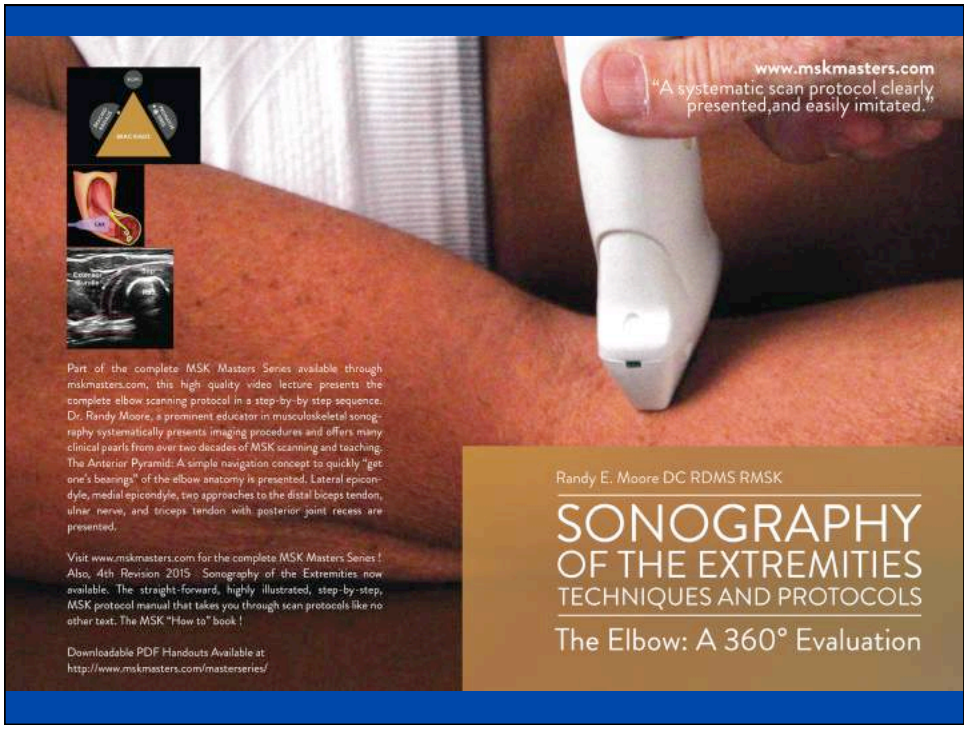
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"A systematic scan protocol clearly presented,and easily imitated."
Part of the complete MSK Masters Series available through mskmasters.com, this high quality video lecture presents the complete elbow scanning protocol in a step-by-by step sequence. Dr. Randy Moore, a prominent educator in musculoskeletal sonography systematically presents imaging procedures and offers many clinical pearls from over two decades of MSK scanning and teaching. The Anterior Pyramid: A simple navigation concept to quickly "get one's bearings" of the elbow anatomy is presented. Lateral epicondyle, medial epicondyle, two approaches to the distal biceps tendon, ulnar nerve, and triceps tendon with posterior joint recess are presented.
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SONOGRAPHY
OF THE EXTREMITIES
TECHNIQUES AND PROTOCOLS
The Elbow: A 360° Evaluation

The Elbow

The Elbow

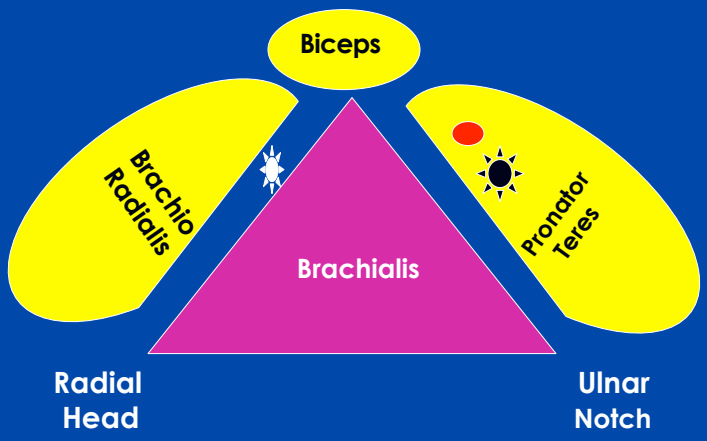
Scanning Sequence

* Anterior Joint
(The anterior "Pyramid")
* Lateral Epicondyle
* Medial Epicondyle
* Posterior Joint

