

**4th Annual
National Conference
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RhAPP
RHEUMATOLOGY ADVANCED
PRACTICE PROVIDERS



Ultrasound Pathology

McKenna Cornforth, BSN

Nate Mathews, RMSK

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- There are no financial relationships to disclose at this time.

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.

Terminology (Oh, EWWW, 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)

Defining Synovitis v Fluid...

Key features that may help are part of the definitions for synovitis and Fluid provided by the Outcome Measures in Rheumatoid Arthritis Clinical Trials (OMERACT) group, with the name recently broadened to Outcome Measures in Rheumatology to reflect expanded initiatives.

Synovitis can be defined as:

- an abnormal hypochoic intra-articular tissue that is *nondisplaceable* and poorly compressible and that may exhibit a Doppler signal.

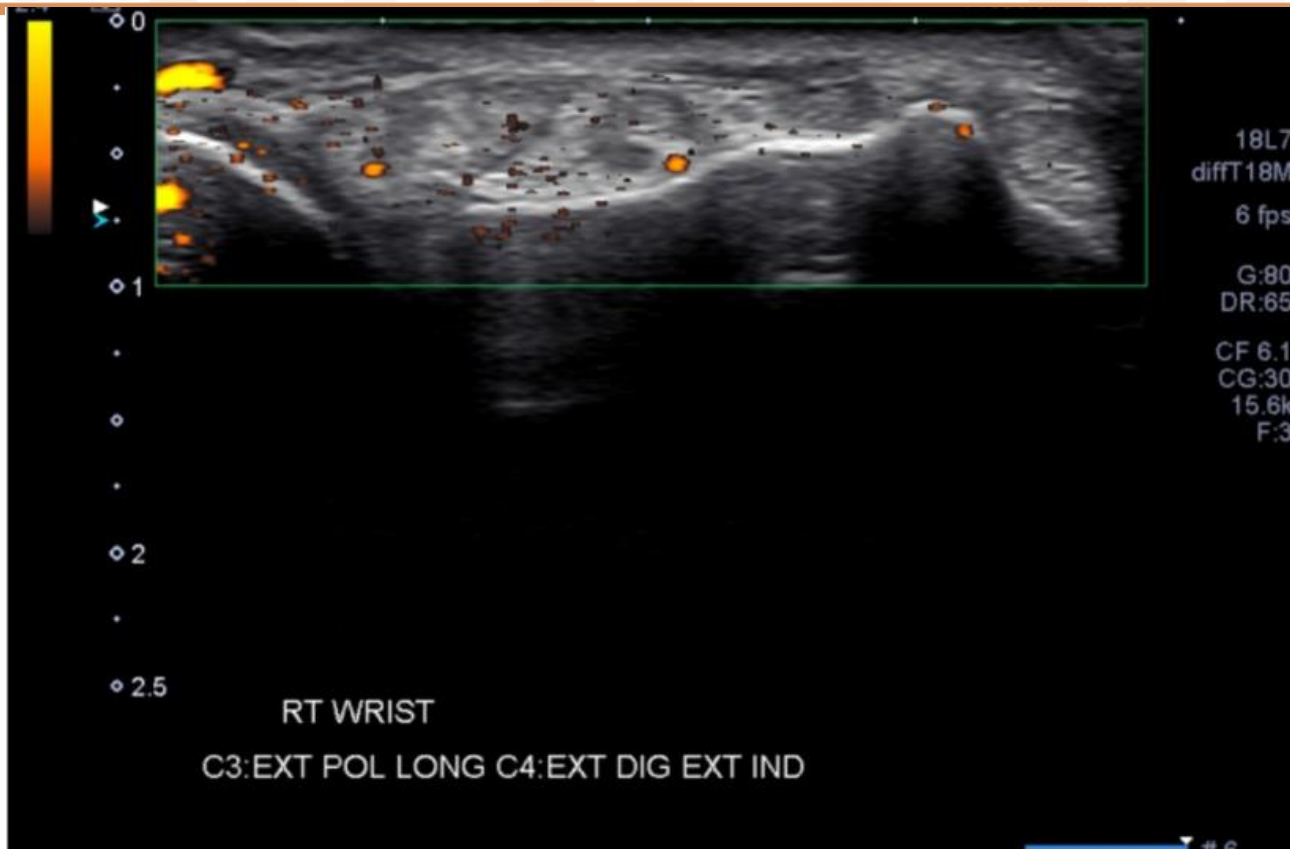
Fluid can be defined as:

- an abnormal hypochoic intra-articular material that is *displaceable* and **compressible** and that does **not** exhibit a Doppler signal.

OMERACT Grading System:

- Grade 1: Single Vessel Signals
- Grade 2: Confluent Vessel Signals
- Grade 3: >50% of synovium covered with vessel signals

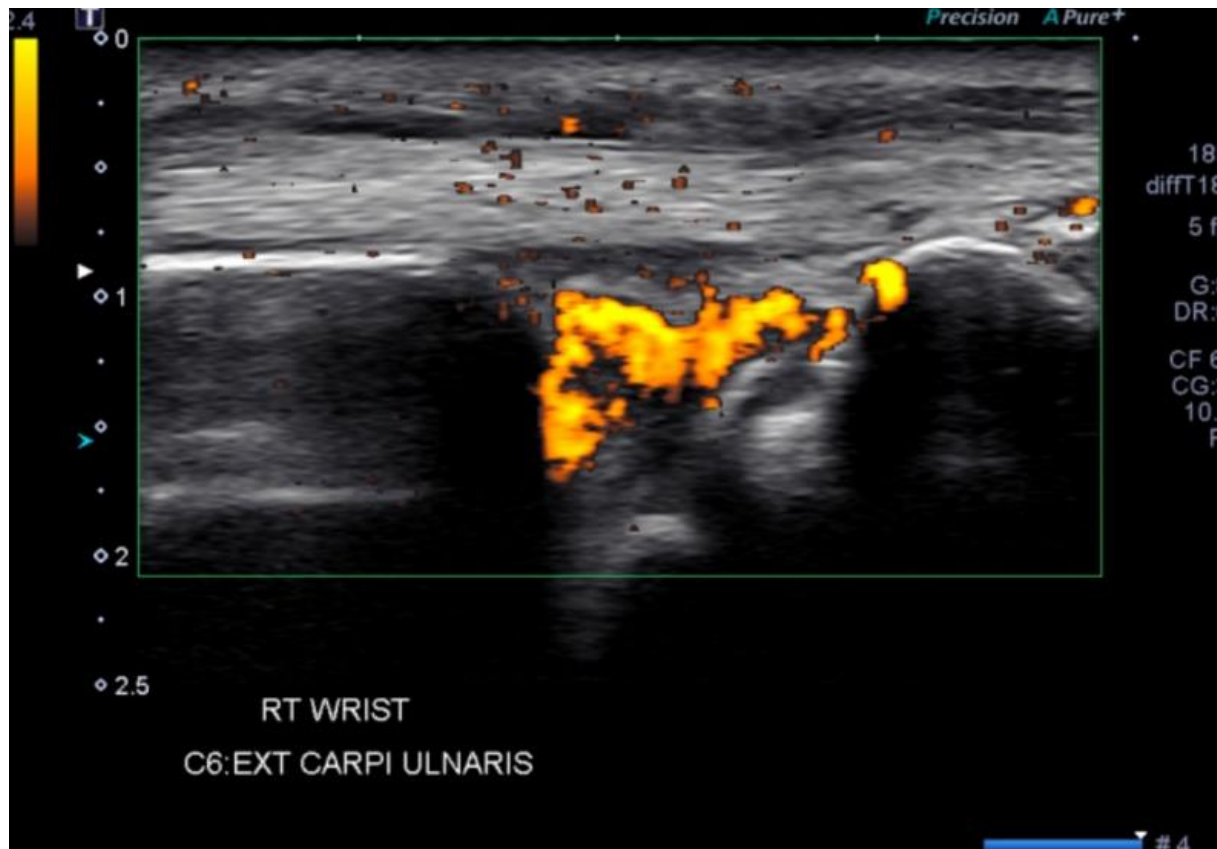
Grade 1 (Single Vessel Signals)



