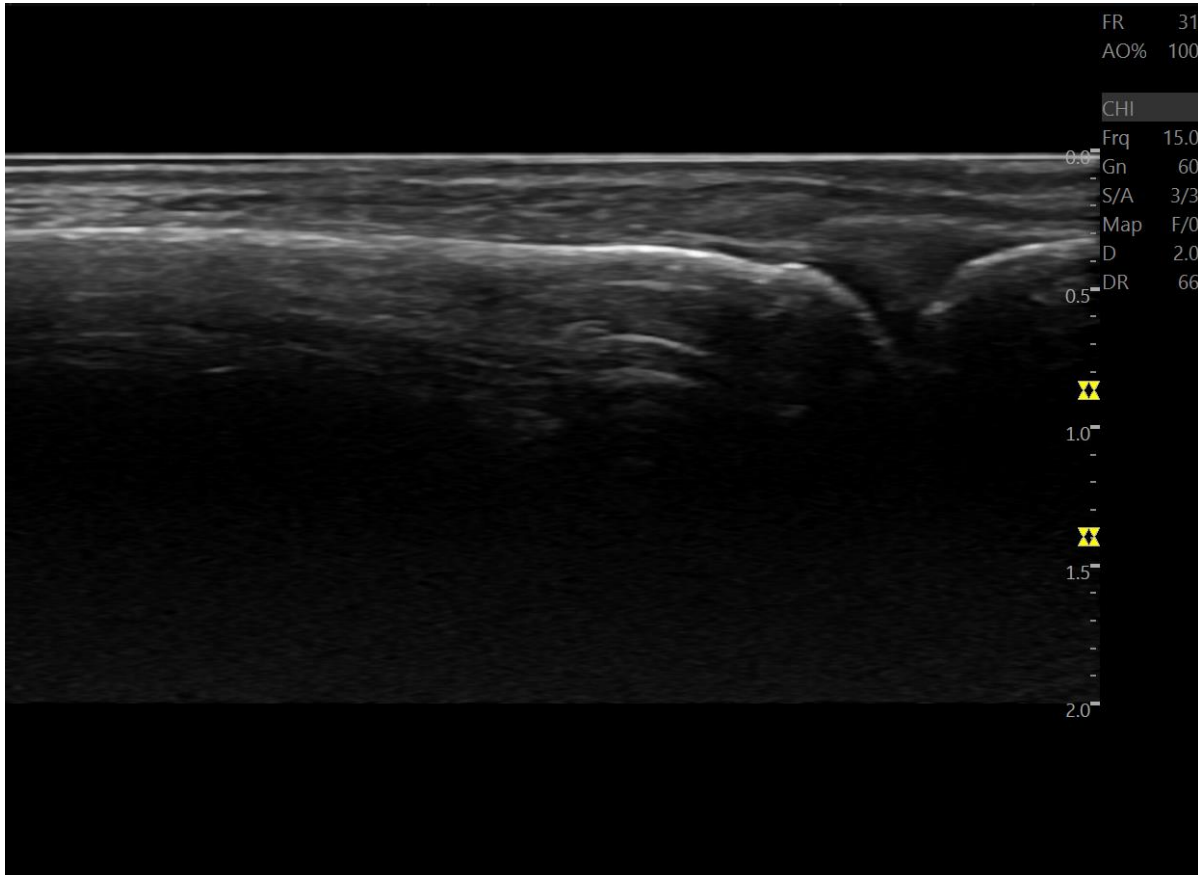


# Some More Gravy...

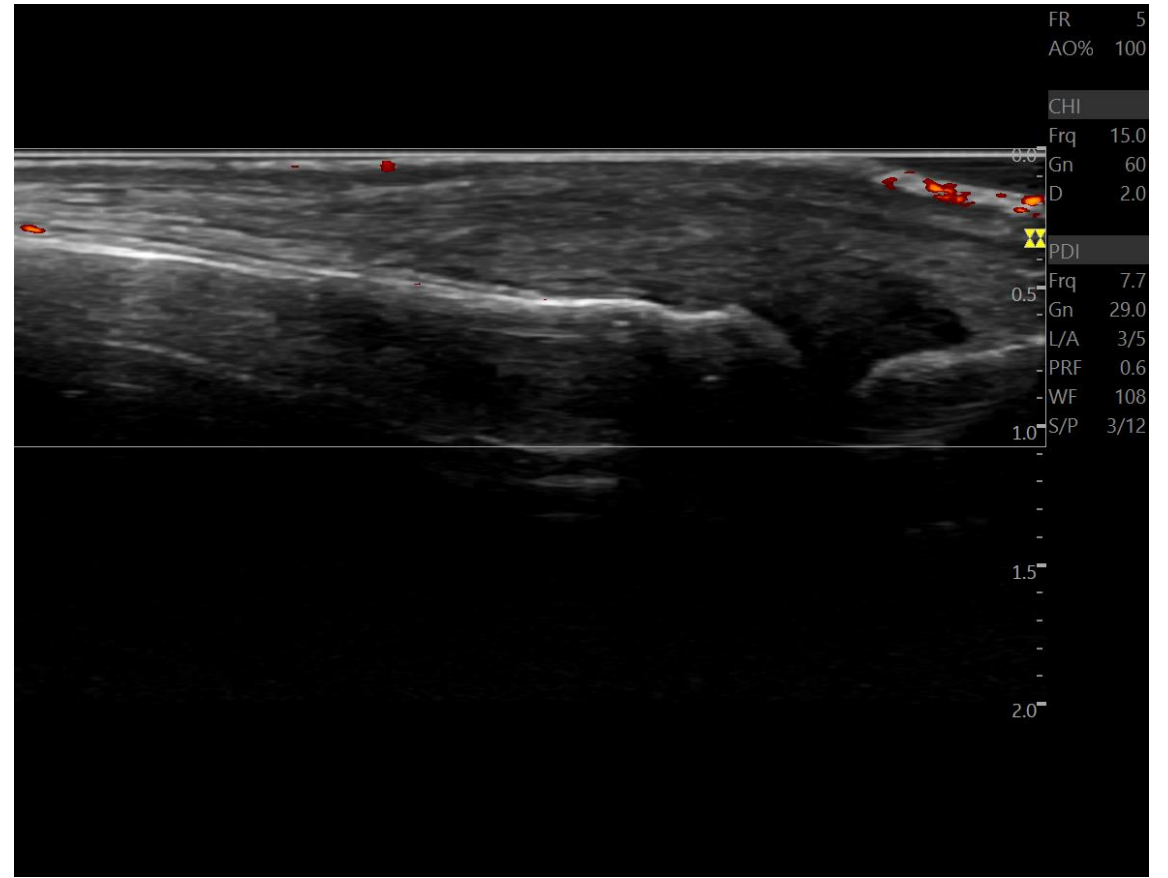
# Synovial Proliferation



# Synovial Hypertrophy

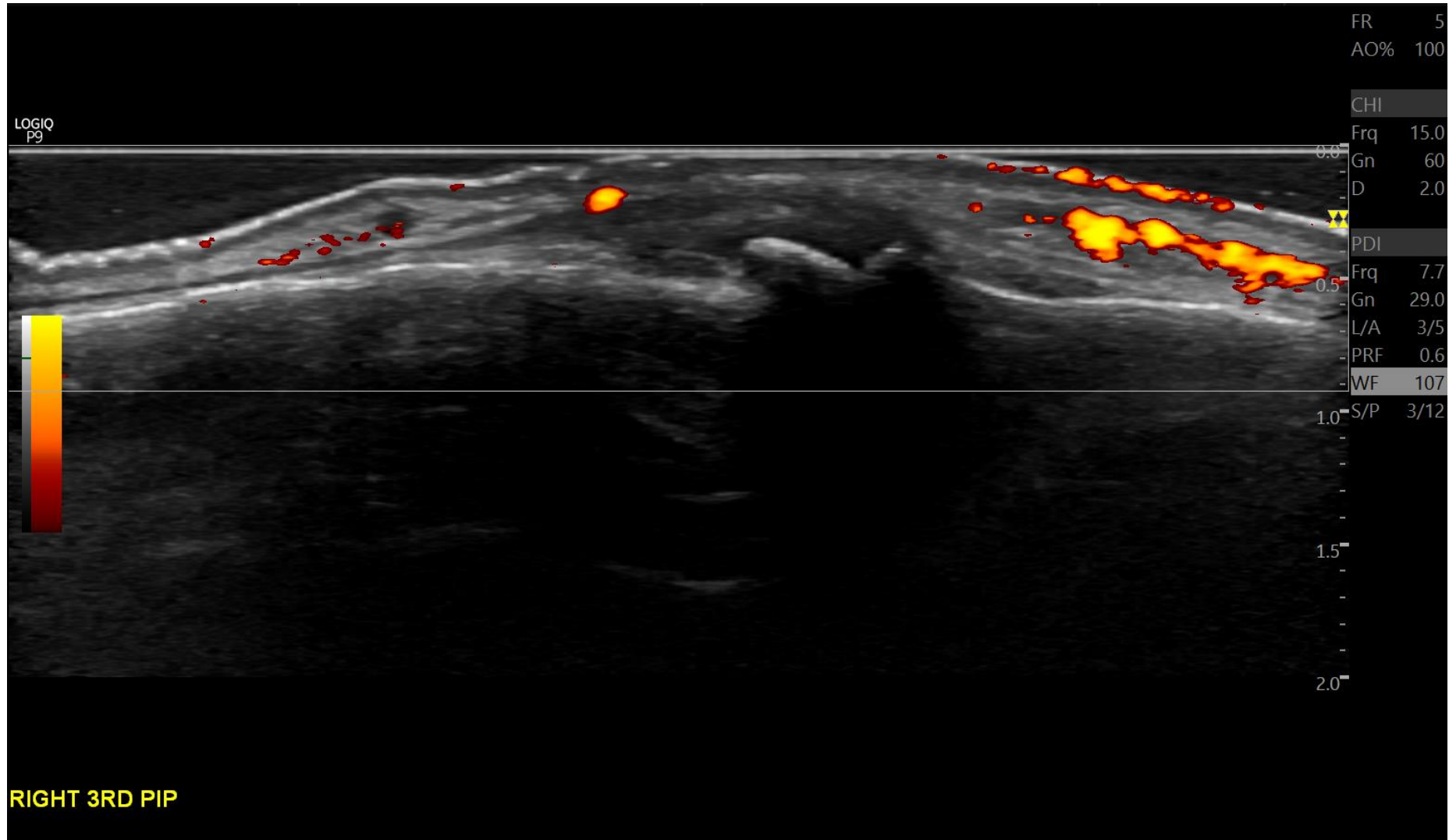


Normal



