RhAPP

RHEUMATOLOGY ADVANCED PRACTICE PROVIDERS

4th Annual National Conference

September 21–23, 2023

Ultrasound Boot Camp!!

Nate Mathews, RMSK

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Faculty Disclosures

- There are no relevant financial relationships to disclose.

Greetings, Everyone!!

Hi in English

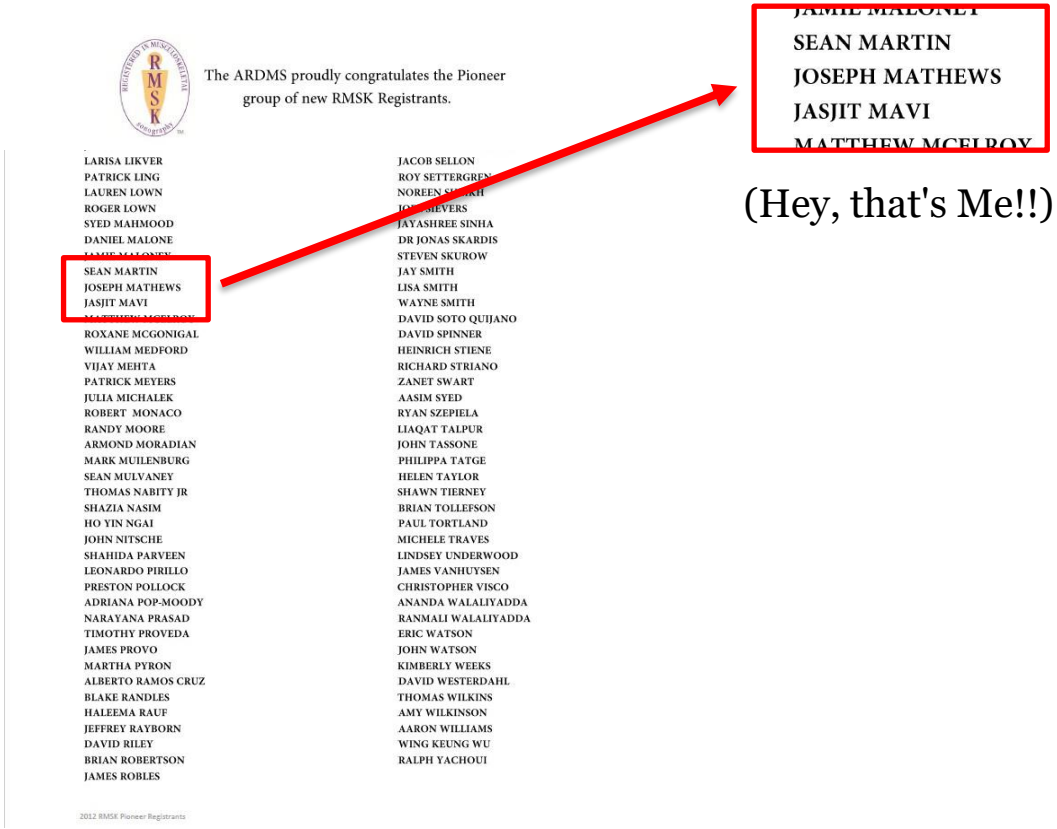
hi

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.

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PATRICK LING
LAUREN LOWN
ROGER LOWN
SYED MAHMOOD
DANIEL MALONE
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SEAN MARTIN
JOSEPH MATHEWS
JASJIT MAVI
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ROXANE MCGONIGAL
WILLIAM MEDFORD
VIJAY MEHTA
PATRICK MEYERS
JULIA MICHALEK
ROBERT MONACO
RANDY MOORE
ARMOND MORADIAN
MARK MUILENBURG
SEAN MULVANEY
THOMAS NABITY JR
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JAYASHREE SINHA
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LISA SMITH
WAYNE SMITH
DAVID SOTO QUIJANO
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HEINRICH STIENE
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JOHN TASSONE
PHILIPPA TATGE
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BRIAN TOLLEFSON
PAUL TORTLAND
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CHRISTOPHER VISCO
ANANDA WALALIYADDA
RANMALI WALALIYADDA
ERIC WATSON
JOHN WATSON
KIMBERLY WEEKS
DAVID WESTERDAHL
THOMAS WILKINS
AMY WILKINSON
AARON WILLIAMS
WING KEUNG WU
RALPH YACHOUI

2012 RMSK Pioneer Registrants

[illegible]
SEAN MARTIN
JOSEPH MATHEWS
JASJIT MAVI
[illegible]

(Hey, that's Me!!)