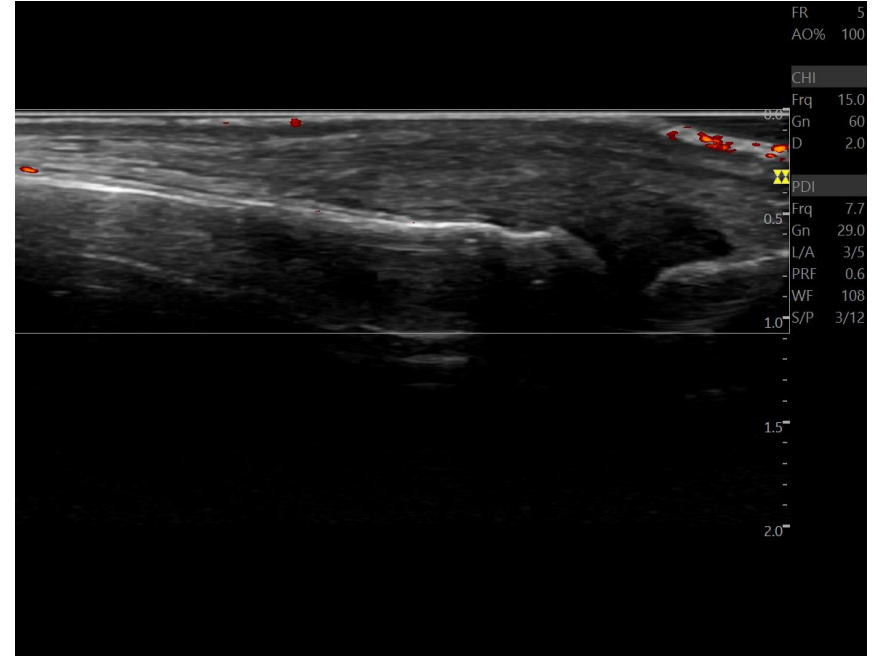
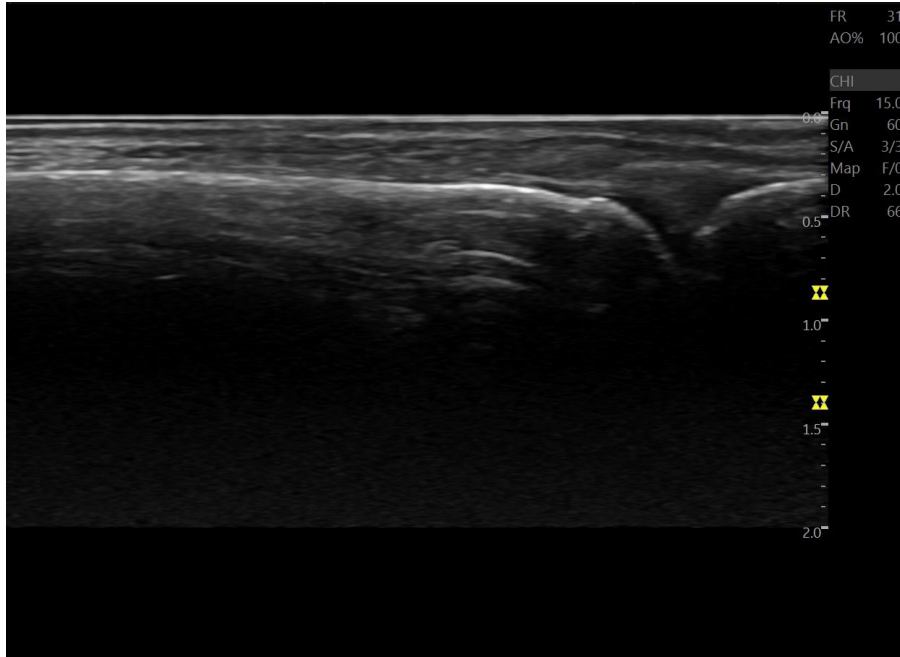
Grade 2 (Confluent Vessel Signals)



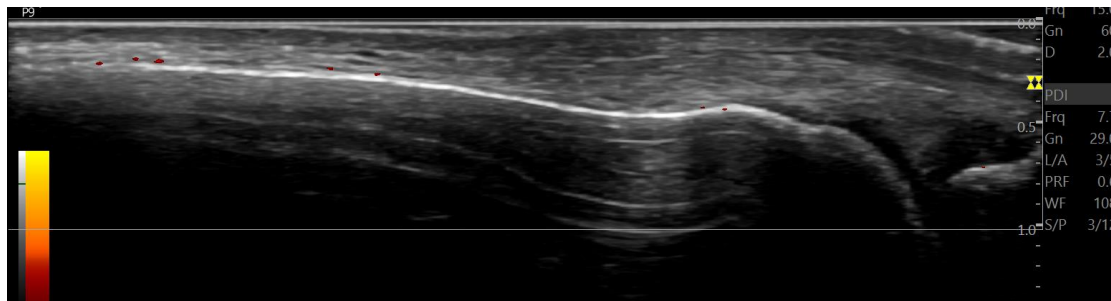
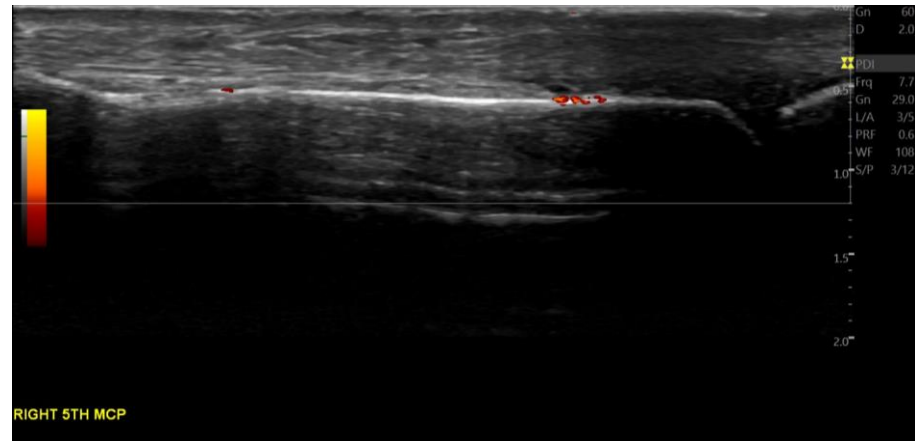
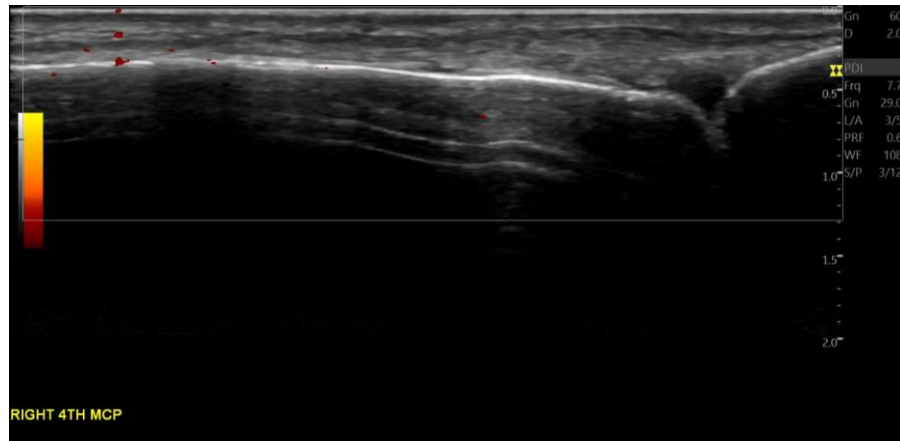
Grade 3 (>50% of synovium covered with vessel signals)



Synovial Hypertrophy



Synovial Proliferation



Defining Erosions...