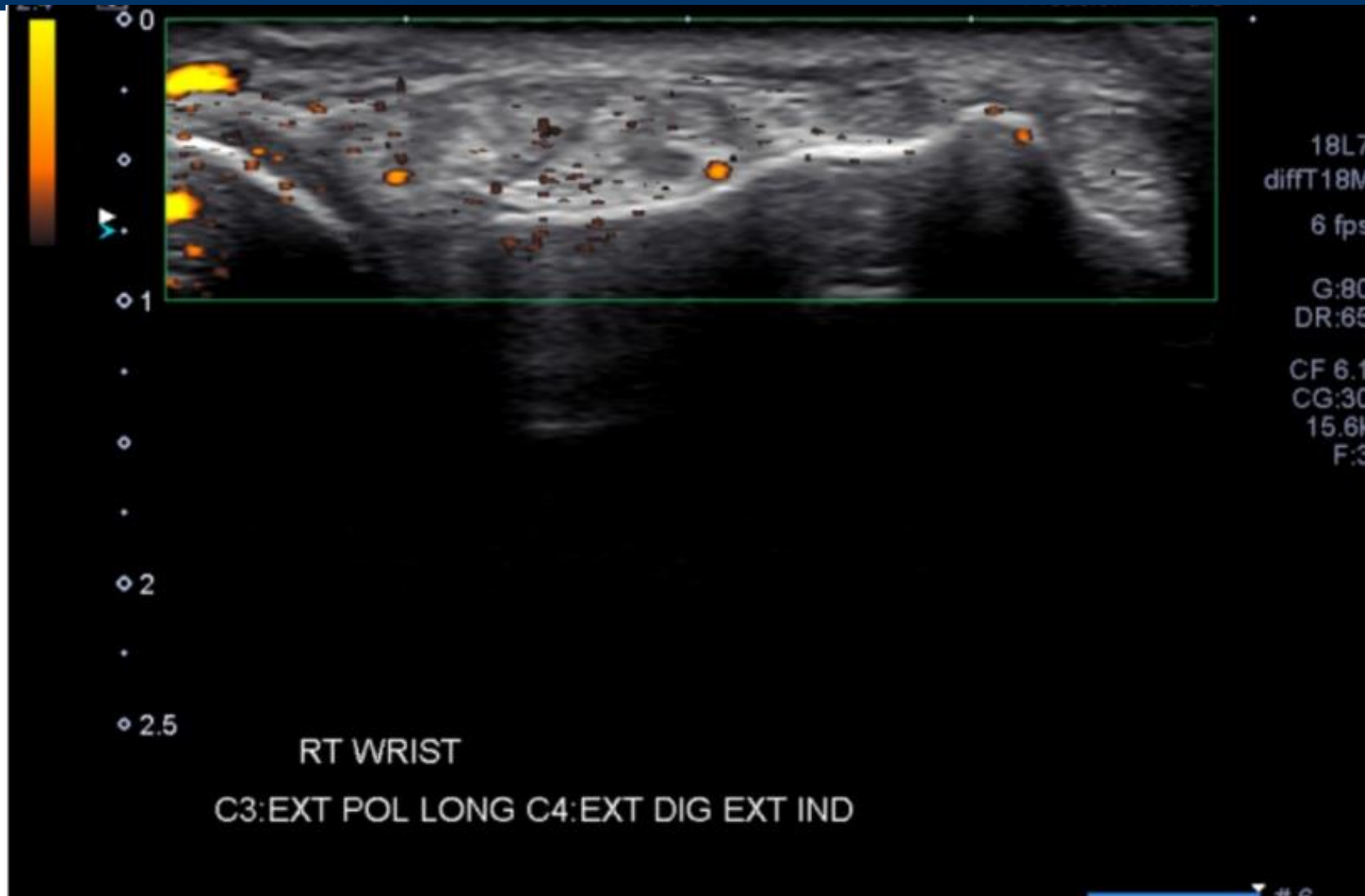
Synovial Hypertrophy

# Miscellaneous PIP Pathology

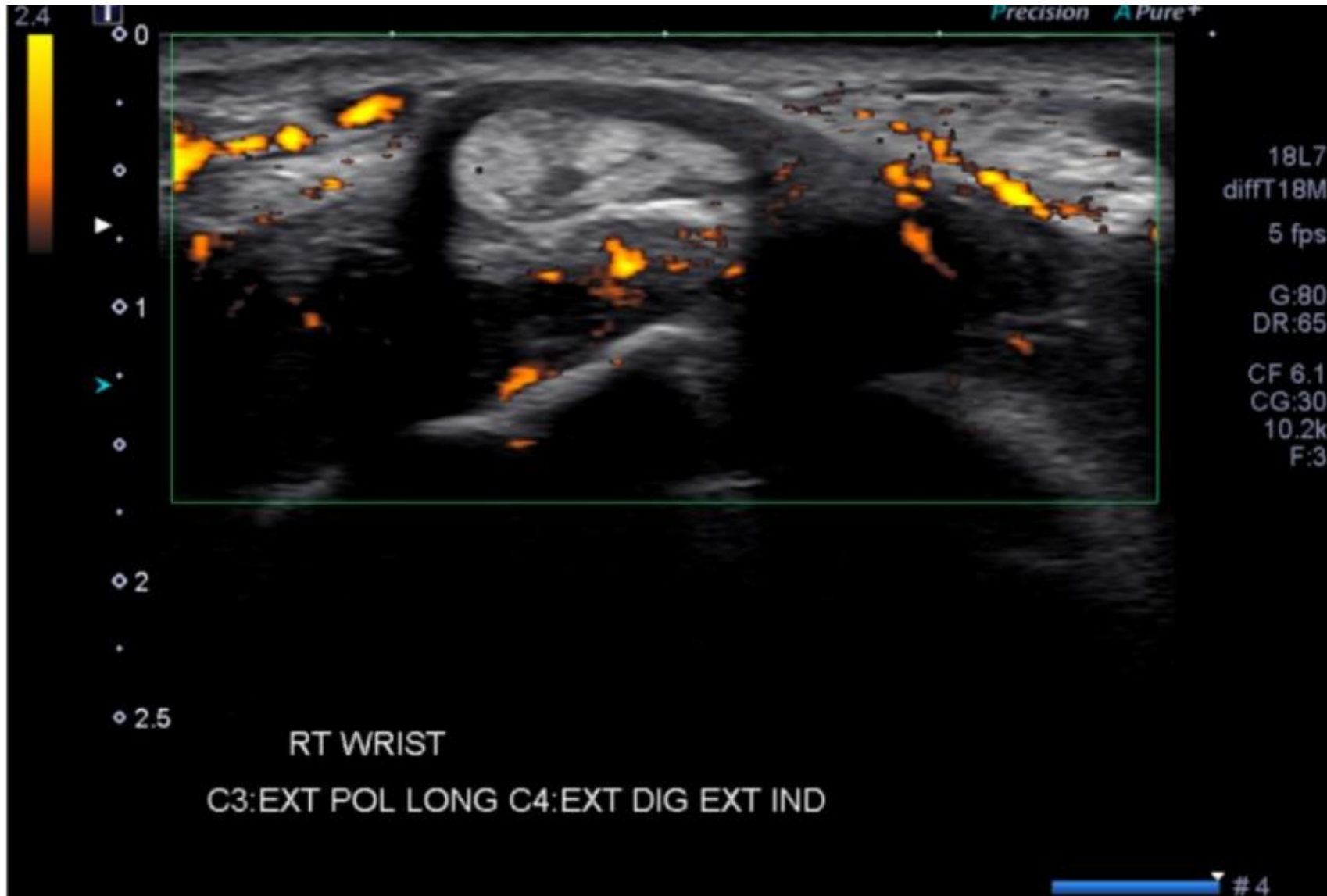




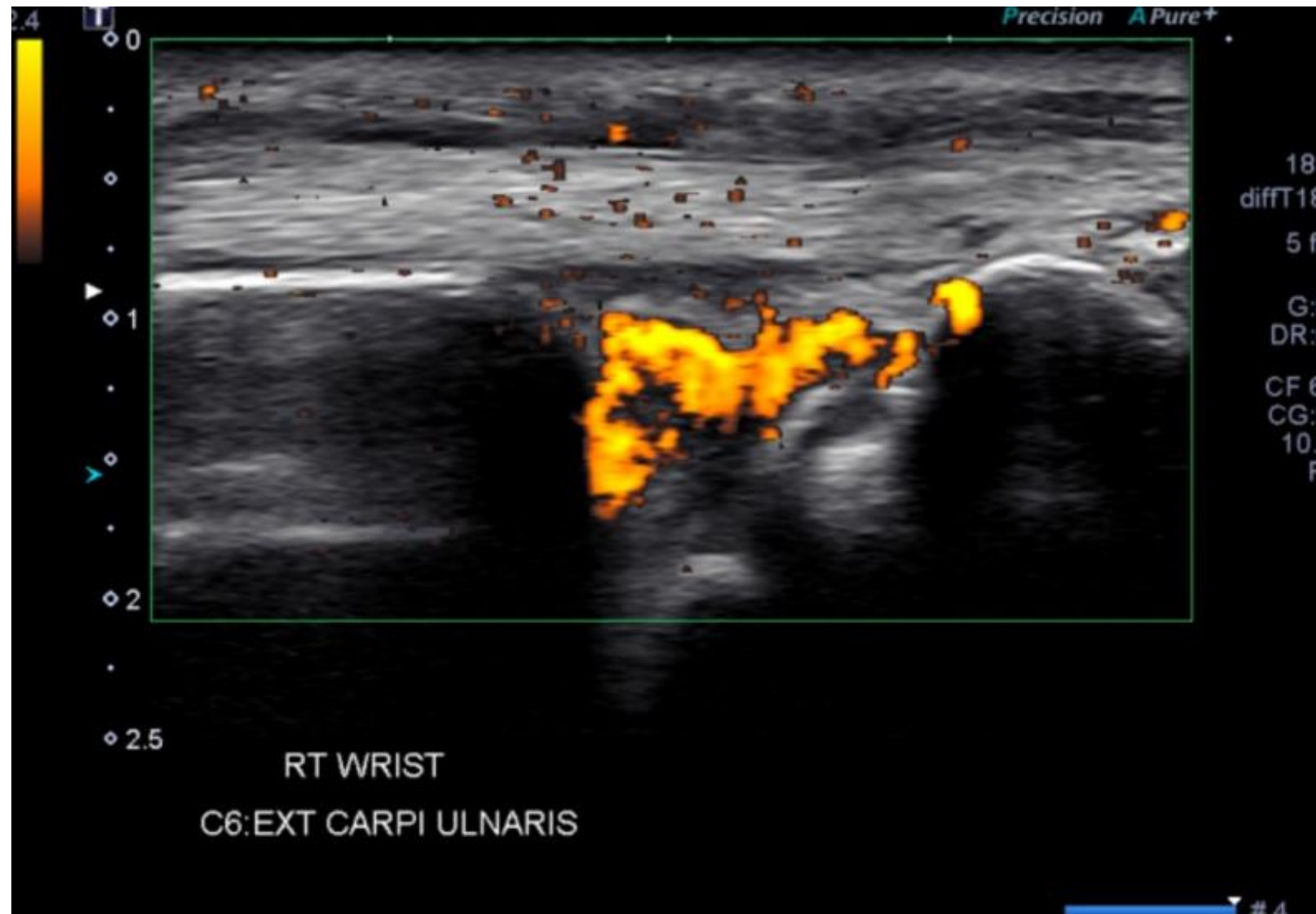
# Grade 1 (Single Vessel Signals)