The Elbow

Anterior Elbow "Pyramid"

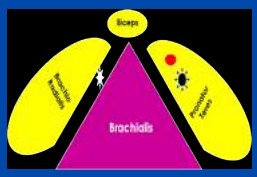
Short axis probe placement at the antecubital fossa

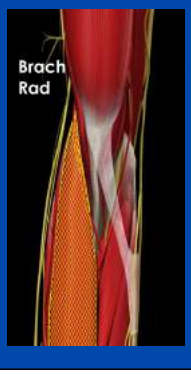


The Elbow

Anterior Elbow "Pyramid"

The Surrounding Musculature

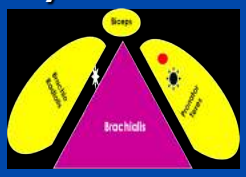


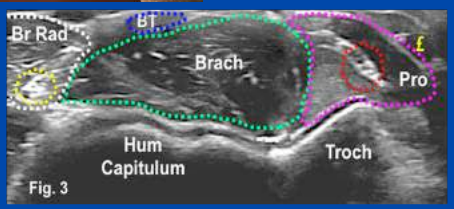


The Elbow

Anterior Elbow "Pyramid"

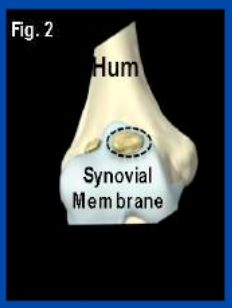
Supine patient
Bolster under hand to limit extension

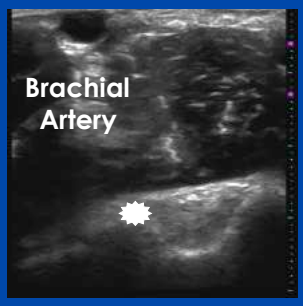




Brach = Brachialis
Br Rad = Brachio-radialis
Pro = Pronator
BT = Biceps Tendon
Radial Nerve = Yellow dotted outline
Brachial Nerve = Red dotted outline
£ = Brachial Artery

The Elbow
Anterior Compartment Effusion
Fat Pad Displacement





Short axis scan through the Humeral Coronoid Fossa may reveal fat pad displacement as seen with occult fracture.

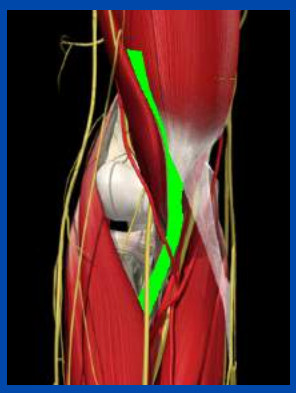
90 degree flexion with light probe pressure is helpful.

Distal Biceps Tendon

Anterior Approach

The Elbow

Anterior Transverse: Distal Biceps Tendon



The two heads of Biceps Brachii unite forming a thick tendon, attaching at the Radial Tuberosity.

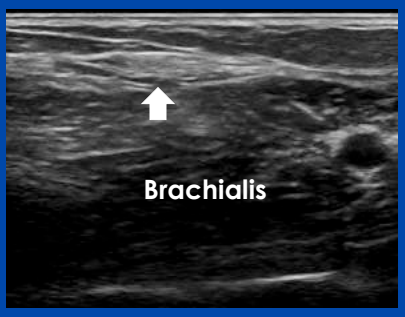
Transverse probe at the crease Antecubital Fossa.

The Elbow

Distal Biceps Tendon

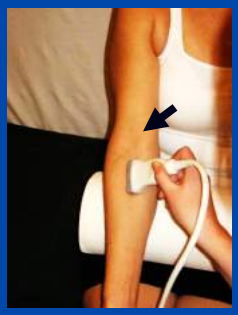
Transverse Orientation

Slight proximal beam angulation helps visualize the hyperechoic tendon in cross-section

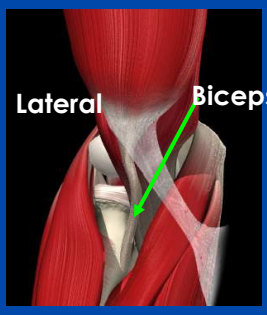


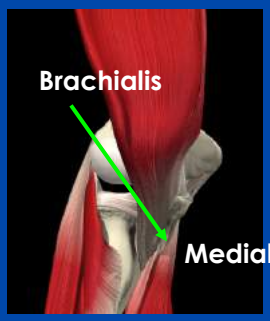
Biceps tendon is centrally positioned on TOP of the Brachialis