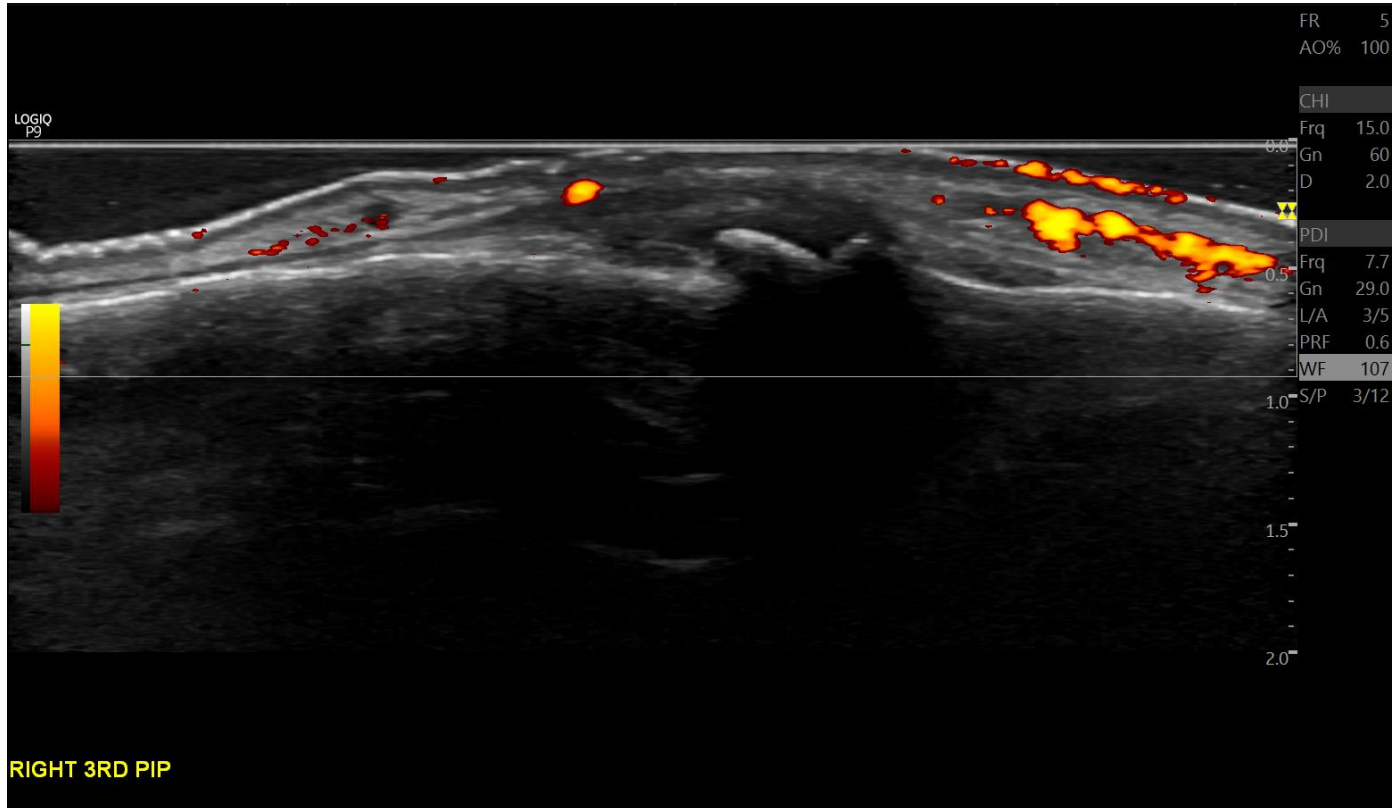
Bone erosions are often considered the pathologic hallmark of rheumatoid arthritis, although they are not specific for the disease. They represent a localized destructive process associated with loss of mineralized tissue and a break in the bone cortex. The cause and site of bone erosion is linked to the presence of synovitis and local biomechanical factors.

At a cellular level, periarticular damage begins with resorption of mineralized cartilage, followed by more widespread loss of surface cartilage mediated by synovial fibroblasts. Radiographically detected erosions are an important diagnostic criterion for rheumatoid arthritis, and they offer predictive information about future structural damage and poor functional outcomes, as well as providing a means for monitoring disease progression. Radiographically identified erosions in early, undifferentiated arthritis has been shown to be a risk factor for developing persistent arthritis.