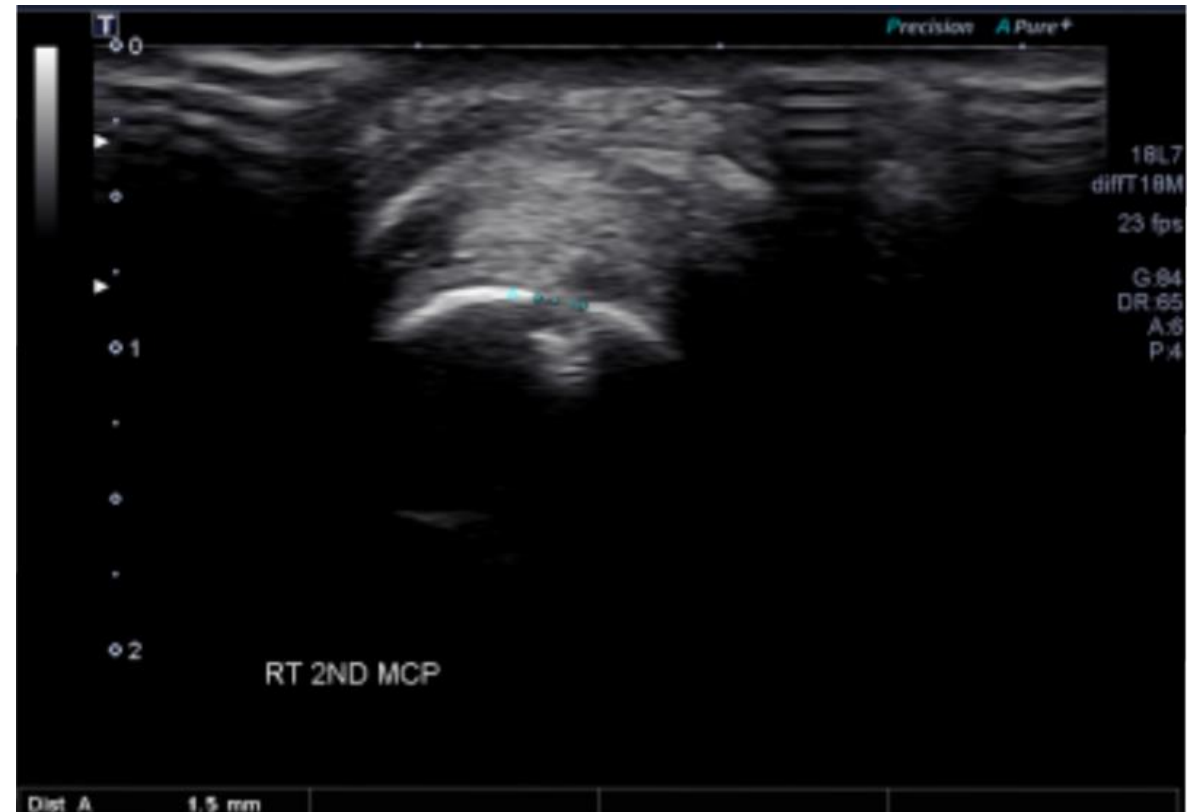
# Grade 2 (Confluent Vessel Signals)



# Grade 3 (>50% of synovium covered with vessel signals)

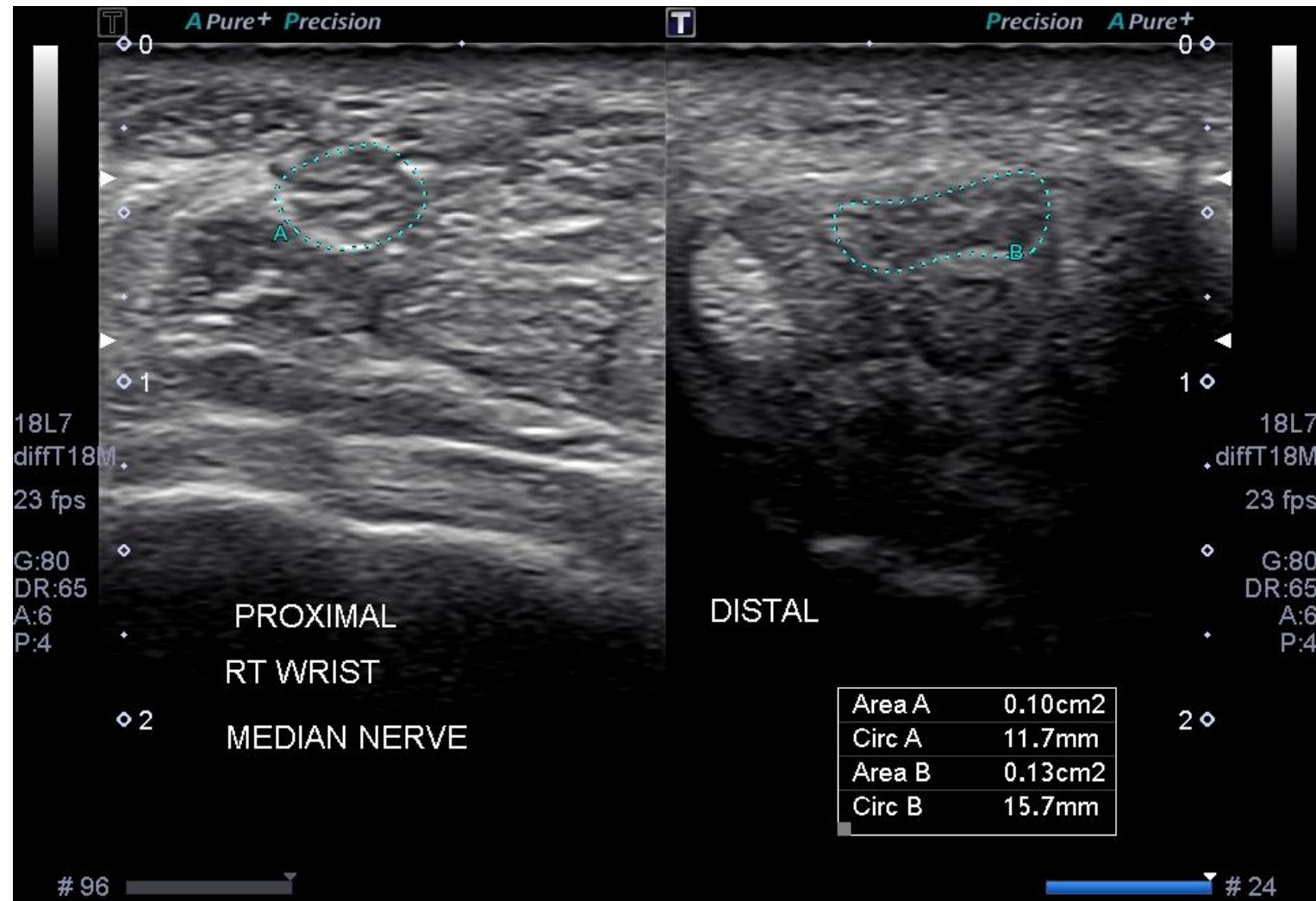


# 2<sup>nd</sup> MCP Marginal Erosion

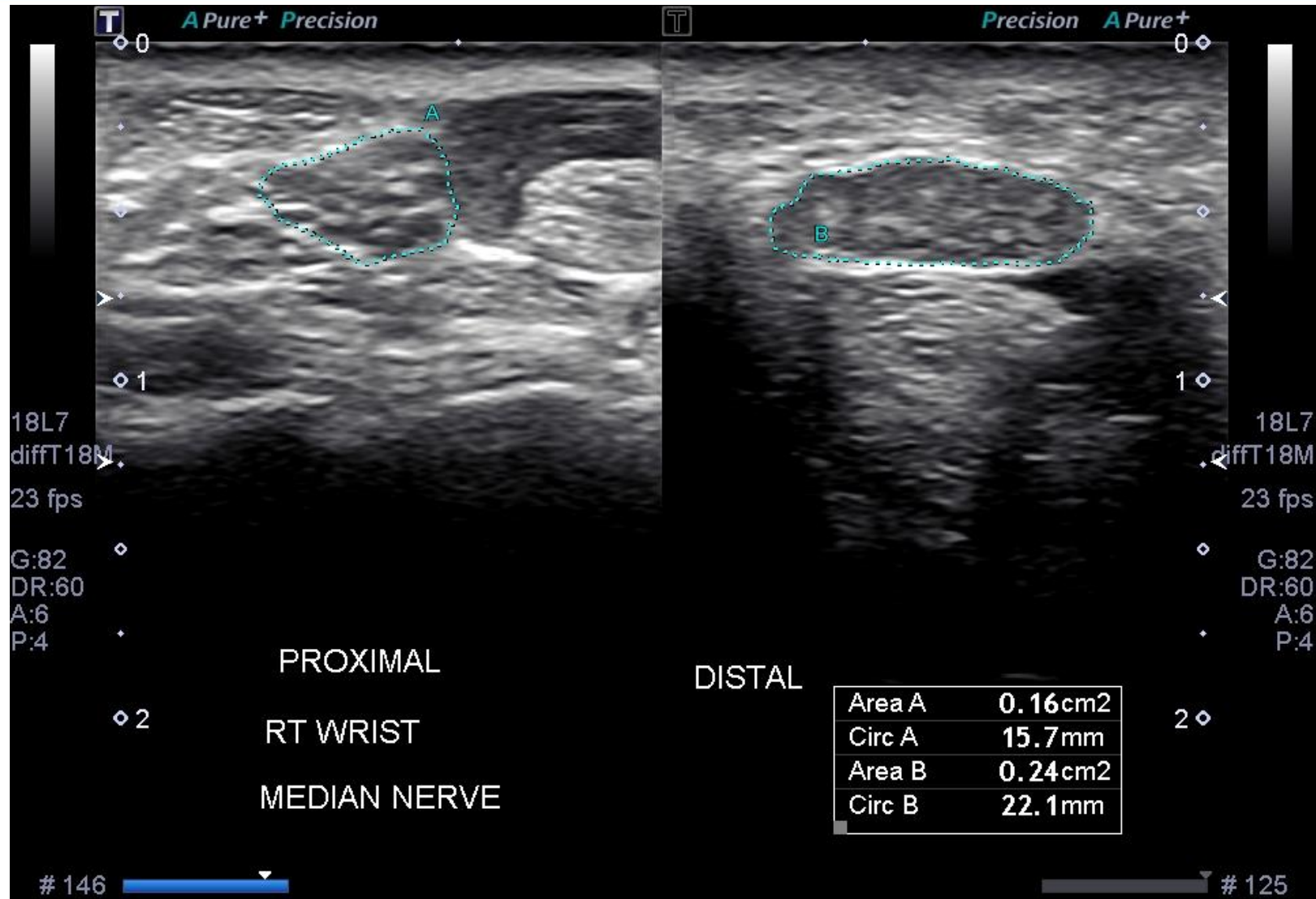




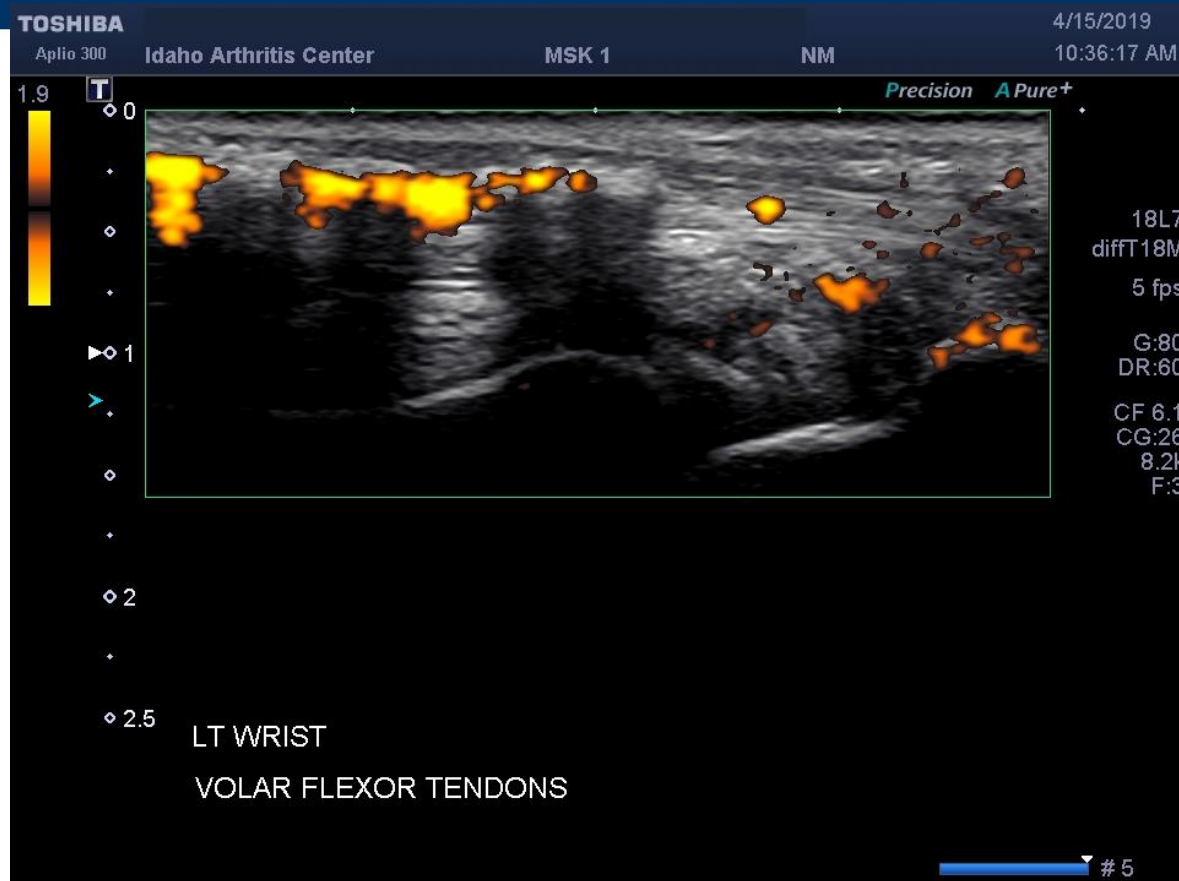
# Carpal Tunnel Syndrome (Minor)