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

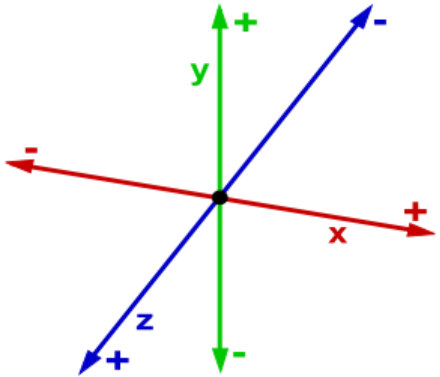
- Central Processing Unit
- Transducer Probe
- Control Panel
- Display
- Ultrasound Transmission Gel (the goo)

#GelIsCheap!!!!

The Bicameral Mind

A Bit About Axes (Because I Like Axes)

Not this kind



This Kind

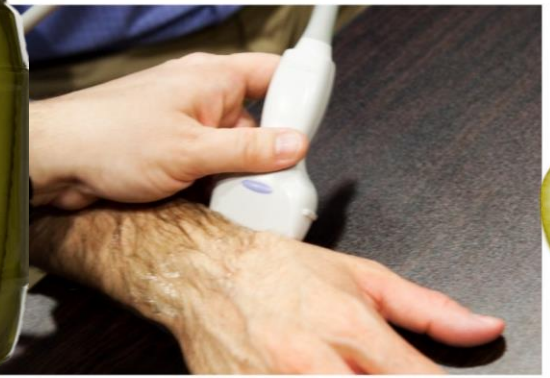
BackGround

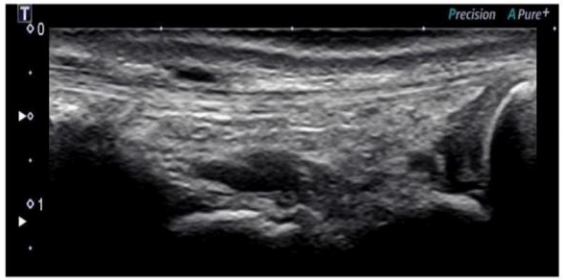
Subject

Foreground

The Long and Short of it

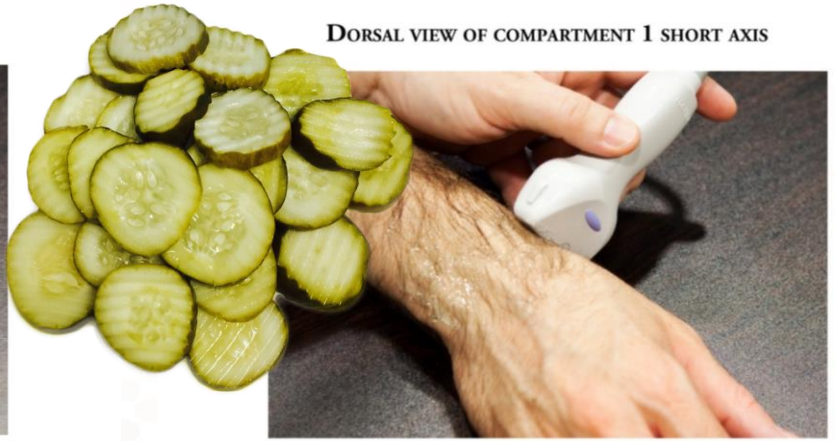
Dorsal view of compartment 1 long axis

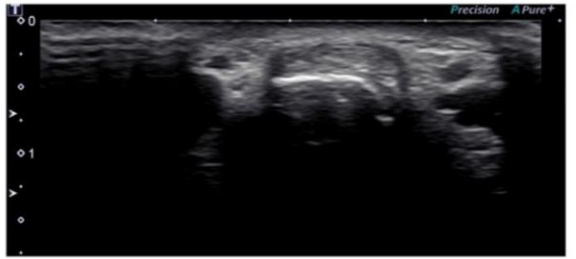