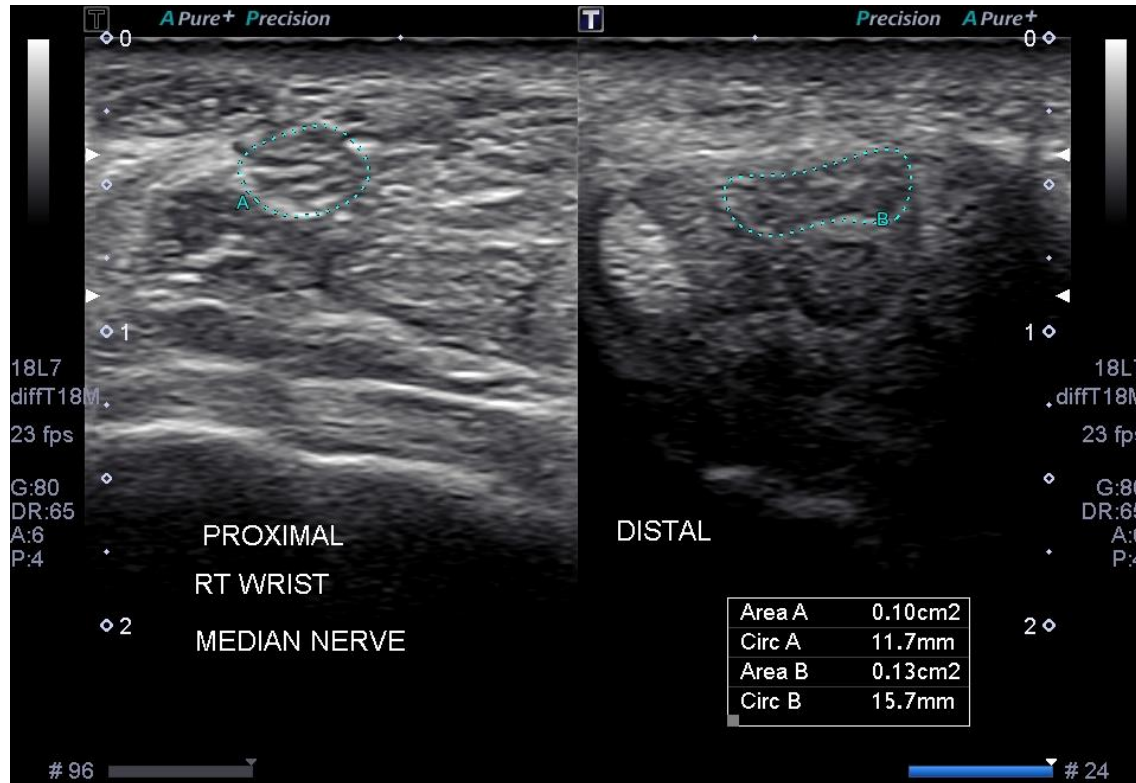
2nd MCP Marginal Erosion



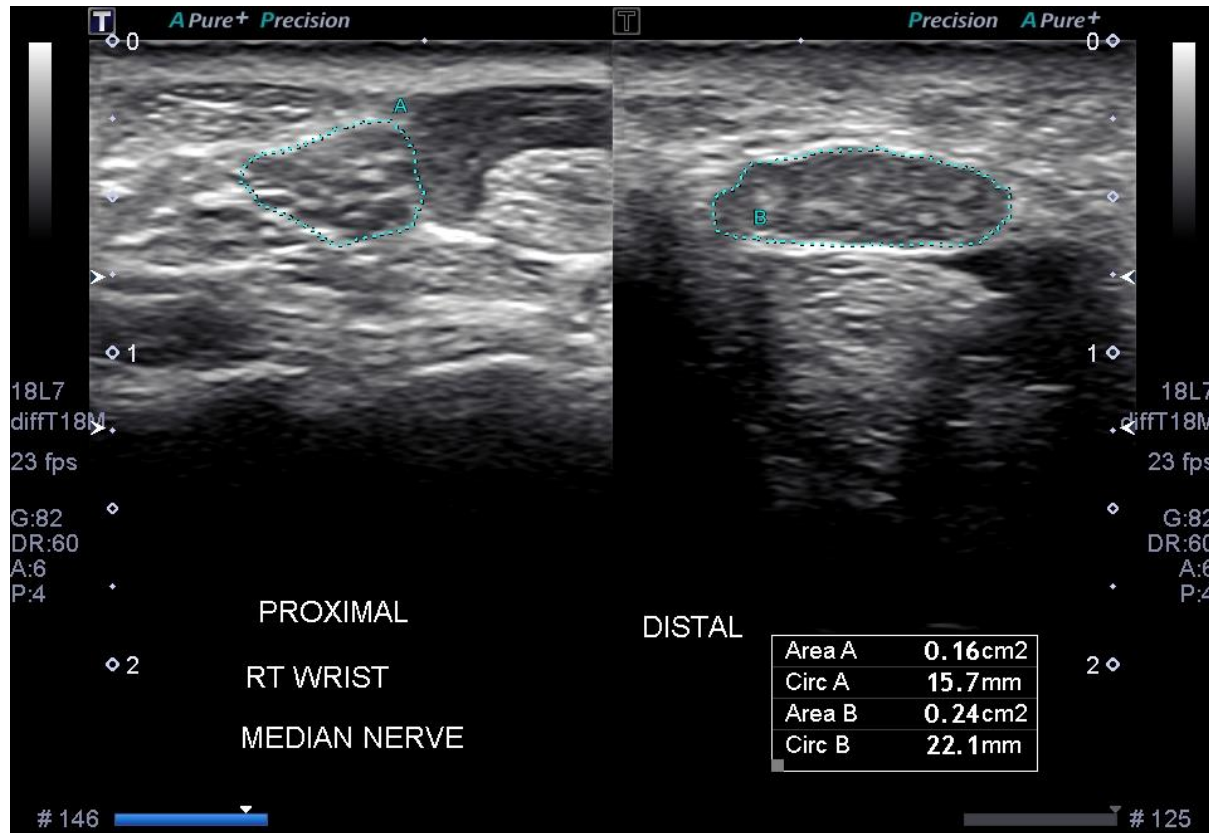
Miscellaneous PIP Pathology



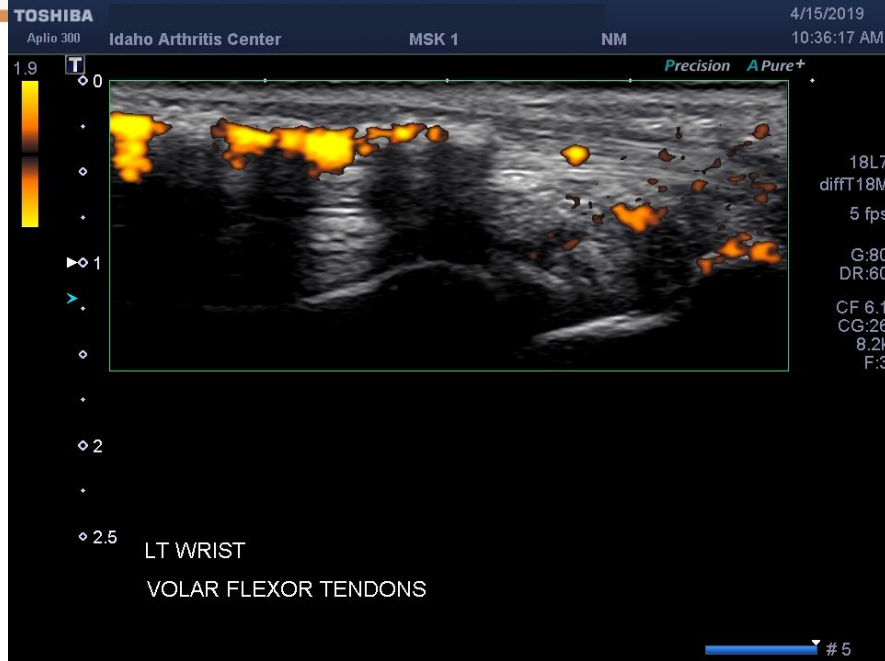
Carpal Tunnel Syndrome (Minor)



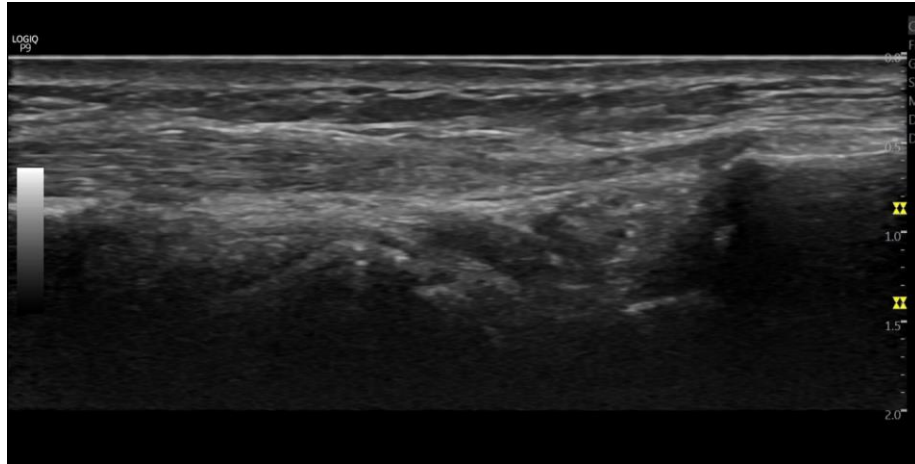
Carpal Tunnel Syndrome (Major)