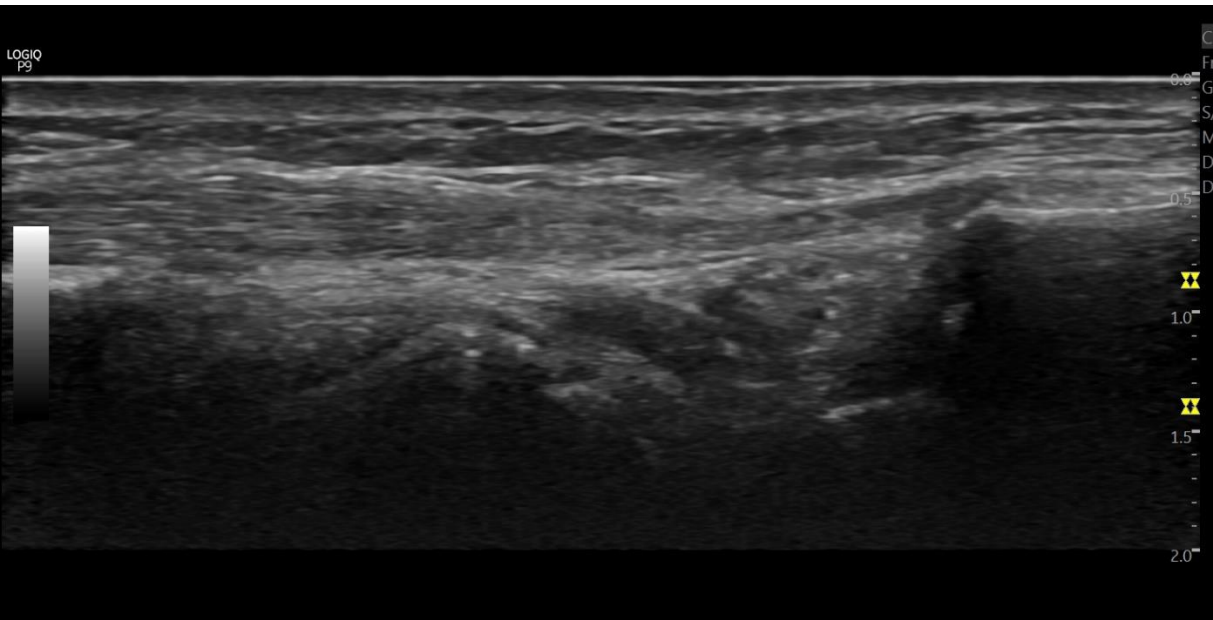
# Carpal Tunnel Syndrome (Major)



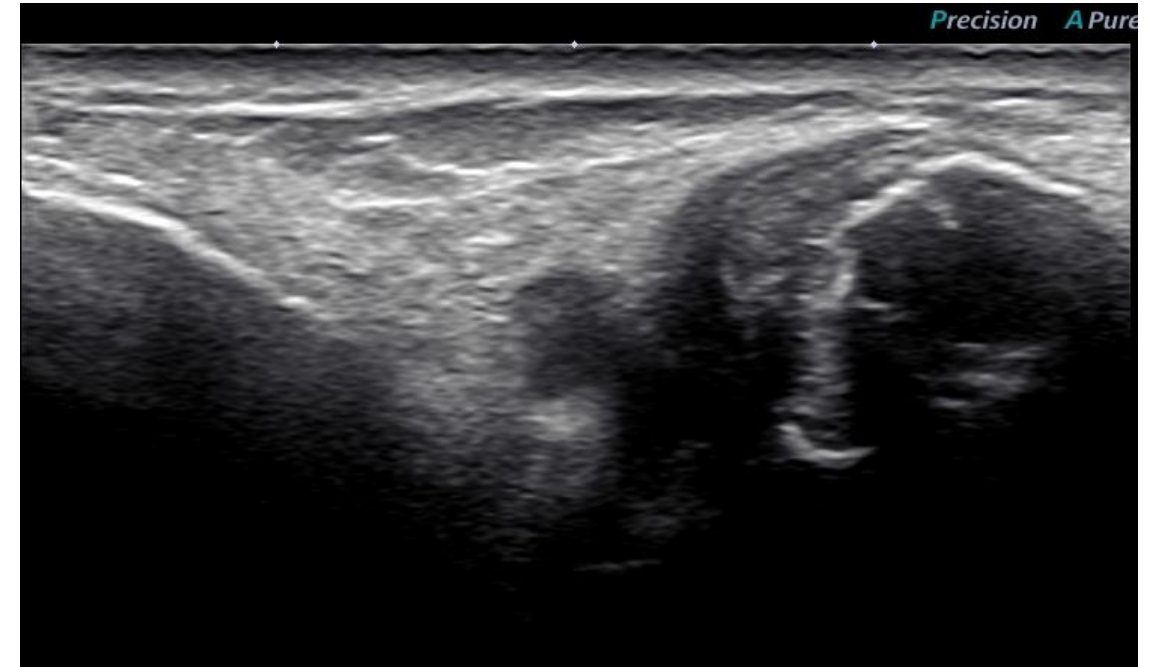
# Calcific Tendinitis (Flexor Carpi Radialis)



# 1<sup>st</sup> Compartment Joint Space Narrowing, Capsular Distention & Intracapsular Hyperechoic Debris (Osteoarthritis)