Structures of interest:
radius, scaphoid, trapezium, extensor pollicis brevis and abductor pollicis longus in view

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)

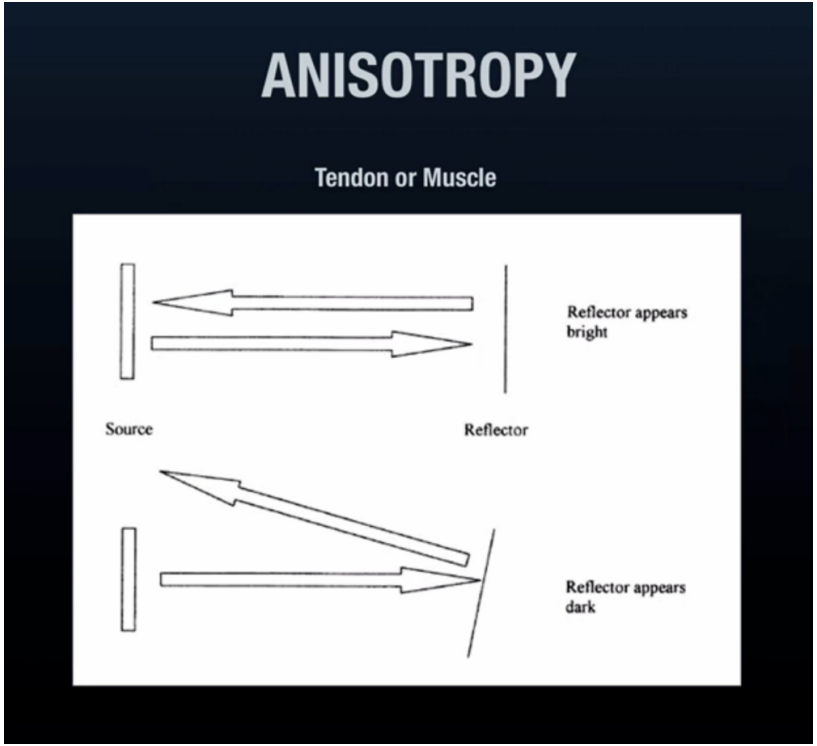
- Bone surface – Hyperechoic with Posterior Acoustic Shadowing
- Bursae – Hypoechoic or anechoic
- Cartilage –
  - Hyaline: Anechoic
  - Meniscal: Mildly Hyperechoic
  - Fibrocartilage: Mildly Hyperechoic
- Connective tissue – Midechoic and mildly irregular
- Ligaments – Hyperechoic with multidirectional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