The Elbow
Distal Biceps Tendon
Anterior Longitudinal Orientation



LAX probe angled Radially

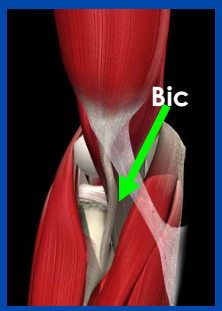




Tracking the Biceps tendon to it's Radial attachment requires firm probe contact, and can be difficult due to anisotropy

The Elbow
Distal Biceps Tendon
Longitudinal Orientation

Long Axis Radial Beam

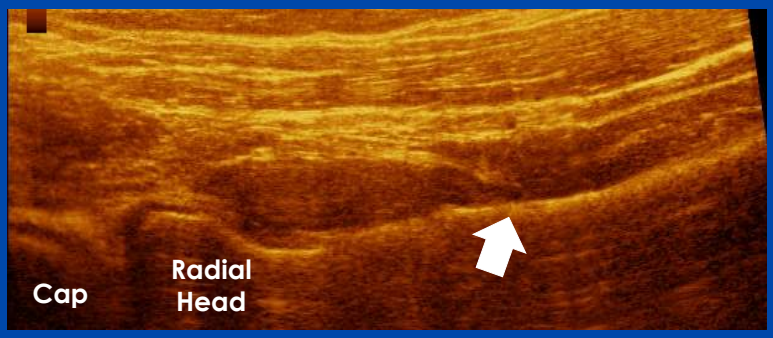


Anisotropy presents due to oblique, deeper course to the attachment on the Radial Tuberosity.

The Elbow

Distal Biceps Tendon

Panoramic Image



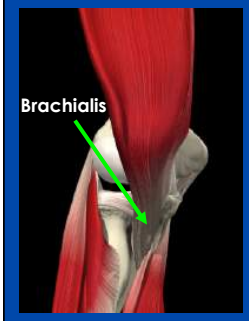
Slight lateral probe translation reveals Capitulum & Radial Head.

Tracing Radial cortex to the tuberosity may visualize tendon attachment.

The Elbow

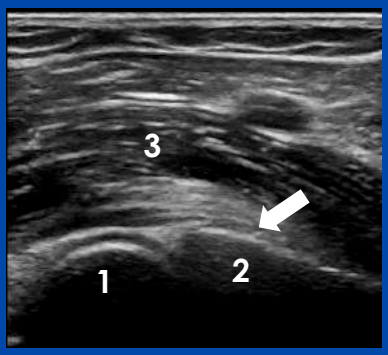
Anterior Longitudinal

(Medial Probe Angle = Brachialis tendon)



Brachialis attachment

Probe *Angled medially*



1 = Humeral Trochlea
2 = Coronoid Process of Ulna

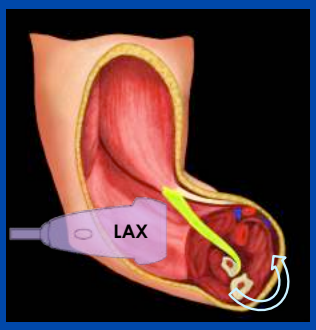
Arrow: Brachialis attachment

3 = Pronator Teres Muscle

Distal Biceps Tendon

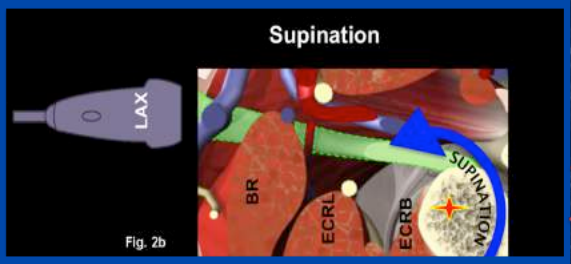
Lateral Approach

The Elbow
Lateral Approach to the Distal Biceps Tendon

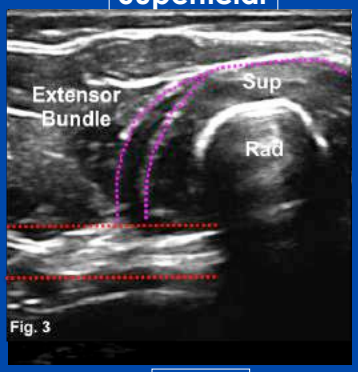


90 degree elbow flexion
Sufficient hand supination to expose tendon
Longitudinal/Coronal Probe
Slightly distal from Radial Head