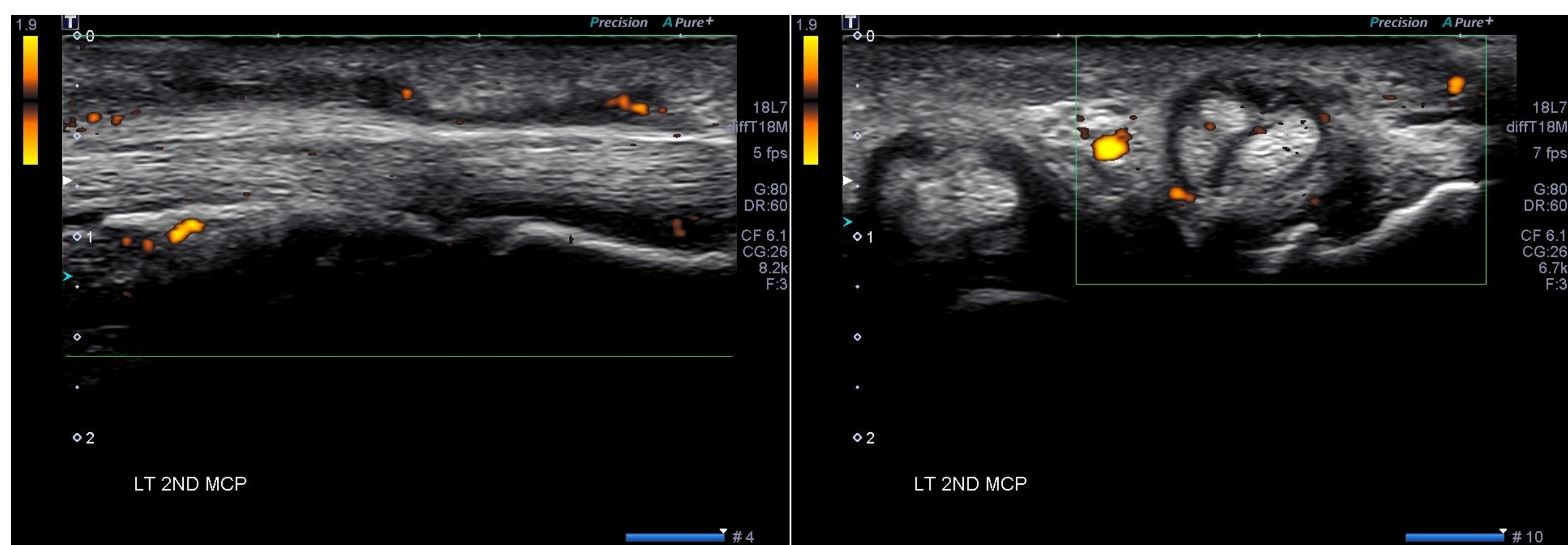
Normal



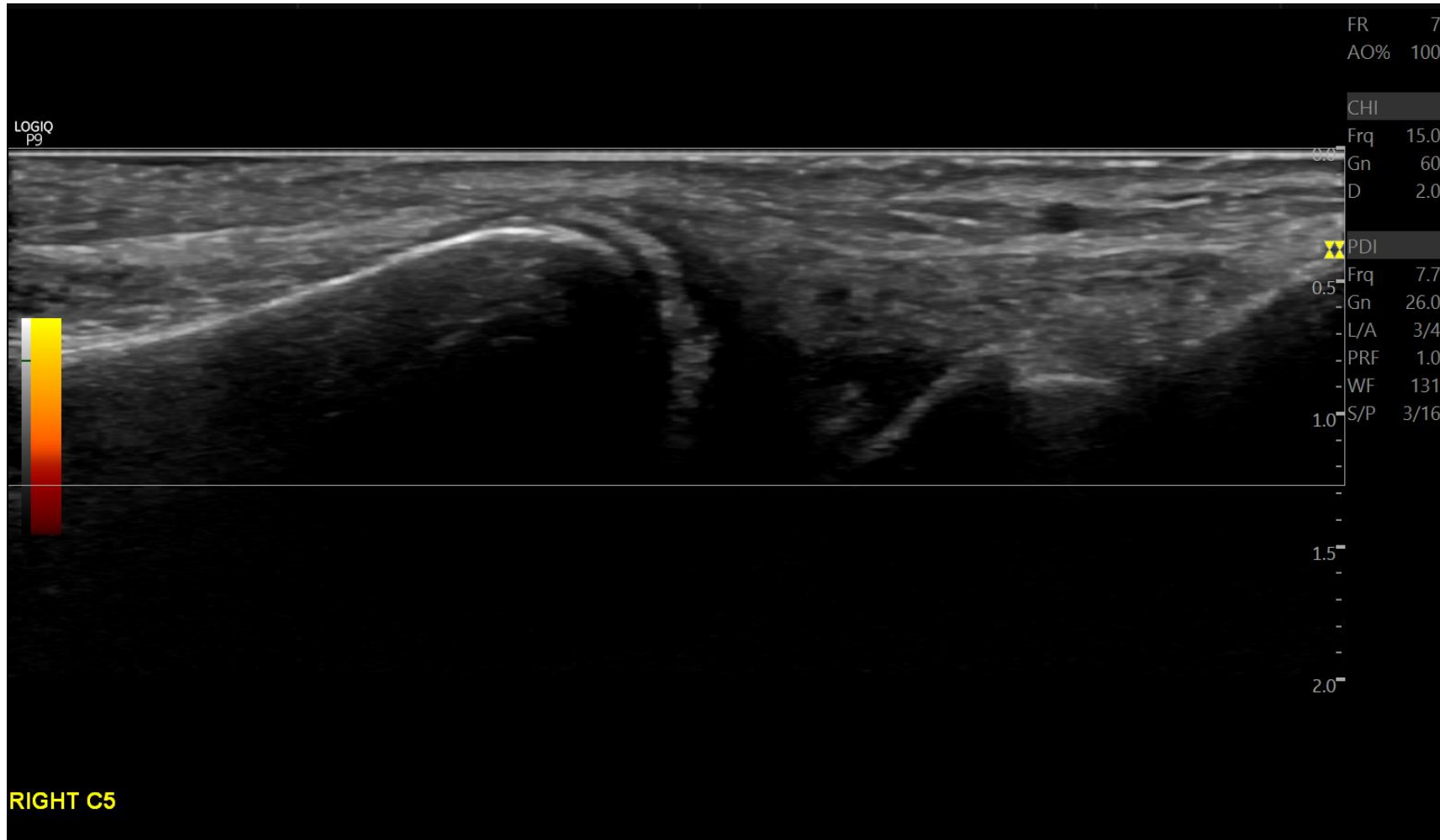
Pathology



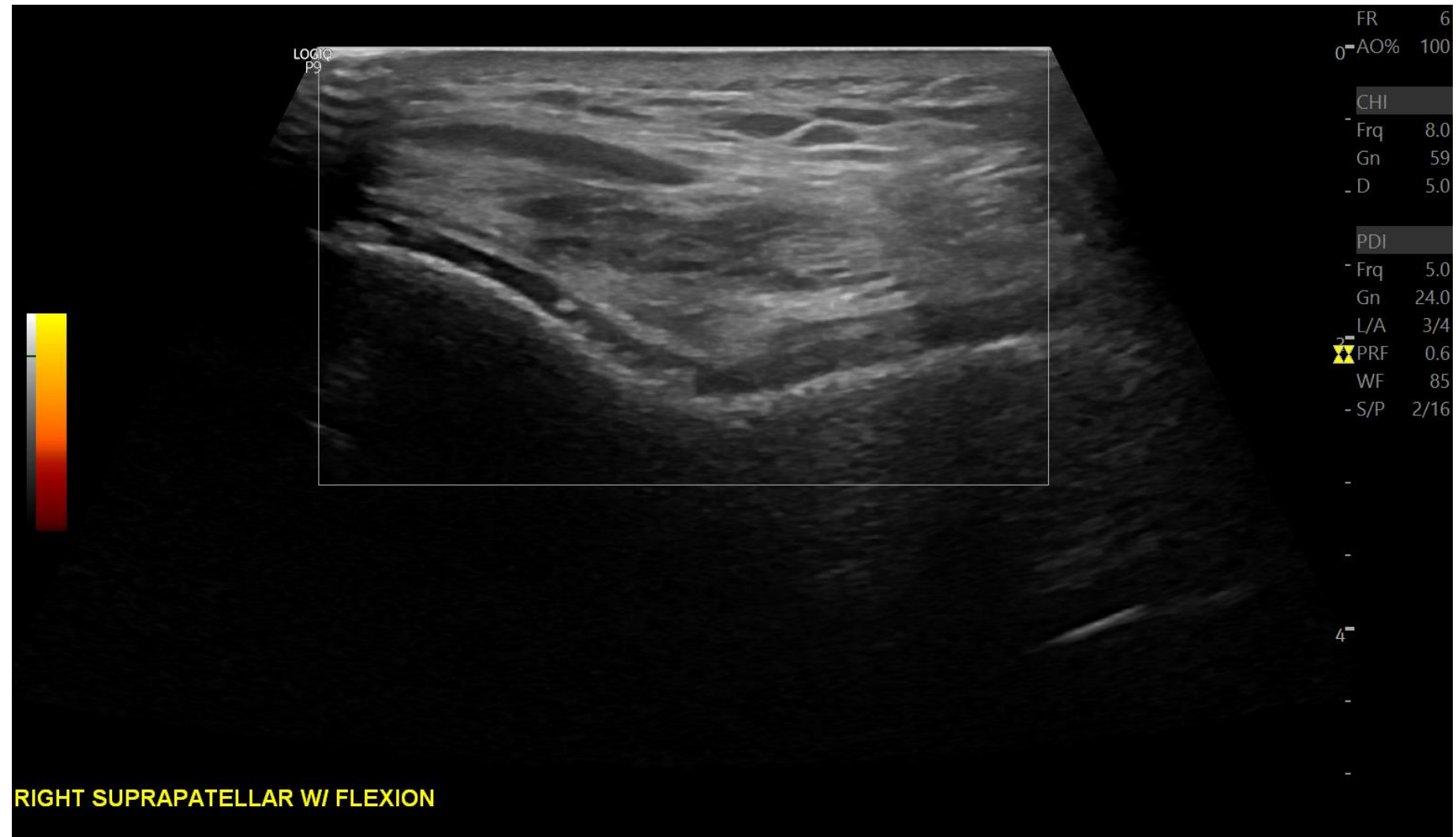
# Flexor Tenosynovitis & Peritendinous Fluid Accumulation



# Chondrocalcinosis (Pseudogout)



# Chondrocalcinosis (Pseudogout)



# Double Contour (Gout)

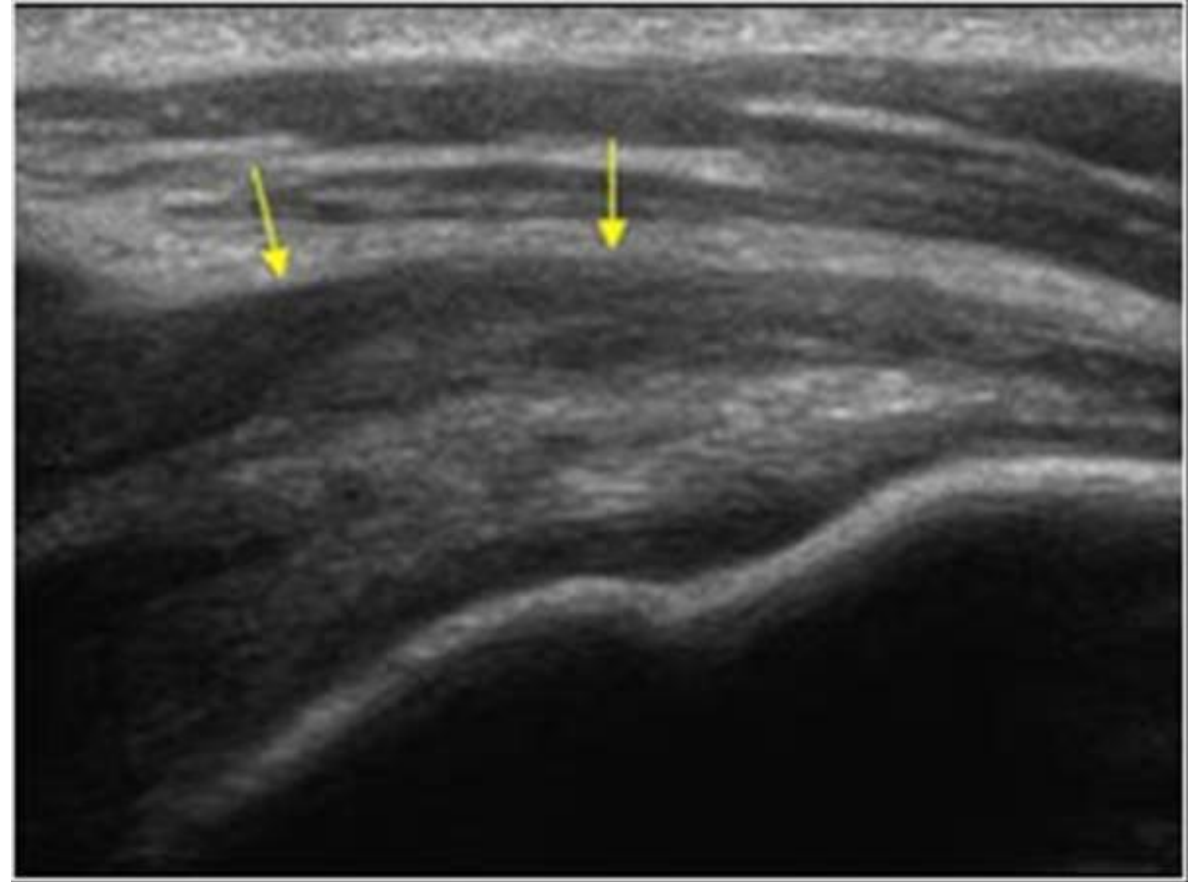
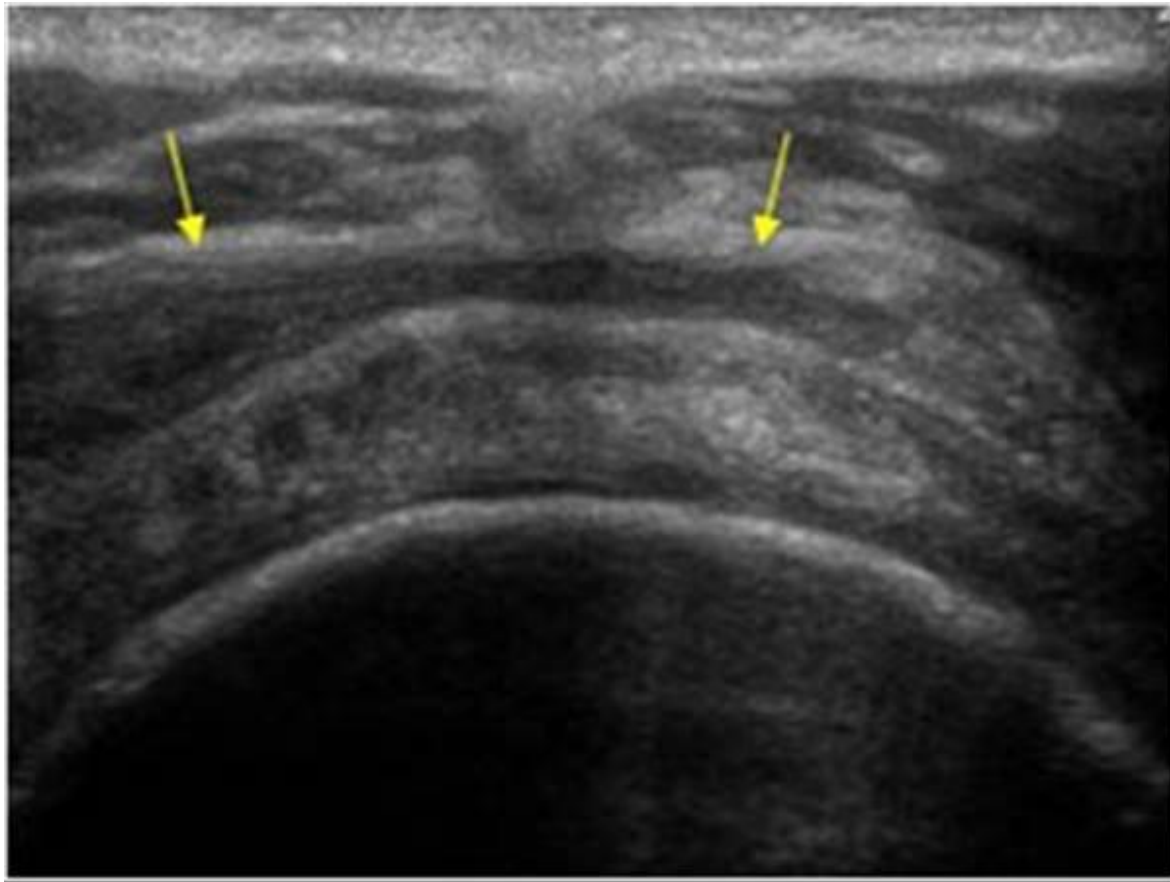