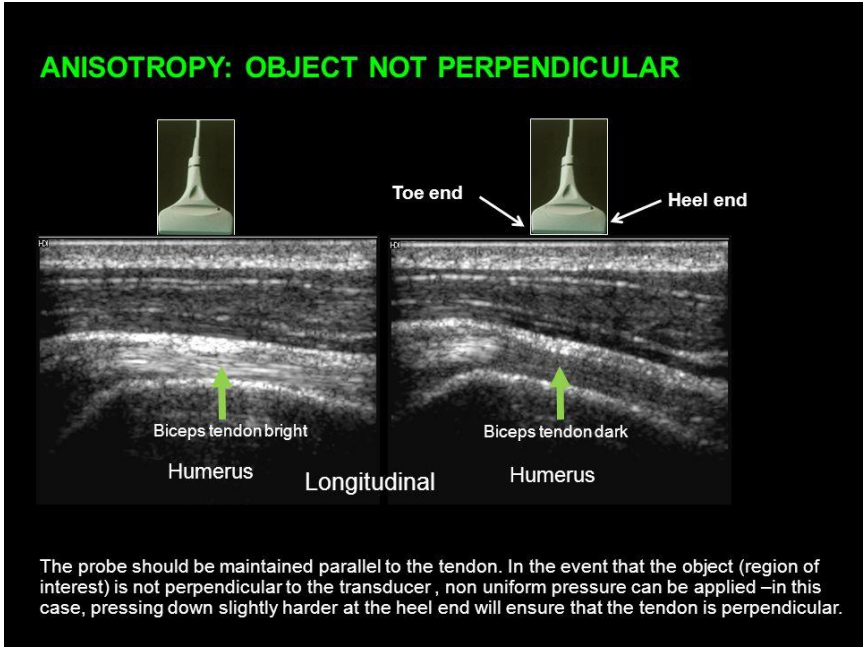
Echogenicity of Interesting Structures (Tissue Characteristics)

- 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
Reflector appears bright
Source
Reflector
Reflector appears dark


ANISOTROPY: OBJECT NOT PERPENDICULAR
Toe end
Heel end
Biceps tendon bright
Biceps tendon dark
Humerus
Longitudinal
Humerus
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.

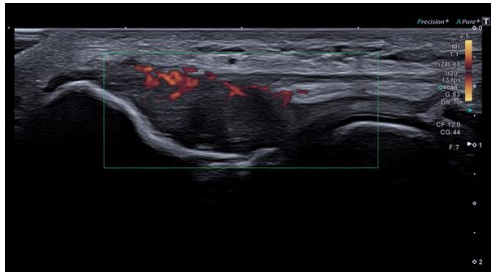
The Big Physics Takeaway!!!
(You, in the back, WAKE UP FOR THIS!!)

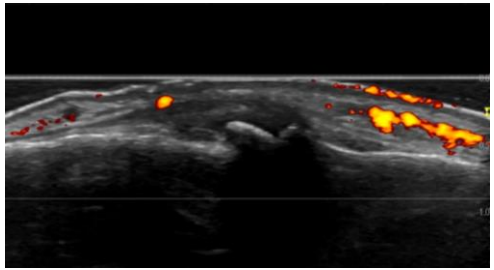
- Frequency – As frequency goes up, Resolution goes up, but Penetration (depth) decreases
- Depth – As Depth increases (goes deeper), Frequency and Resolution go down
- Resolution – Increases with frequency, Decreases with greater depth
- For Superficial Soft Tissue, High Frequency Results In Higher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

Okay, Why?

Okay, Why?

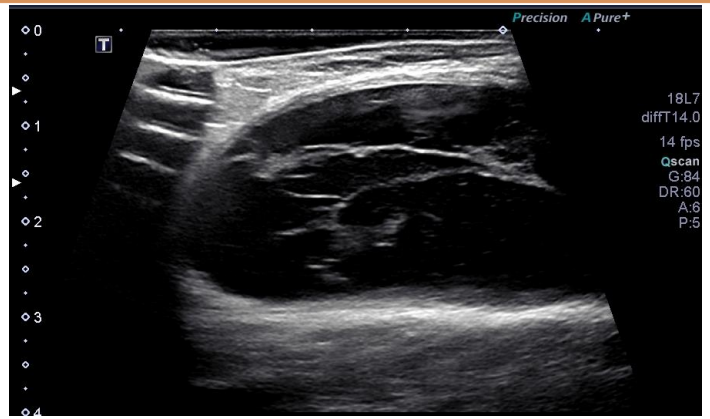
- Smoking gun?
  - Inflammation (Synovitis)
  - Erosive Damage (RA)
  - Enthesitis (PsA)
  - Osteophytosis (OA)