The Elbow
Lateral Approach : Image Orientation



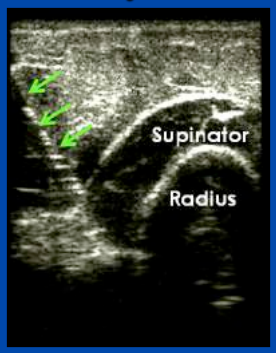
Superficial

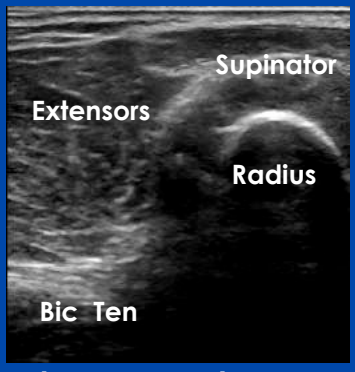


Deep

Orientation of image can be difficult due to a 90 º rotation of the anatomy on the ultrasound monitor.

The Elbow
Lateral Approach Distal Biceps Tendon
Injection Setup





<u>Probe Position and Needle Advancement</u>

The probe is in short axis /coronal orientation along the lateral elbow compartment. The needle is advanced *in plane* with the radius and tendon well visualized.

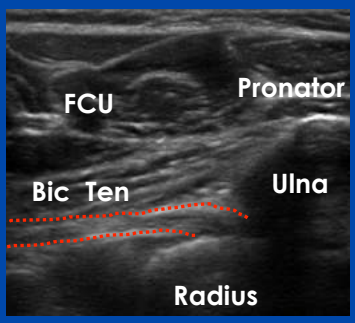
Distal Biceps Tendon

Medial Approach

The Elbow

Medial Approach to the Distal Biceps Tendon Through the Pronator "window"

Unchanged patient position.
Medial to lateral beam angle
Probe at radial tuberosity



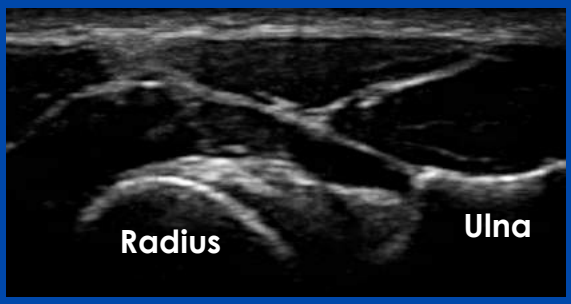
Hyperechoic fibers seen from left side of image.

Distal Biceps Tendon

Dorsal Approach

The Elbow

Dorsal Approach to the Distal Biceps Tendon



The most direct approach to view the attachment and perform guided injection.

The Elbow

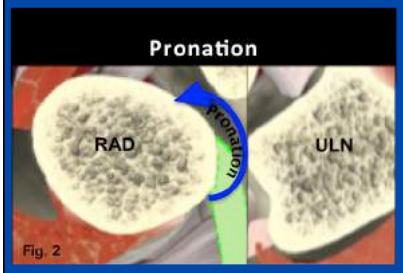
Dorsal Approach Distal Biceps : Supination

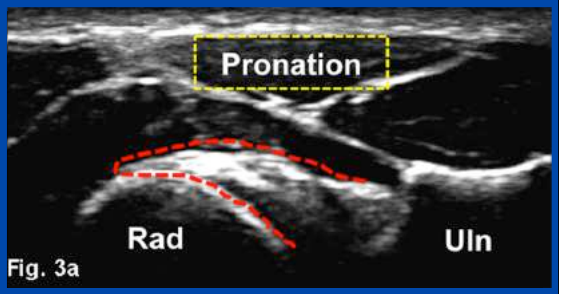
Biceps attachment on Radial Tuberosity NOT visible with supinated arm in 90° flexion