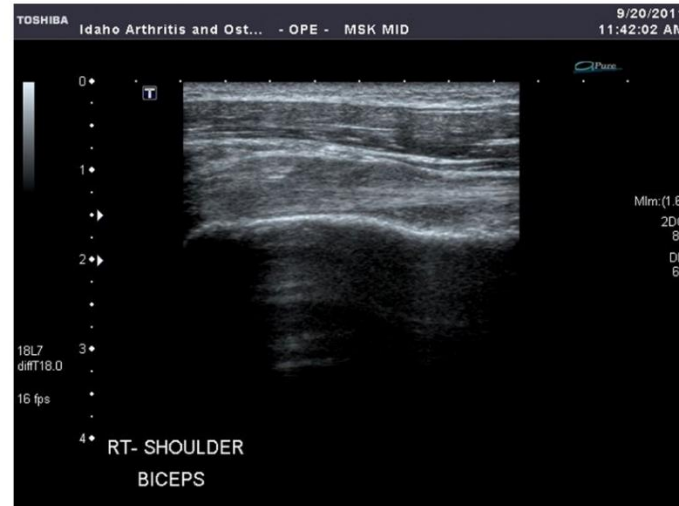
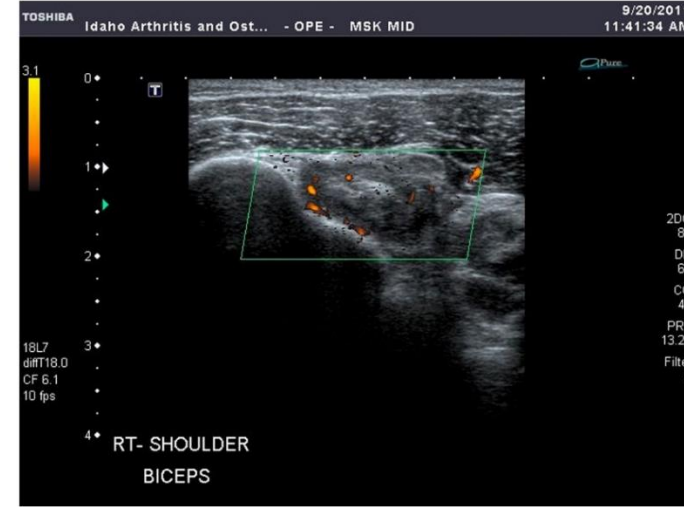
# C6 Peritendinous Tissue Thickening (RA)



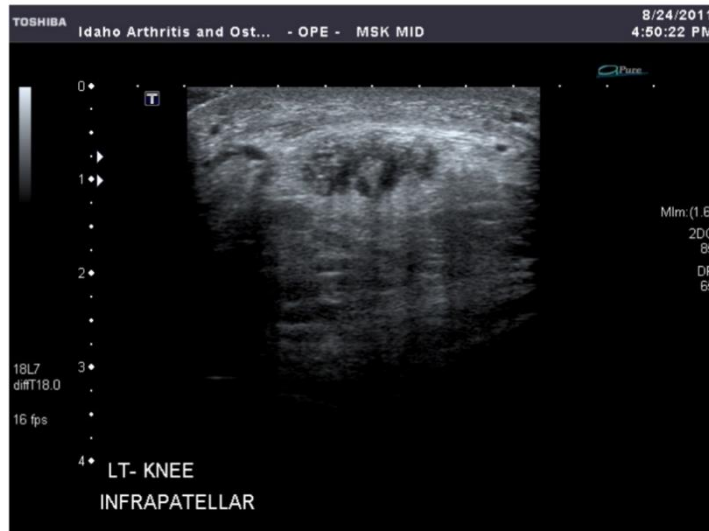
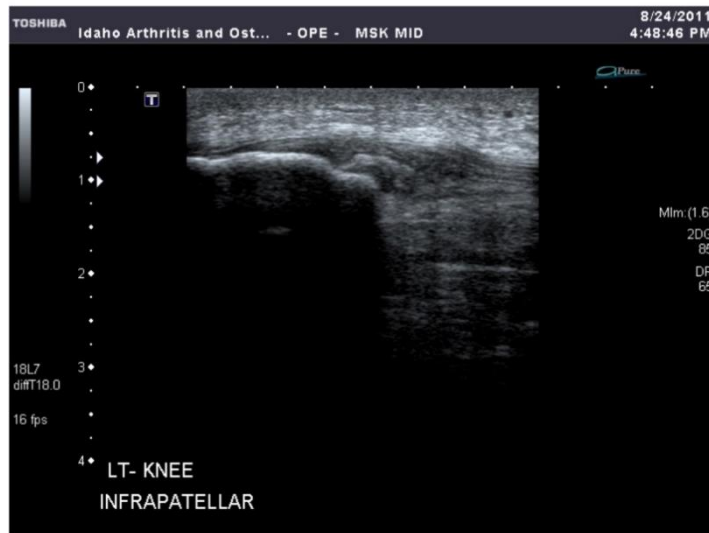
# Subacromial Bursal Thickening & Bursal Effusion



# BICEPS TENDINITIS AND TENOSYNOVITIS



# Patellar Tendinitis



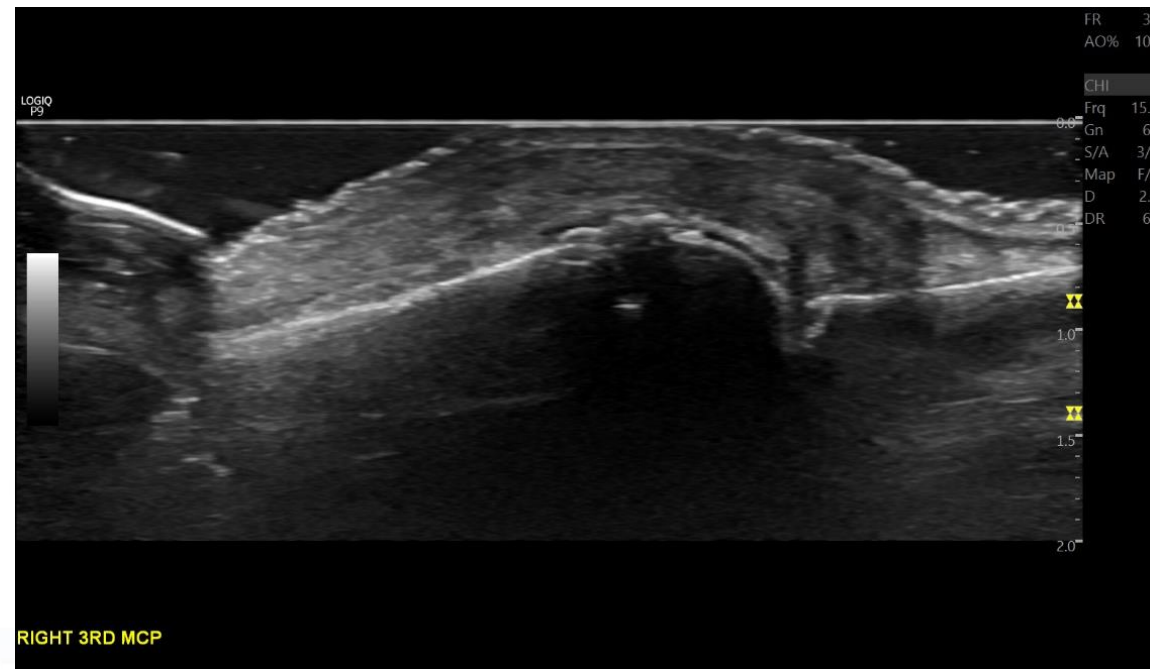
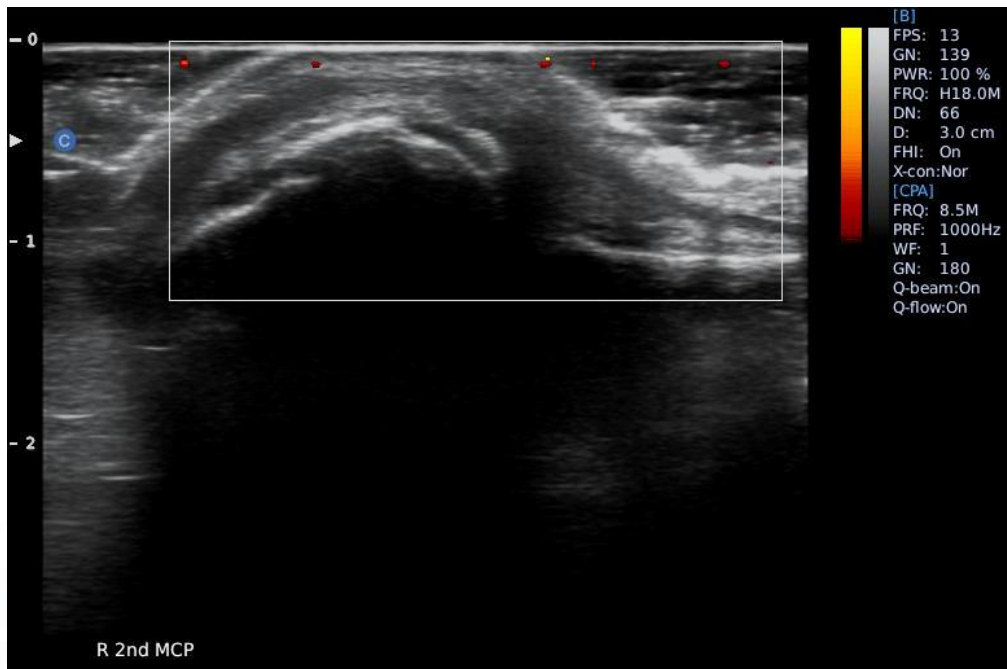




# RhAPP

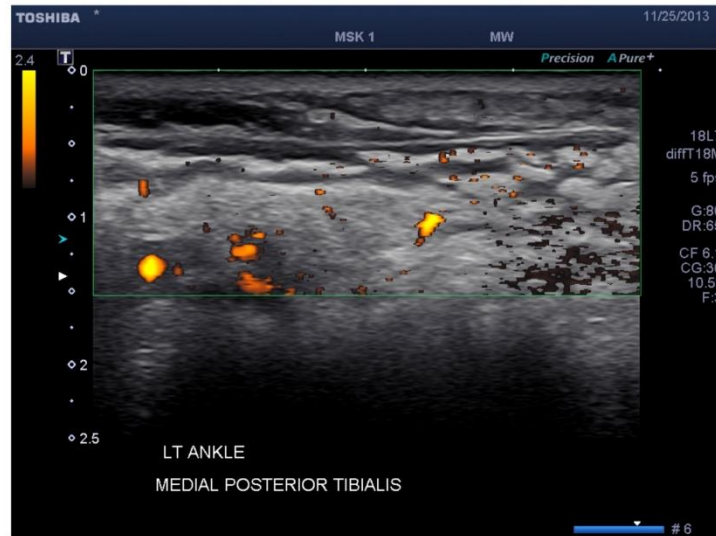
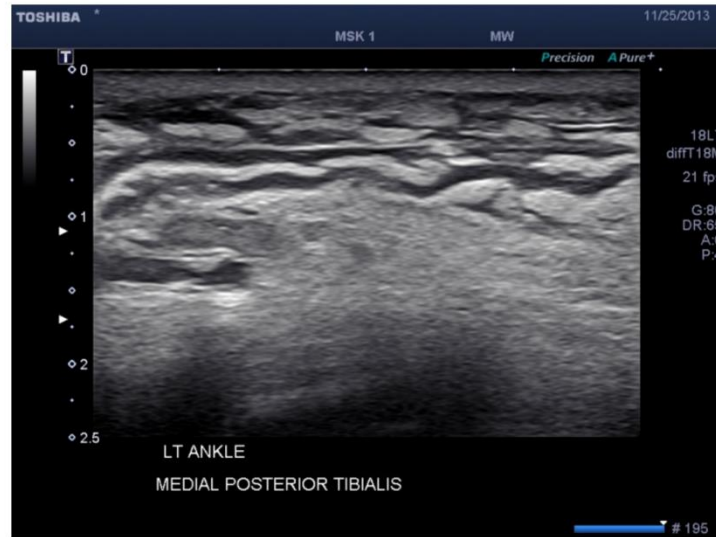
RHEUMATOLOGY ADVANCED  
PRACTICE PROVIDERS

