



Diagnostic Ultrasound shows us the “current physiological state” of the body

Knobology: instrument controls and their functions

Depth-enough to get to the structure

Focus- Point of interest

Gain-brightness of entire picture

Freeze- freezes a frame / picture on screen

TGC-Time Gain Controls- allows to increase or decrease brightness as specific depths

Imaging we are involved in primarily

1. Real-time: a series of pictures displayed in rapid sequence
2. Pulse echo: sound pulses produced with time interval between to be able to receive an echo in return
3. B-Mode: means “brightness” mode proportional to the amplitude of the returning echo.

How to get a successful and reproducible intra-rater and inter-rater reliable image:

1. PATIENT POSITION- Patient position is important to create a positive image
2. PROBE POSITION- Long Axis (LAX) or Short Axis (SAX) {always view both}
 - a. Hot Dog example long vs short axis view
 - b. View: Putty Knife
 - c. Long axis-cephalad is left side of screen (indicator on probe is towards head); short axis always pointed laterally, left side of screen is lateral side of body
3. PROVIDER POSITION- Holding probe with at least one to two fingers on patient.
 - a. Technique- Go Slow!
 - i. Fanning/translating
 - ii. Toggle
 - iii. Heel toe
 - iv. Rotate
4. PARAMETERS- start with proper preset for body part and use depth, focus, gain (even frequency) to get a proper.....
5. PICTURE: Position with bony landmark “window”, when possible.
6. Read image from bone up to skin

- a. Bone
- b. Hyaline cartilage
- c. Synovium and synovial fluid (when possible)
- d. Joint Capsule
- e. Ligaments
- f. Muscles

Labeling

- A. Lt or Rt side
- B. Body Part or primary structure
- C. Probe orientation

Hyperechoic means increased echo density

- a. Post inflammation
- b. Foreign body
- c. Scarring
- d. Calcification
- e. Fibrosis

Hypoechoic means with less density, less echo

- a. Active inflammation
- b. Edema
- c. tears

What do normal structures look like in Ultrasound?

- 1. Cortical Bone
 - a. Hyperechoic
 - b. Continuous and smooth



2. Hyaline Cartilage

- a. Anechoic/black
- b. Thick band of anechoic area sits above the cortical bone
- c. Follows along the bony contour



3. Synovial membrane and joint capsule

- a. Sits superior to the hyaline cartilage
- b. This is visually a combined looking structure of membrane and capsule in normal joint
- c. Hyperechoic, well defined homogenous/uniform
- d. Thickened hyperechoic area that follows the bony margin



4. Skeletal Muscle in Long Axis

- a. Repetitive lined feathered Pattern
- b. Hyperechoic Muscle Septae Border Hypoechoic bundles



5. Skeletal Muscle in Short Axis

- a. Speckled Hyperechoic appearance
- b. No diagnosis is made in this view; it acts as a supplement to LAX



6. Ligaments Long Axis

- a. Found between two bones along the fibers of the way the ligament runs
- b. Less Echogenic than tendons frequently
- c. A multi string like look to it.



7. Tendons Long Axis

- a. Hyperechoic
- b. Brighter than ligaments
- c. Fibrous striated look to it



8. Tendons Short Axis

- a. Visualized within a tendon sheath
- b. "Bristle Like" and compact in its fibers



9. Tendon Enthesis/Attachment Long Axis

a. Two Criteria Required for Normal Finding

- i. Tapering wedge shape tendon contour
- ii. Anechoic linear/uniform interface along bony margin, this is called the Tendon “Footprint” (Sharpey’s fibers)



10. Peripheral Nerves Short Axis

- a. Usually with a perineural hyperechoic outline
- b. Nerves have a “Honeycomb” appearance within the nerve



11. Peripheral Nerve Long Axis

- a. Less bright/echogenic than tendons
- b. Parallel hyperechoic lines with dark separations
- c. Often adjacent to anechoic vascular bundle
- d. "Railroad tracks" looks like a collection of rods



12. Bursae

- a. Usually less than 2mm wide considered normal therefore not
- b. Anechoic look and typically separates two structures.
- c. Can be seen as a "black thin line" (because it is not typically filled with fluid) bordered by Hyperechoic BRIGHT Peri-bursal Fat.
- d. Exception is the suprapatellar bursae commonly is visualized and larger as it communicates with the knee joint



13. Fibrocartilage (meniscus and Labrum)

- a. Homogeneous and triangular look
- b. Only see the outer margins and may need to decrease frequency of probe to visualize
- c. Grey appearance most of the time due to bones.
- d. Black lines through is indicative of tear.
- e. Example TFCC, labrum, MM, LM, A-C



14. Veins (SAX)

- a. Anechoic
- b. Compressible on sonopalpation
- c. Accompanies vascular bundles typically

15. Arteries (SAX)

- a. Anechoic
- b. Non-compressible
- c. Found with veins and nerves



16. Veins and Arteries LAX

- a. Run alongside each other
- b. Anechoic
- c. Doppler can help distinguish between the two



Transducers/Probes:

Linear- more superficial structures, higher frequency 7-15 mhz. Used in extremities and large muscles

Curvilinear – Usually for deeper structures and lower frequency 3-5 mhz. Used in Anterior hip, SI joint and spine

Anisotropy- Self-induced and produced when the probe angle is NOT perpendicular with the structure being evaluated. This is the most common artifact in MSK ultrasound. Shown by unequal properties showing as an artifact image

Other artifacts in ultrasound

Foreign body-posterior shadowing

Surgical hardware- comet tail

Reverberation artifact-multiple, equally spaced linear echoes deep to a needle

TENDINOSIS

1. Hypoechoic looking instead of hyperechoic
2. Misses its fibrosis look, non-fibrous
3. Tendon is thicker
4. Neovascularization on doppler



Normal below



Tendonitis

1. On doppler flow non directional flow will be seen

Chronic Bursitis

1. Can have septation like lines within the bursa