The Elbow

Dorsal Approach Distal Biceps : Pronation

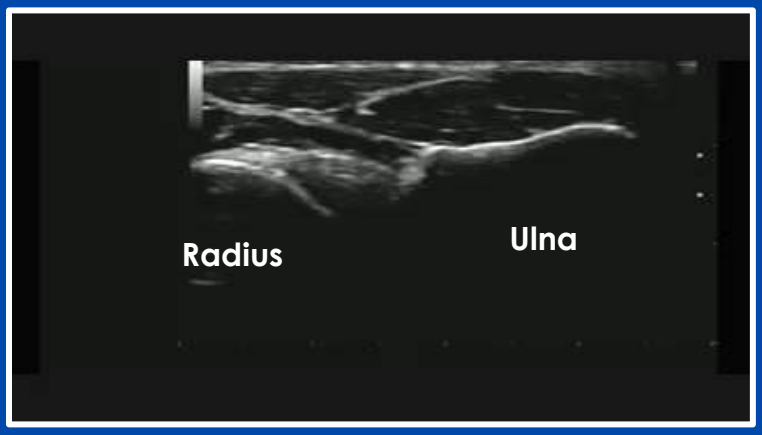
Pronation of hand exposes the tendon attachment on Radial tuberosity





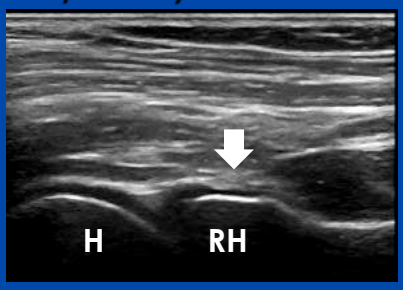
The Elbow

Dorsal Approach Distal Biceps : Dynamic Image



Lateral Elbow

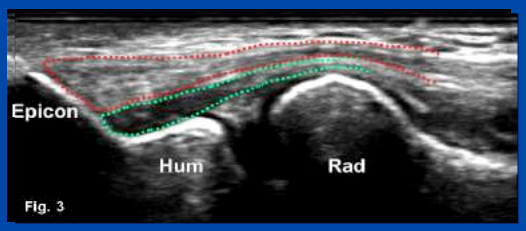
The Elbow
Anterior Lateral Longitudinal
Anterior Joint space and Annular Ligament
(Not the lateral epicondyle view.)



LAX Probe
Lateral margin of
Antecubital Fossa

Anechoic hyaline cartilage lines
Humerus (H) and the Radial Head (RH)
Annular ligament contours Radial head
Anterior joint is "V" shaped
Synovial fringe extends from
synovial membrane.

The Elbow
Lateral Epicondyle Longitudinal
Common Extensor Tendon and Radial Collateral Ligament



LAX Probe
Span the
joint space

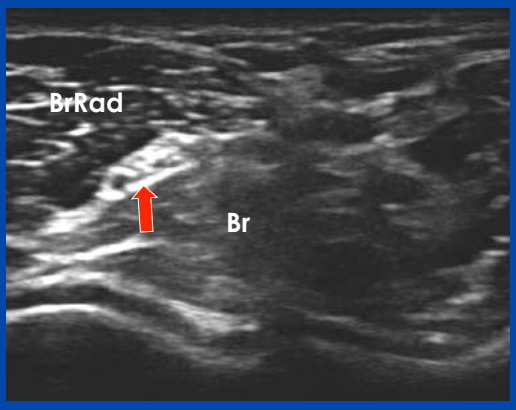
Visualize the
Epicondyle !

<u>Hyperechoic</u> Common Extensor
is fibrillar & superficial to the…
darker/<u>hypoechoic</u> RCL

Radial Nerve
The Cutaneous Sensory …and Posterior Interosseous (PIN)

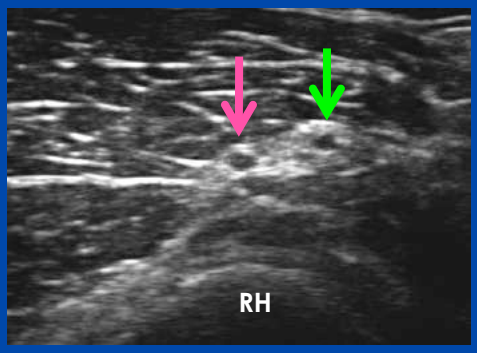
The Elbow
Radial Nerve…Cutaneous Sensory …and Posterior Inter-osseous branches

SAX Probe At the joint space



The hyperechoic RADIAL NERVE is identified between the Brachioradialis and the Brachialis

The Elbow
The Cutaneous Sensory …and Posterior Interosseous (PIN)