Calcific Tendinitis (Flexor Carpi Radialis)



1st Compartment Joint Space Narrowing, Capsular Distention & Intracapsular Hyperechoic Debris (Osteoarthritis)

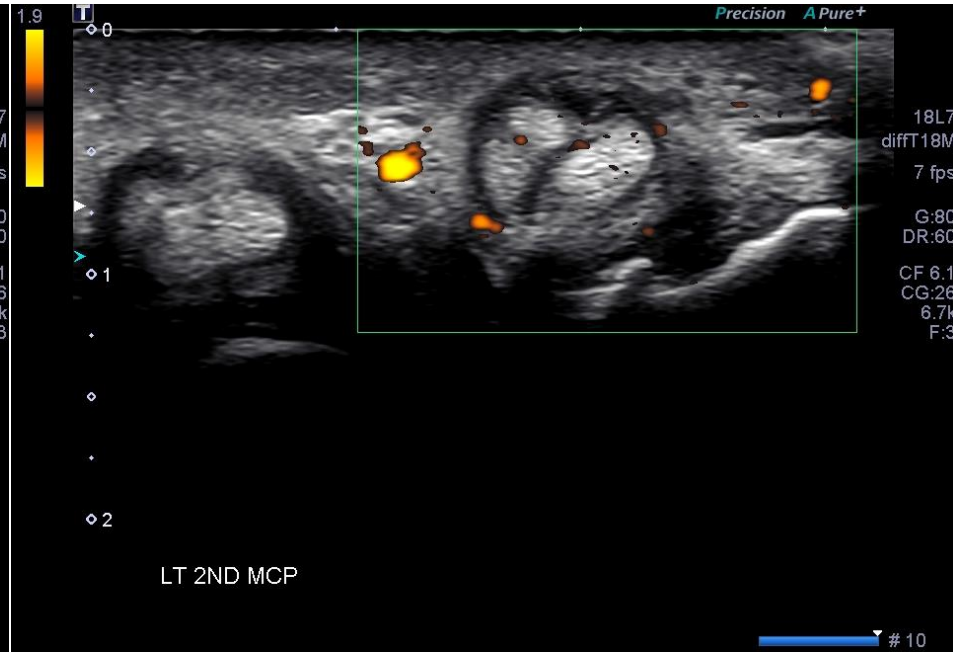
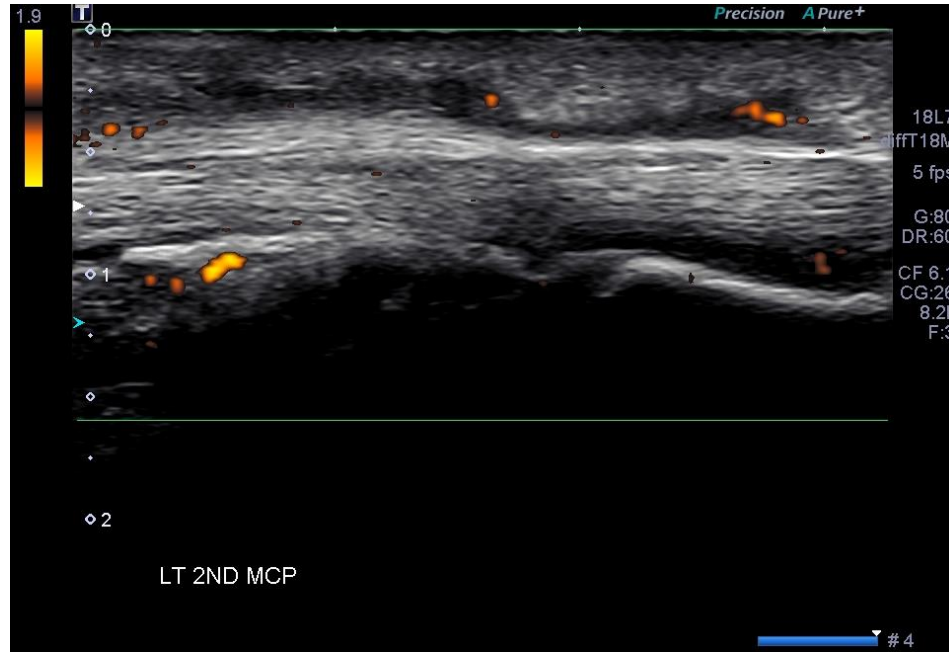