# CHONDROCALCINOSIS



# Synovial Hypertrophy & Soft Tissue Swelling

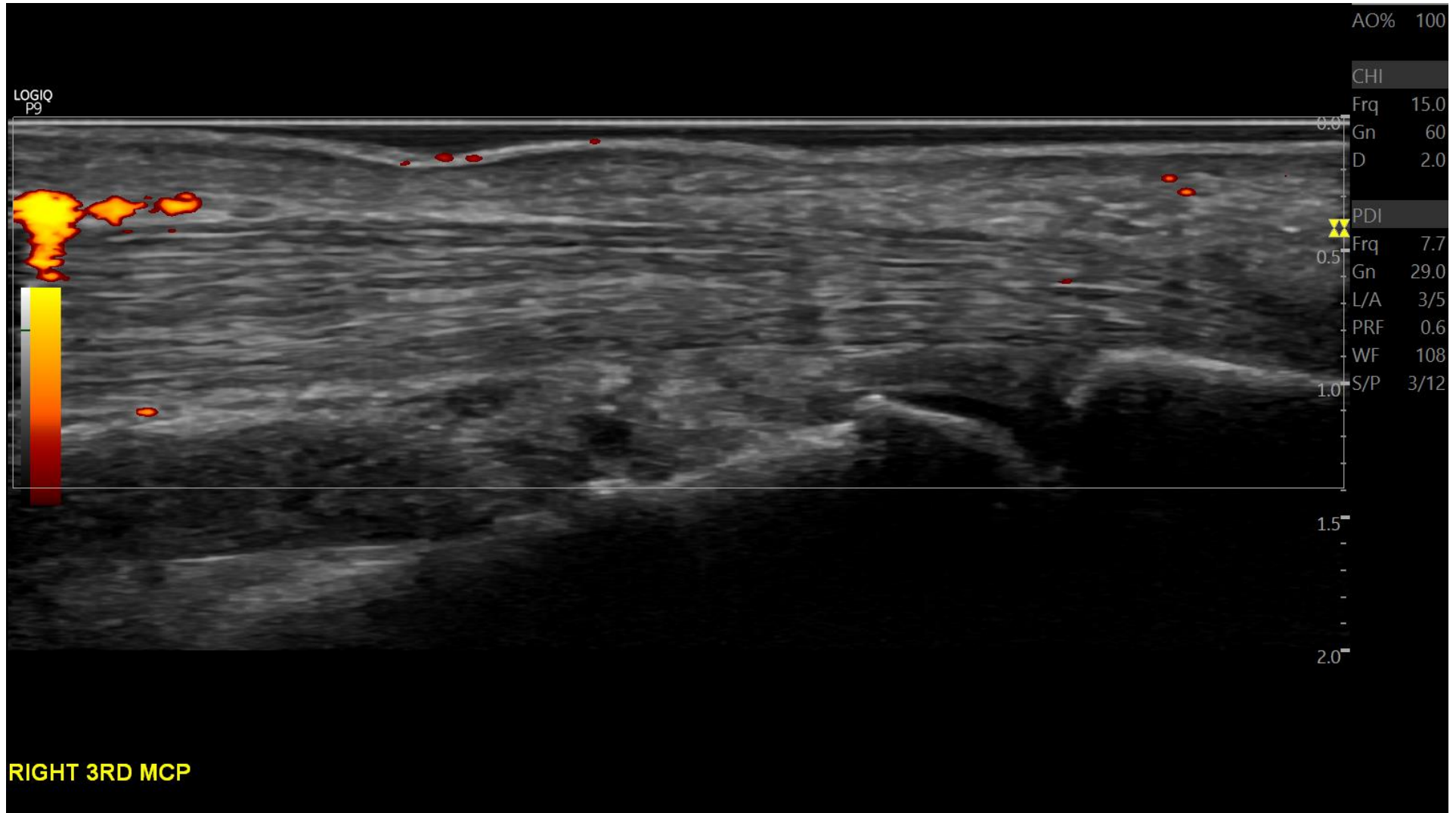
## SOFT TISSUE SWELLING OF THE MEDIAL ANKLE



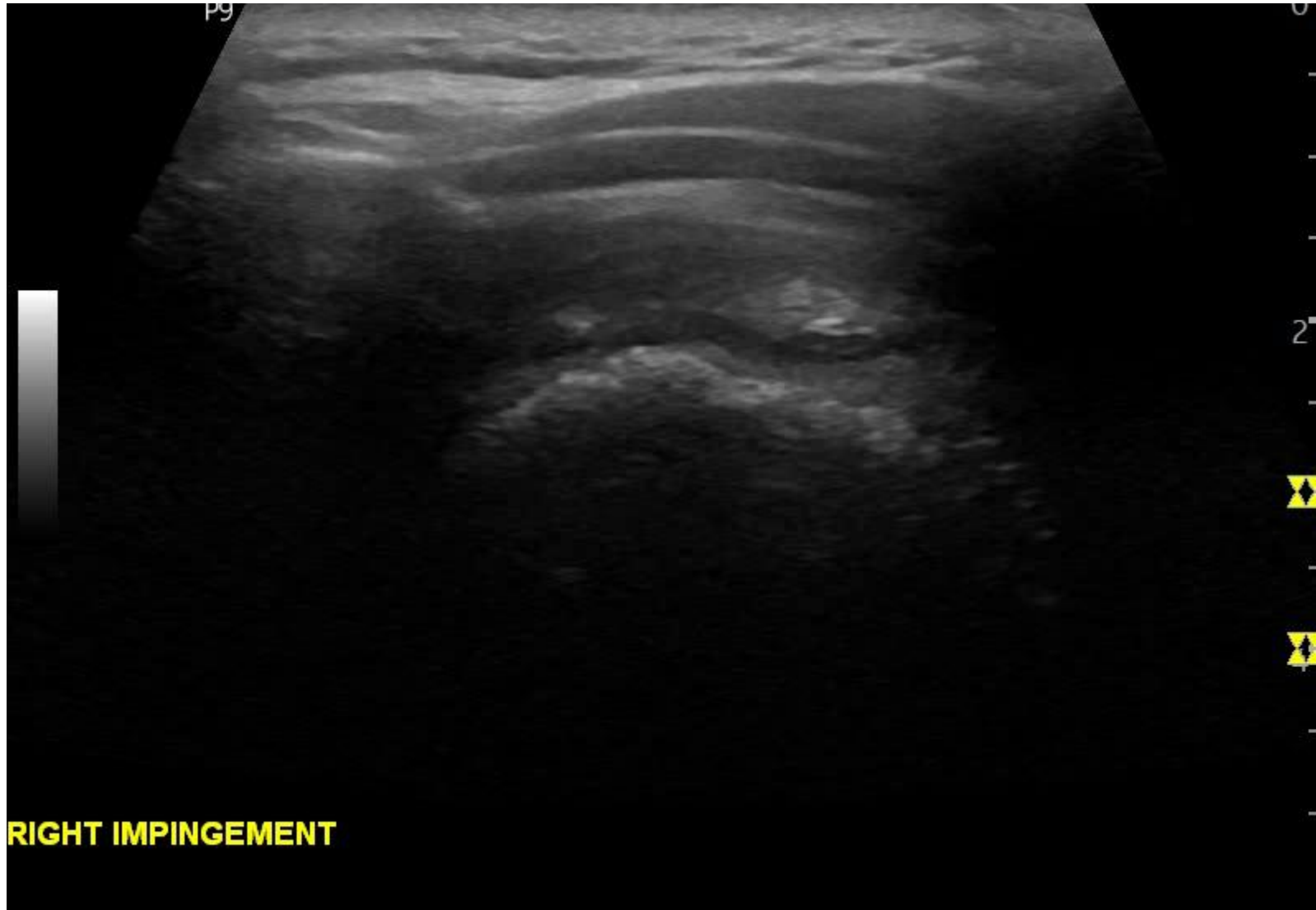
## ANKLE SYNOVIAL HYPERTROPHY, SYNOVITIS