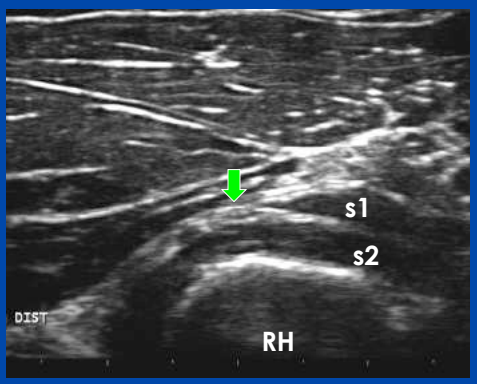


Slight Distal/Lateral Probe translation from RN

Radial Head becomes the only boney landmark.
The PIN splits <u>laterally</u>
The Cutaneous Sensory nerve splits <u>medially</u>
<u>Both</u> are HYPOECHOIC due to anisotropy

The Elbow
Posterior Interosseous (PIN)

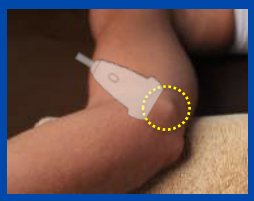
Meticulous Distal Probe translation along radial margin



Radius remains the only bony landmark.
The PIN is quite small and found between the superficial (s1) and deep (s2) heads of the Supinator muscle

Medial Elbow

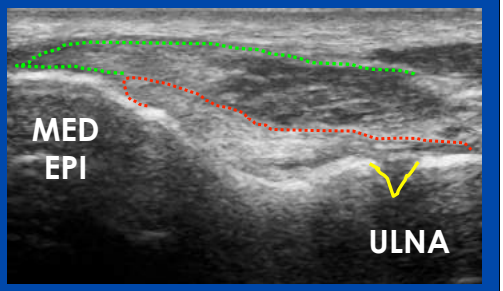
The Elbow
Medial Epicondyle: Common Forearm Flexor and Ulnar Collateral Ligament



Supine patient
Arm in external rotation

Probe Anterior to Epicondyle

The Elbow
Medial Epicondyle



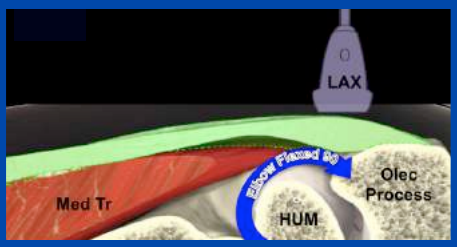
Dynamic UCL Evaluation
Valgus stress by
depressing the wrist
Normal = < 2mm
Abnormal = > 2mm

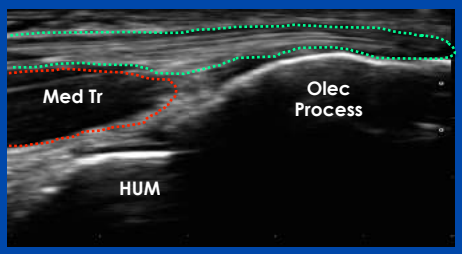
Posterior Elbow

The Elbow
Posterior Midline Longitudinal

Landmarks are Humeral Trochlea. and distal Ulnar Olecranon.

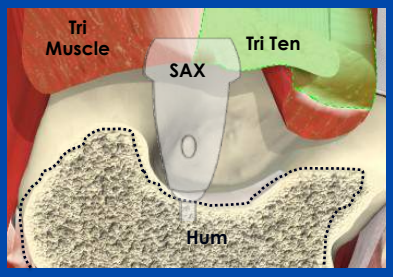
Hyperechoic tendon fibers superficial to deeper Triceps muscle..