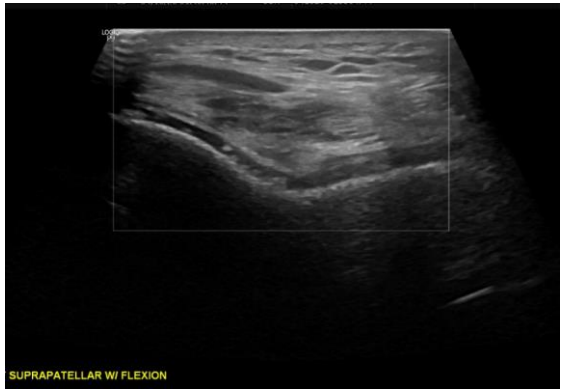


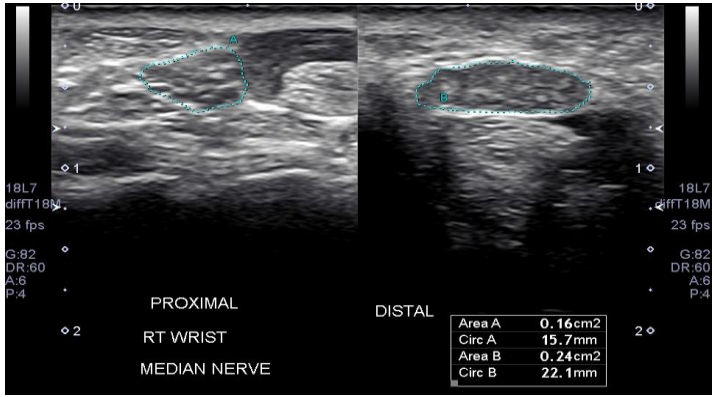


Okay, Why?

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





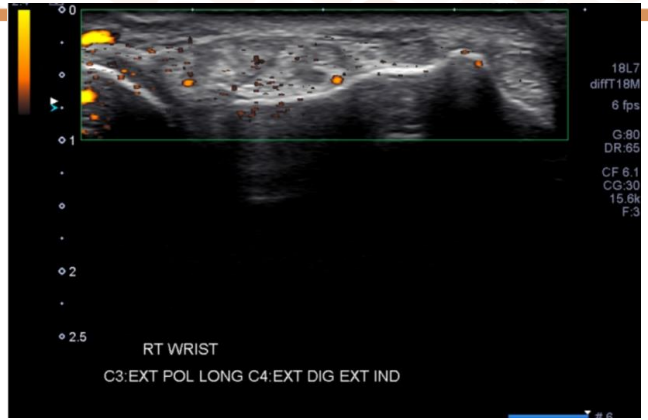


Okay, Why?

- 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)

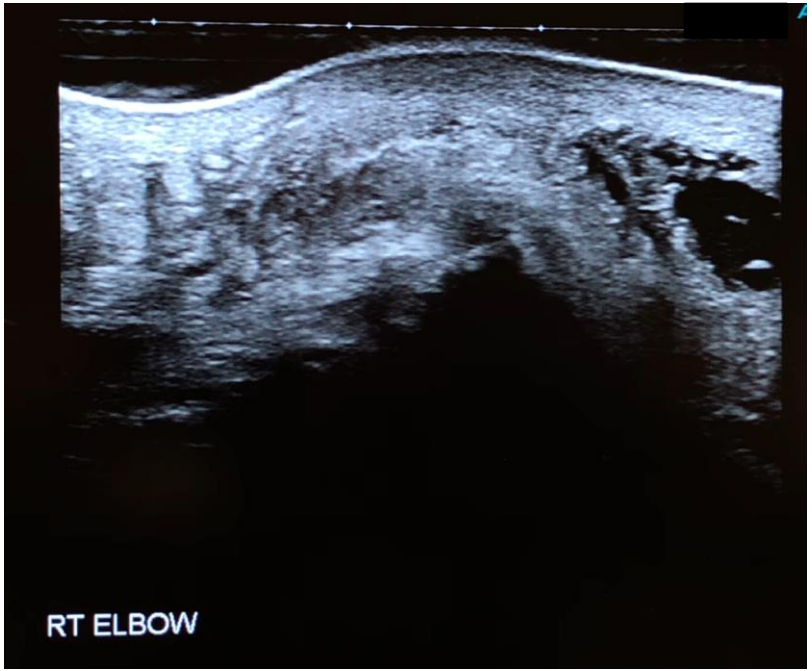
Grade 3 (>50% of synovium covered with vessel signals)

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?