Normal

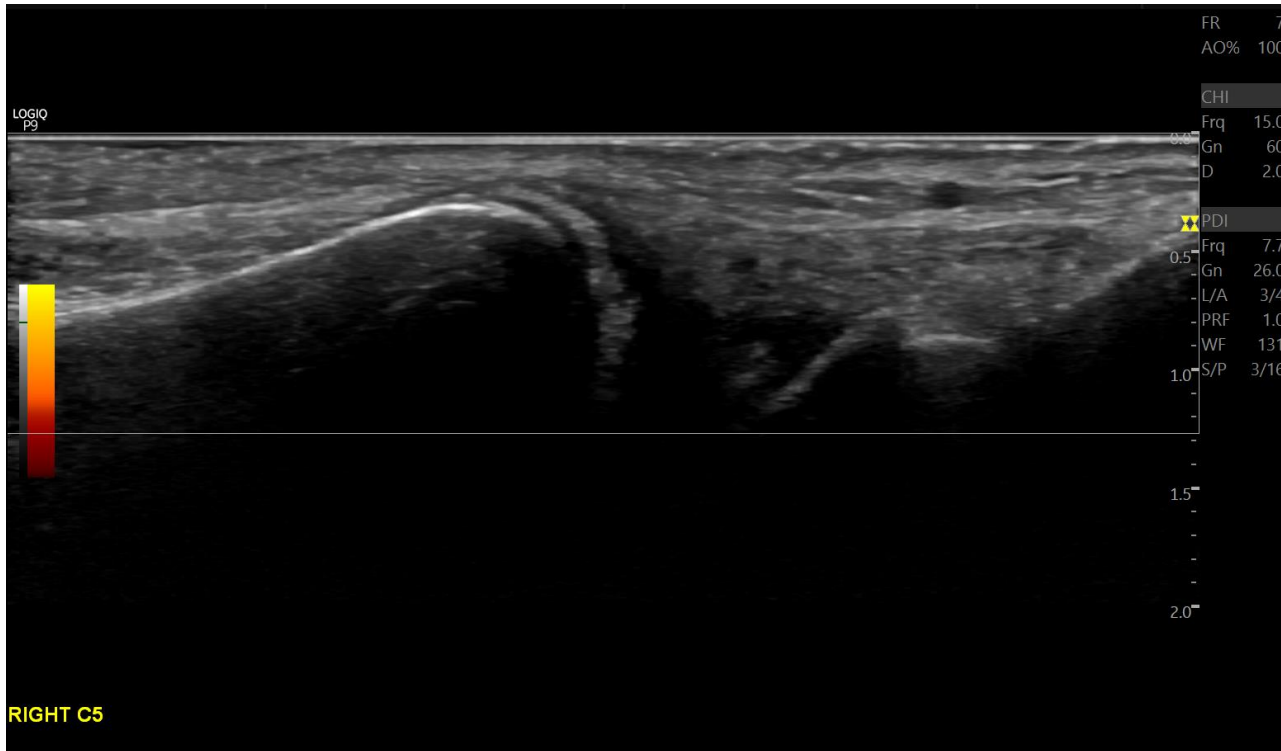


Pathology

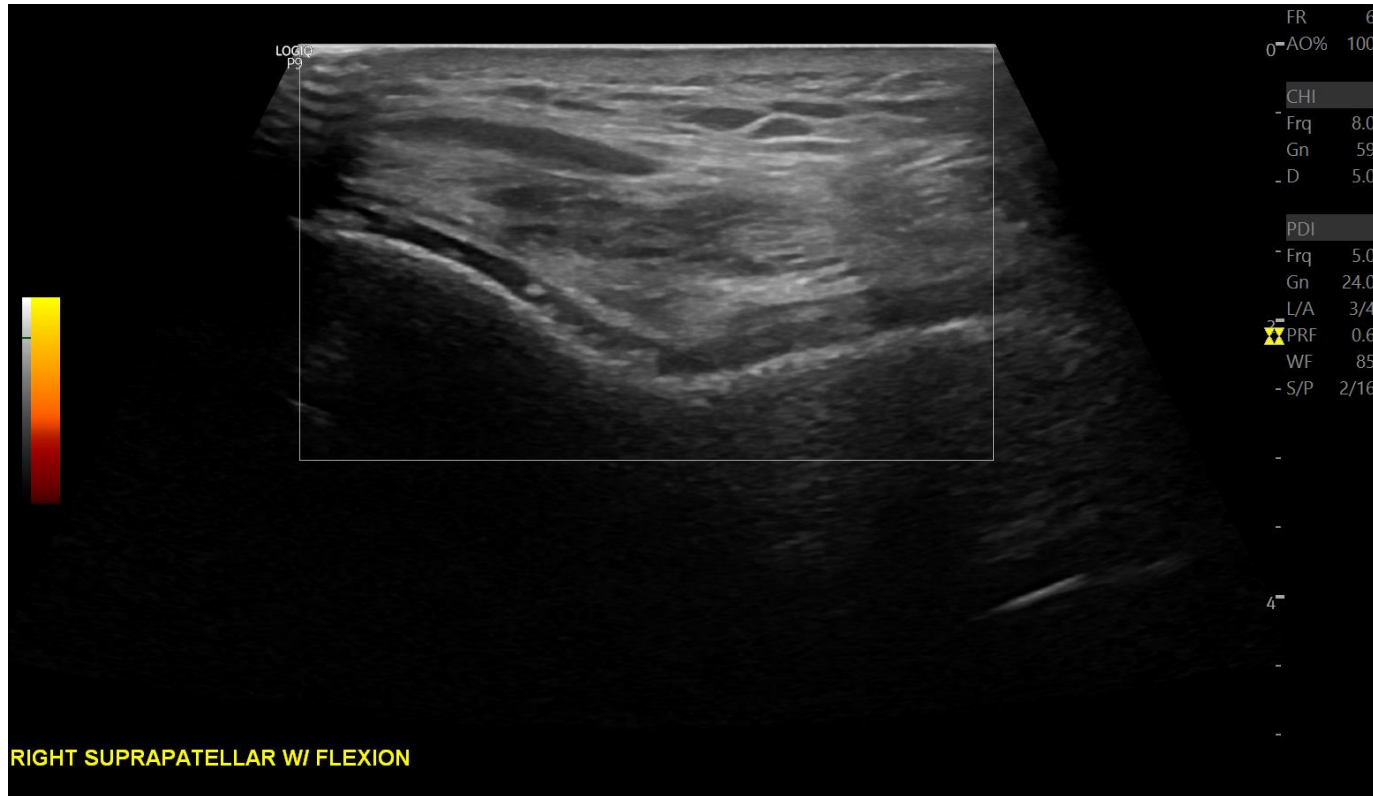
Flexor Tenosynovitis & Peritendinous Fluid Accumulation



Chondrocalcinosis (Pseudogout)



Chondrocalcinosis (Pseudogout)



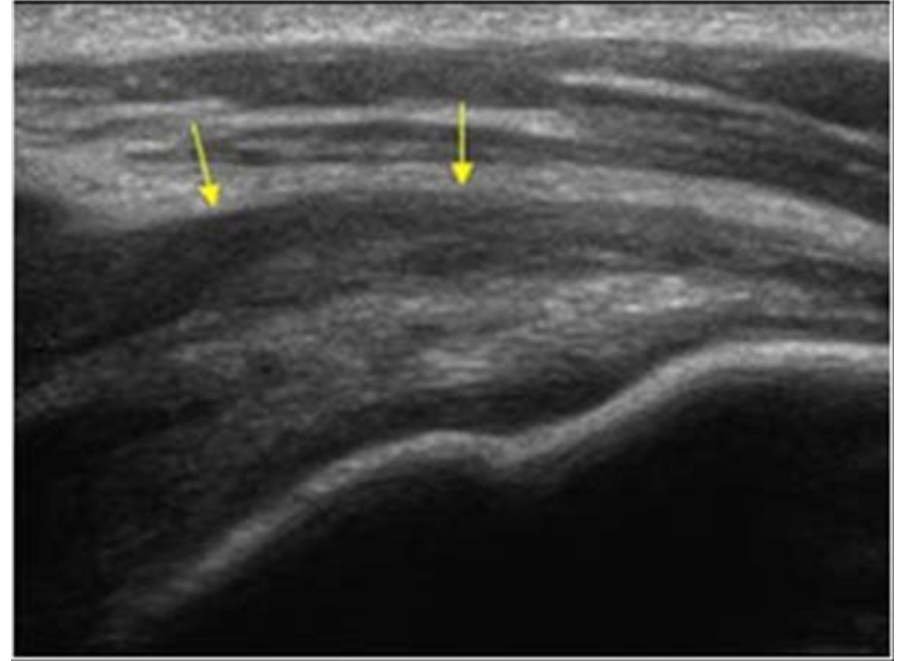
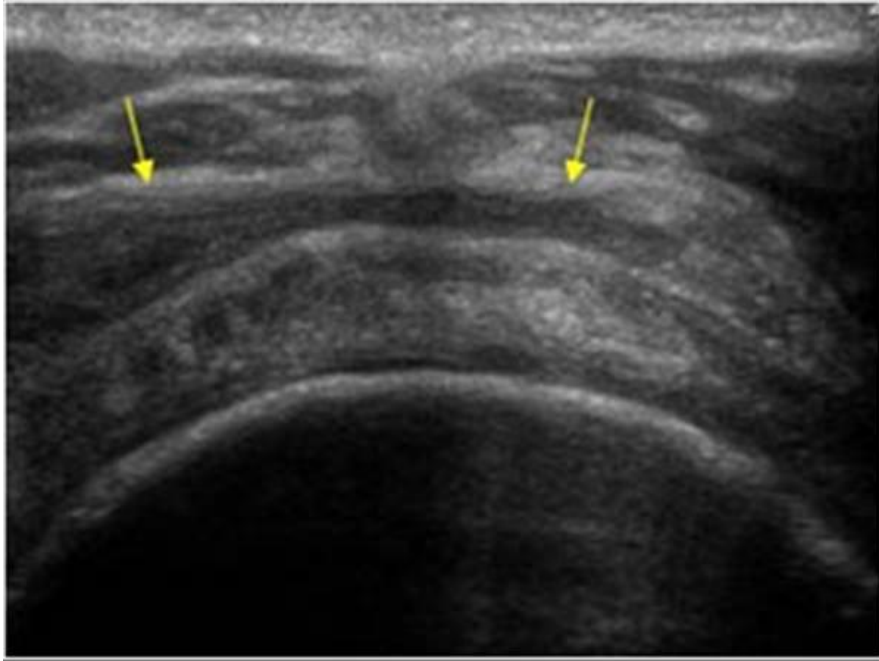
Double Contour (Gout)