# Tendon Hypertrophy

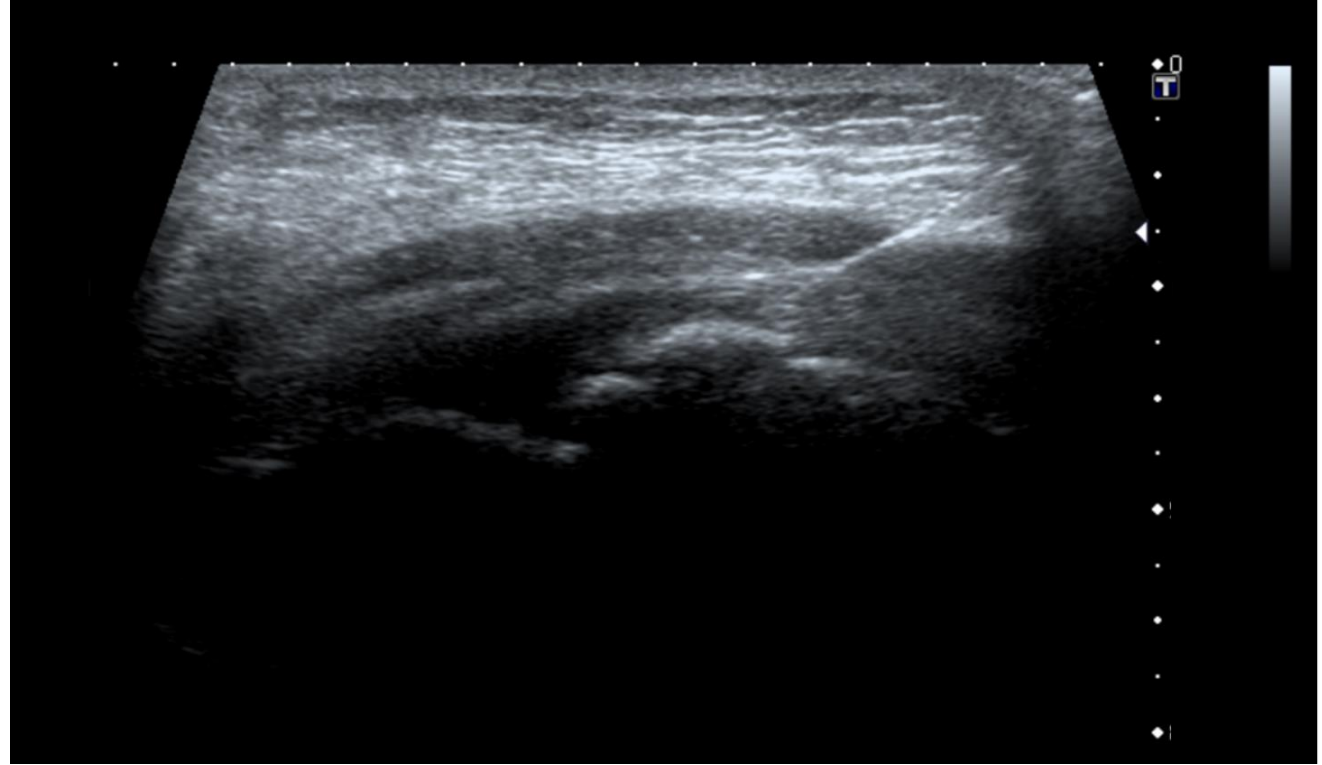


# Subacromial Bursal Impingement

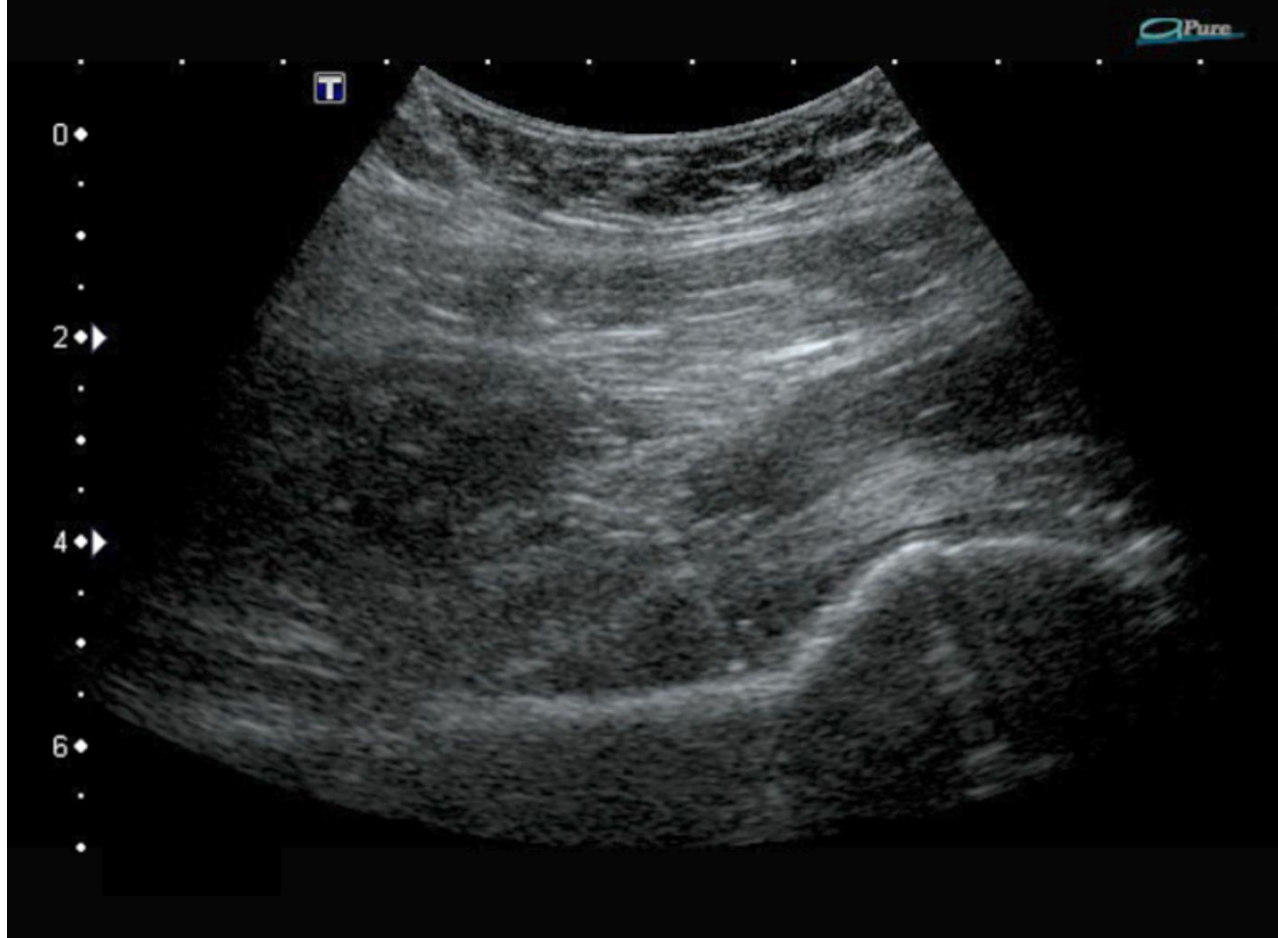




# Greater Trochanteric Bursa Injection

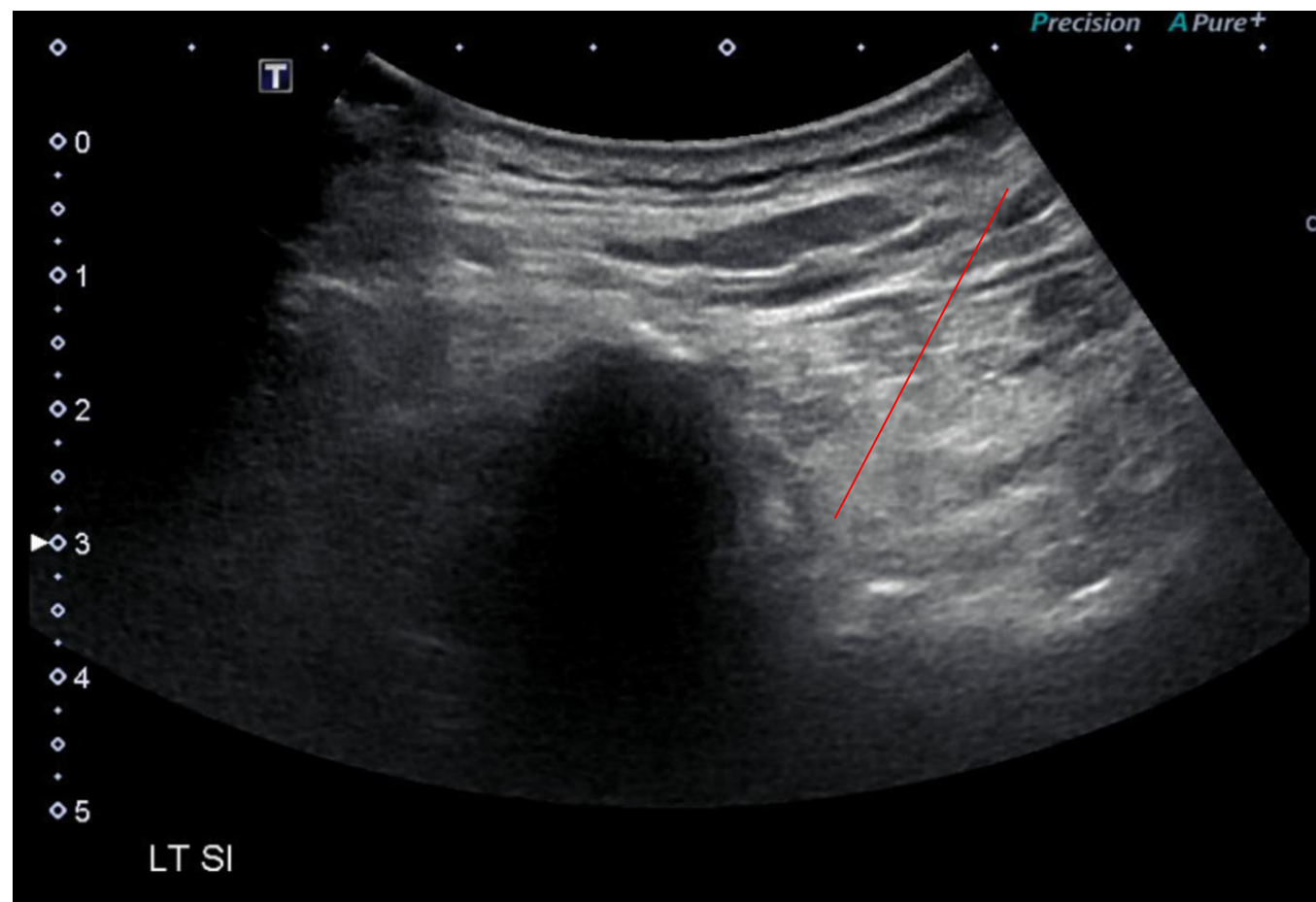


# Hip Capsule Injection

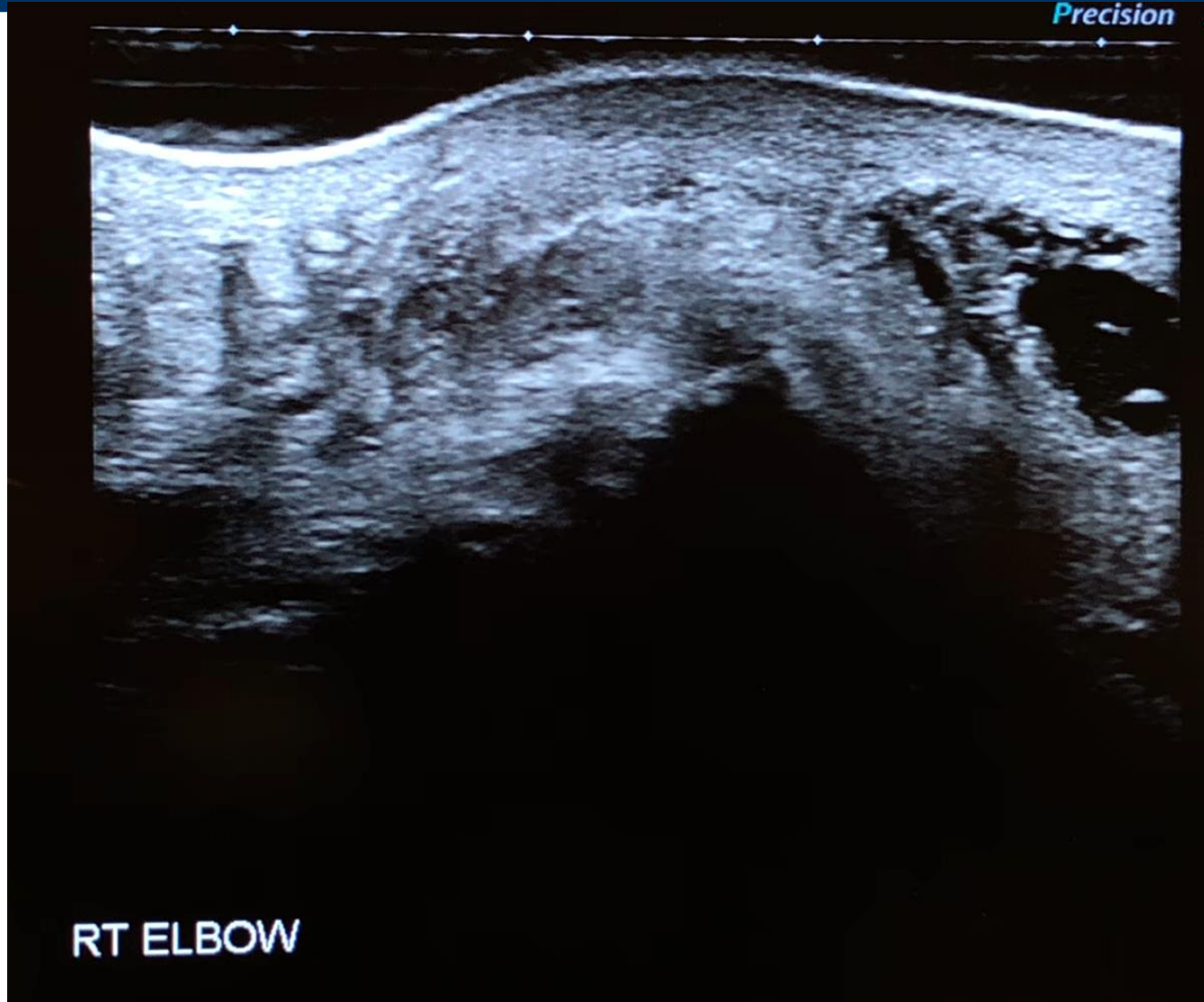




# SI Joint Injection



# Olecranon Bursa Injection





# Subacromial Bursal Injection



# 2<sup>nd</sup> MCP Injection



# Knee Injection