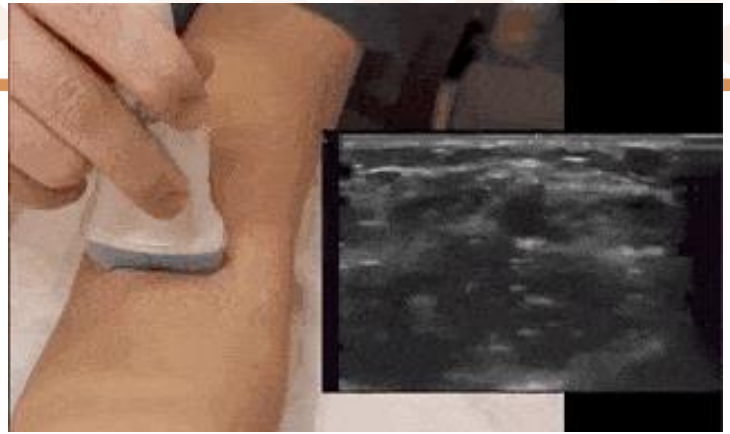
- Interventional Medicine
  - Confident assessment of problem area
    - Simple Injection
    - Aspiration
  - Accurate Placement of Needle
  - Shortest, most concise path to affected area



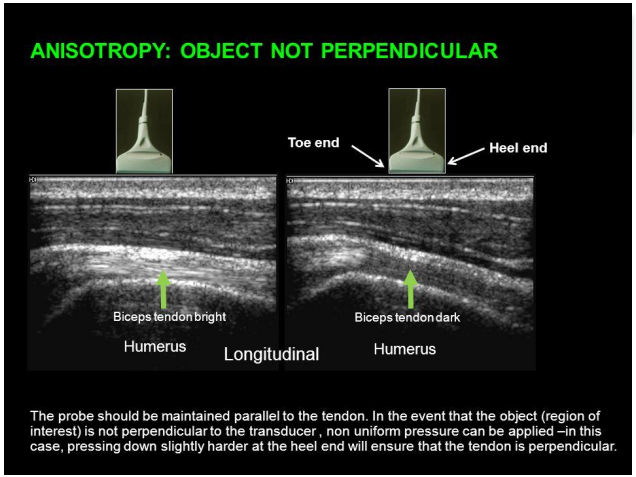
Okay, Smarty Pants… How?

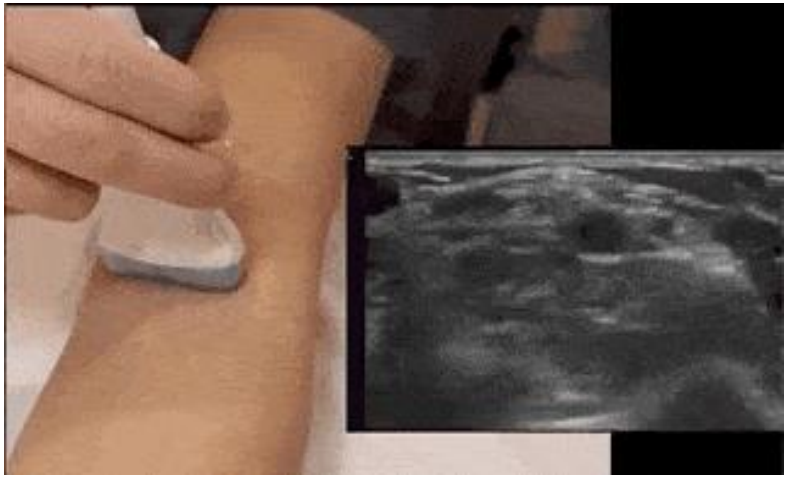
- Light Touch
- Move Slowly
- LOTS OF GEL #GELISCHEAP
- Relaxed Grip