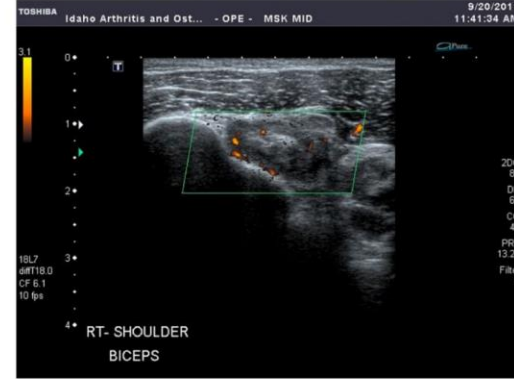
C6 Peritendinous Tissue Thickening (RA)



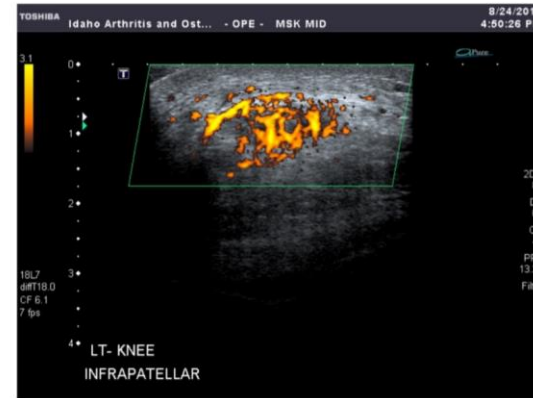
Subacromial Bursal Thickening & Bursal Effusion



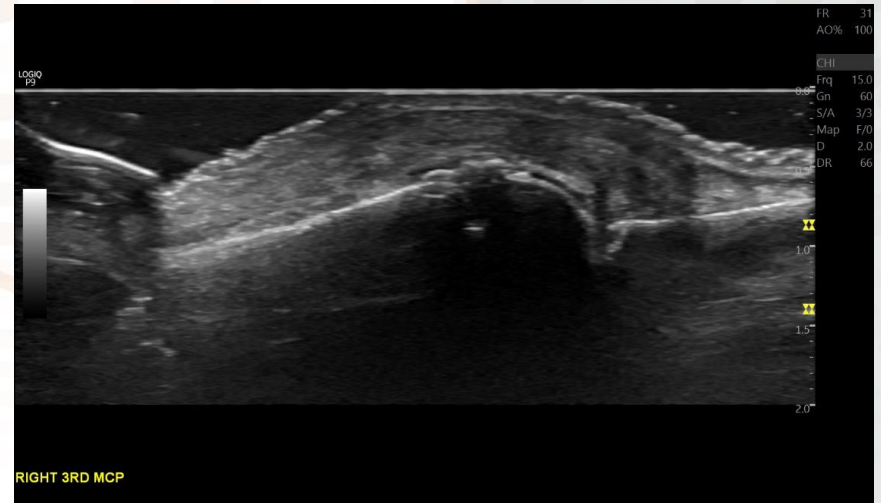
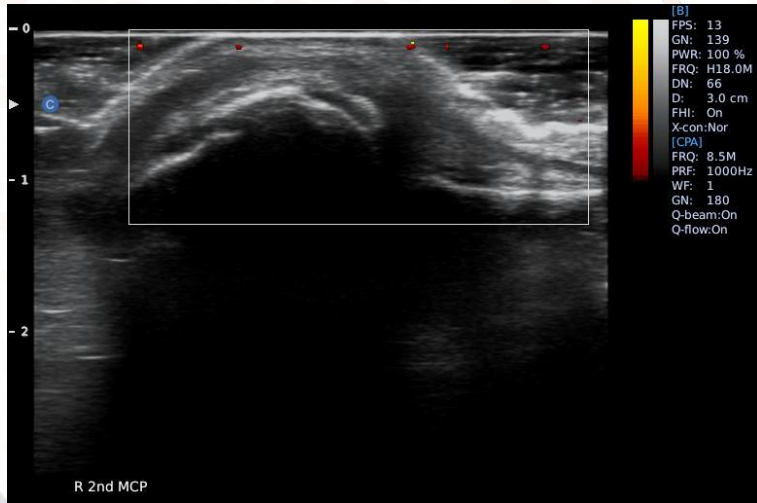
BICEPS TENDINITIS AND TENOSYNOVITIS



Patellar Tendinitis



CHONDROCALCINOSIS



Synovial Hypertrophy & Soft Tissue Swelling (Edema)