5 Motions For Success

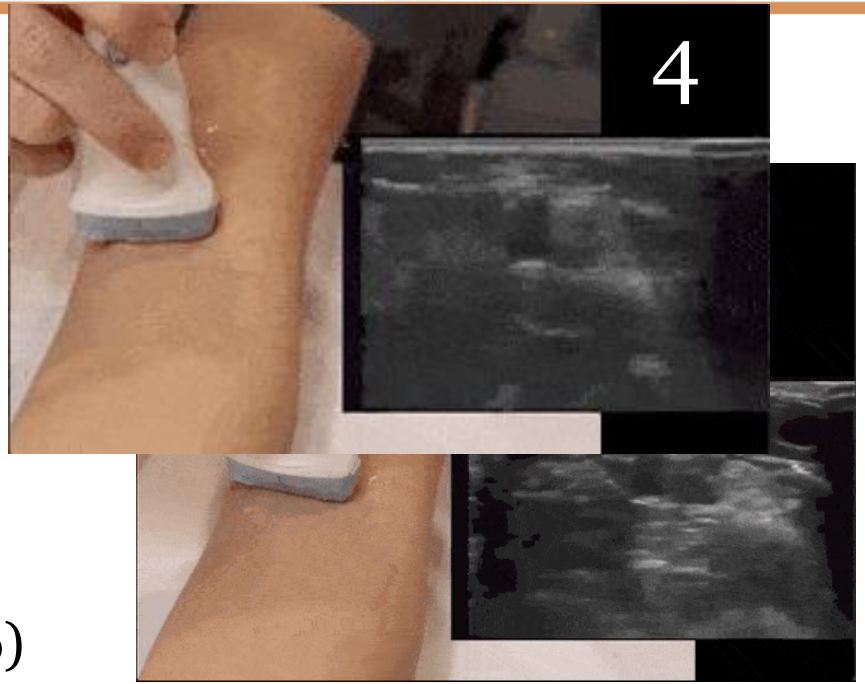


1. Rock
2. Heel-Toe
3. Fan





5 Motions For Success



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

Major Pathology

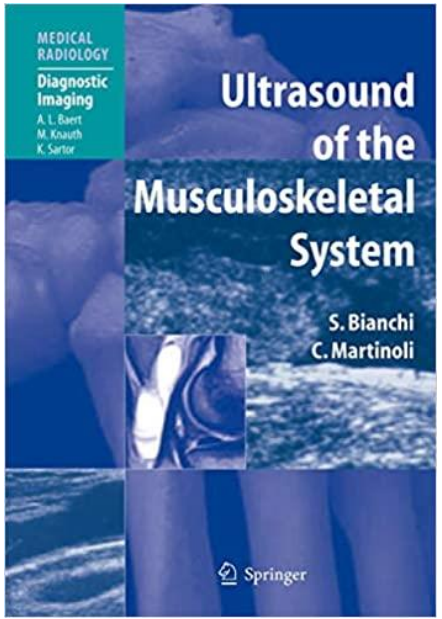
- Synovitis
  - Grade 0 (No Signal)
  - Grade 1 (Single Vessel Signals)
  - Grade 2 (Confluent Vessel Signals)
  - Grade 3 (>50% of synovium covered with vessel signals)
- Enthesitis
- Osteophytosis
- Erosion (≥1 mm on 2 axes)
- Effusion
- Rotator Cuff Rupture
  - Partial-Thickness
  - Intrasubstance
  - Full-Thickness
  - Complete

Minor Pathology

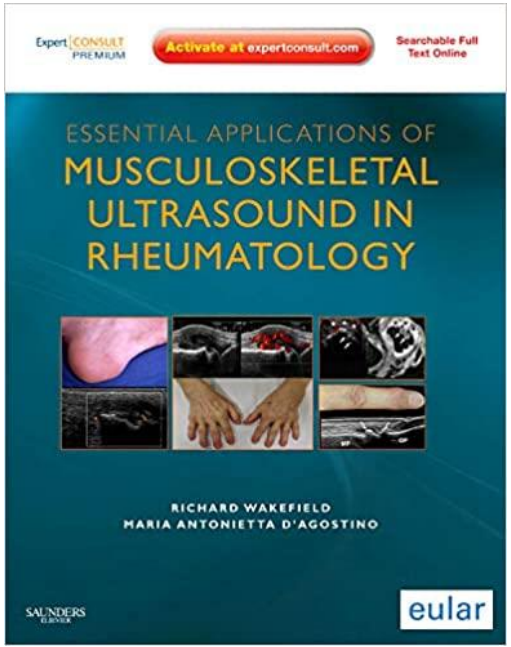
- Synovial Hypertrophy
- Synovial Proliferation
- Tenosynovitis (active)
  - Preclinical RA
  - Peritendinous fluid/tissue thickening
- Early Erosive Damage
  - <1 mm
  - Early RA
- Joint Space Narrowing
  - Mild
  - Moderate
  - Significant

Resources (These are a few of my favorite things)

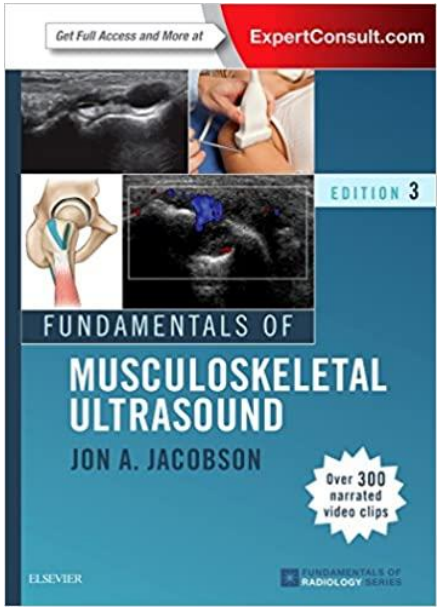
[Ultrasound of the Musculoskeletal System](#)
by Bianchi & Martinoli



[Essential Applications of Musculoskeletal Ultrasound in Rheumatology](#)
By Richard Wakefield

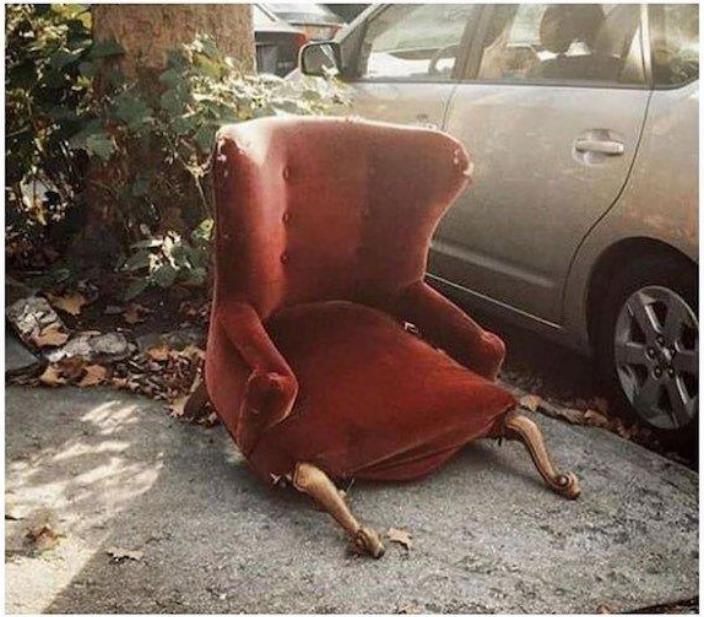


[Fundamentals of Musculoskeletal Ultrasound](#)
By Jon A. Jacobson



Thank you

Me too chair, me too



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/