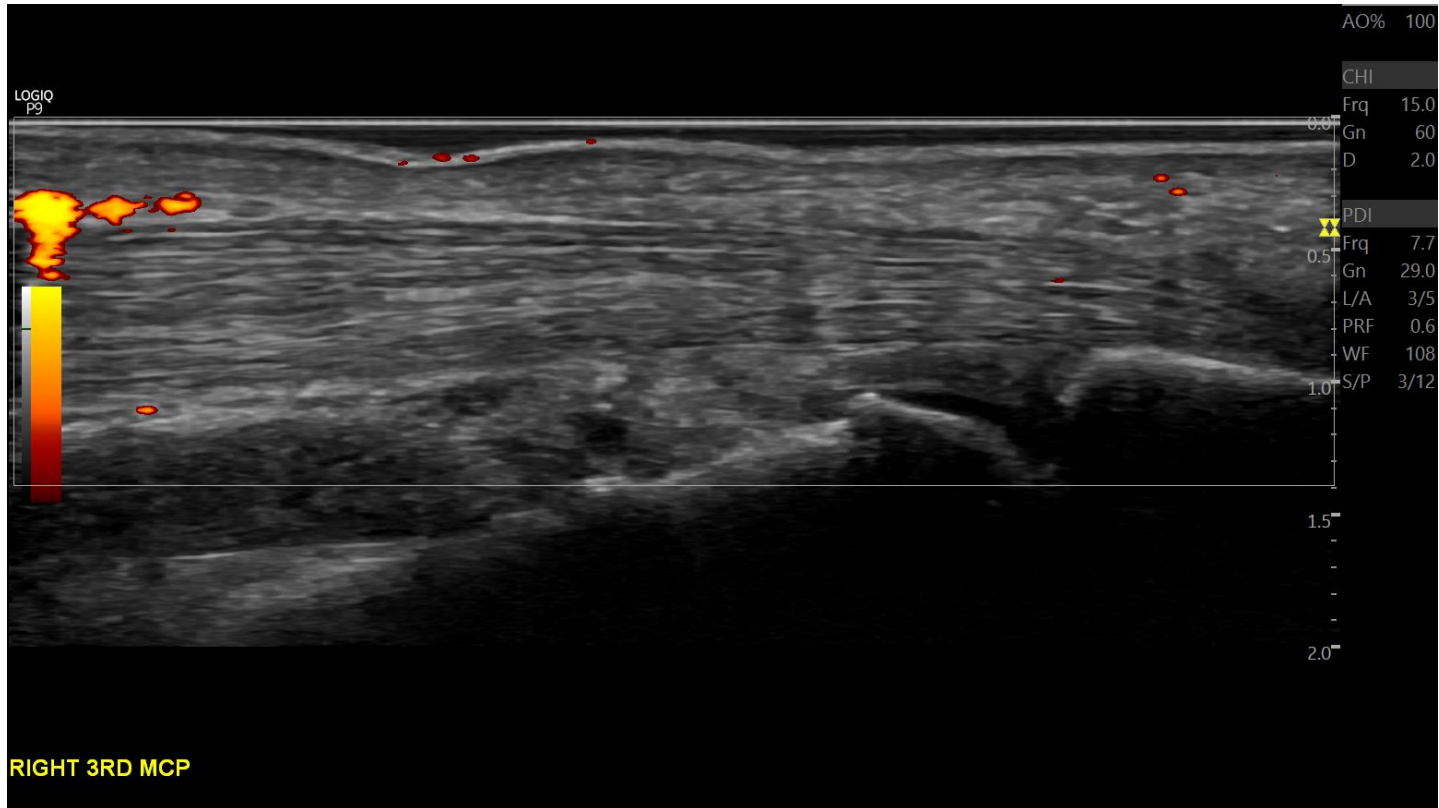
SOFT TISSUE SWELLING OF THE MEDIAL ANKLE



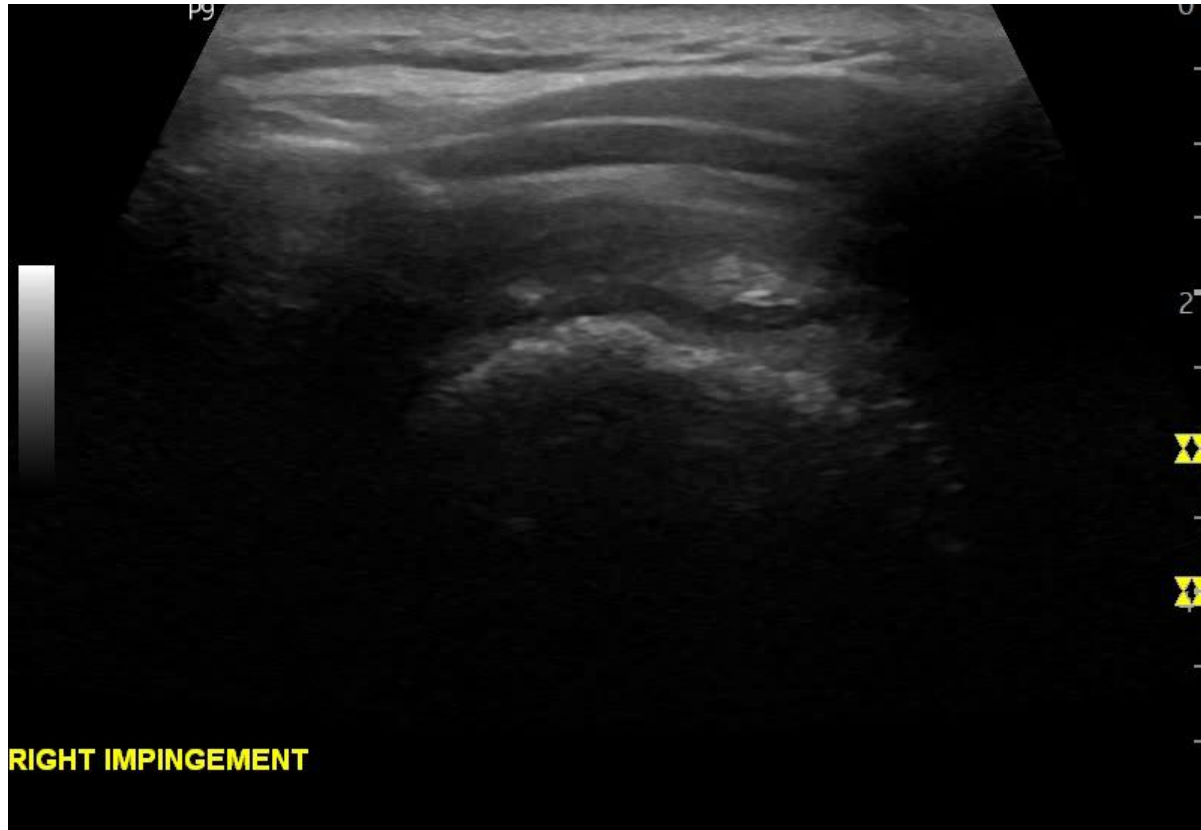
ANKLE SYNOVIAL HYPERTROPHY, SYNOVITIS



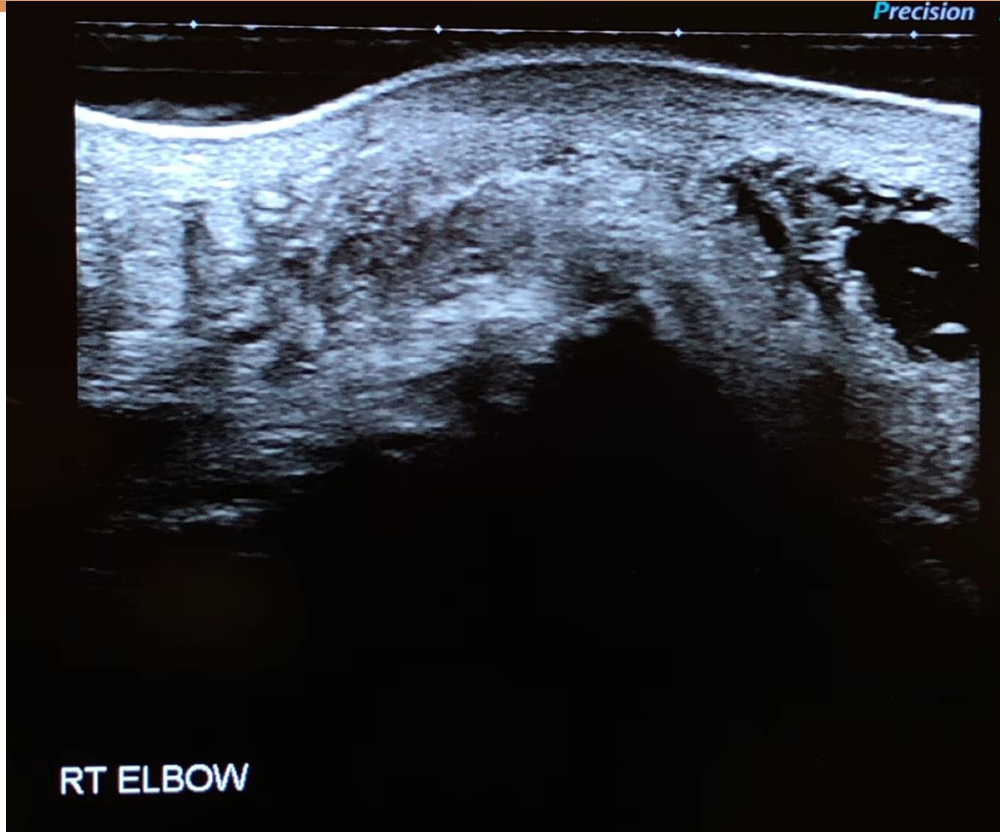
Tendon Hypertrophy



Subacromial Bursal Impingement



Olecranon Bursa Injection



Salivary Gland Parenchymal Heterogeneity and Hyperemia