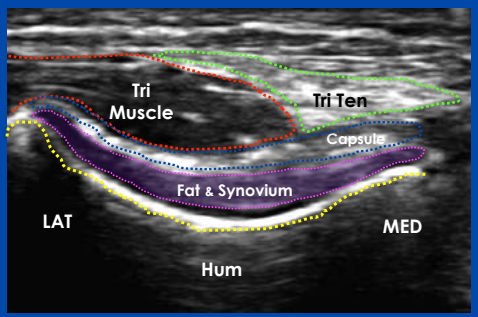
The Elbow
Posterior Midline Transverse

SAX probe proximal to Olecranon



Triceps muscle seen in x-section

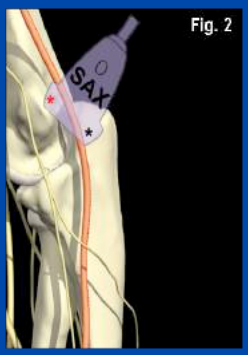
Deep concavity is Olecranon Fossa



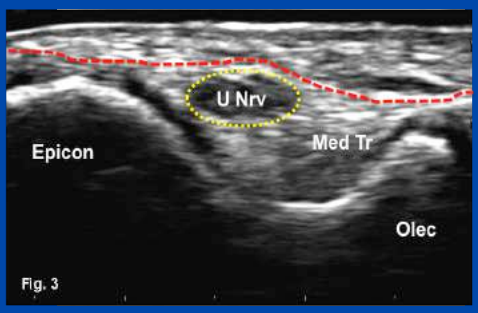
The Elbow
Ulnar Nerve Short Axis

Probe position is SAX
Bridging
the Ulnar groove.
Black Star = Olecranon process
Red Star = Medial Epicondyle

The Elbow
Ulnar Nerve Short Axis



Probe position is SAX
Bridging the Ulnar groove.



The Sub-Q nerve is typically
a hypoechoic oval …
"starry night" internal echoes
adjacent to medial epicondyle

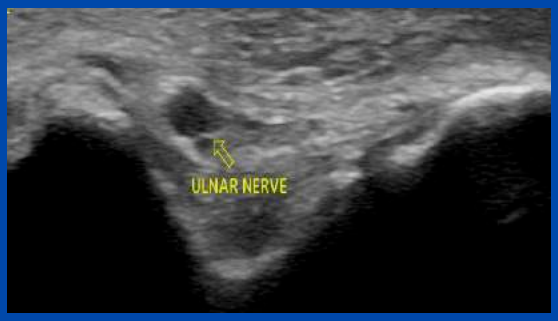
Adjacent Muscle: Medial Triceps (MT)

The Elbow
Ulnar Nerve Dynamic Imaging
Subluxing Nerve

The hypo echoic Ulnar nerve will slide up and over the adjacent Medial Epicondyle

The Elbow

Ulnar Nerve X-sectional Area



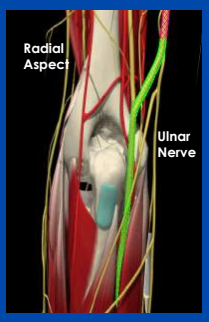
Accepted "abnormal" x-sectional value is
> *10 mm²* proximal to the groove .
Some variability based on individual patient BMI.

Contralateral imaging recommended

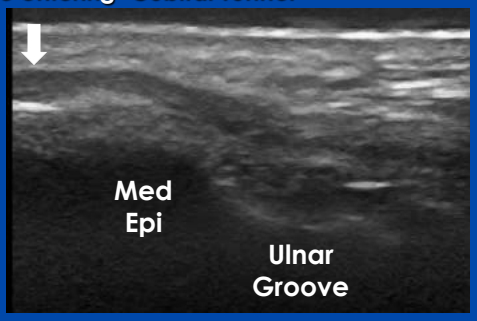
The Elbow

Ulnar Nerve Imaging : Longitudinal

Proximal to the nerve entering Cubital Tunnel

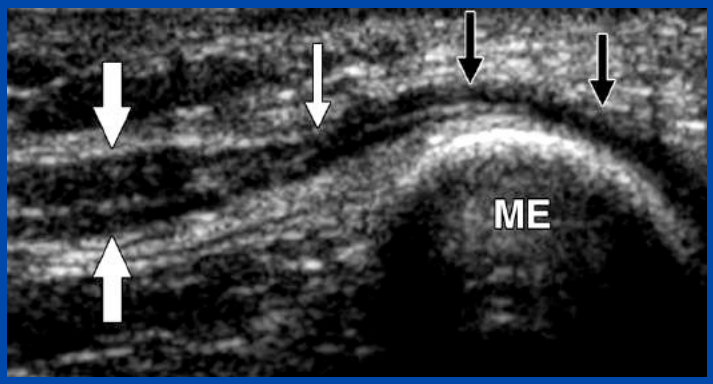


Probe position on posterior aspect of humerus in LAX



Ulnar nerve dips between the Flexor Carpi Ulnaris , and Flexor Digitorum Profundus as it goes distally. Typically, NOT as efficient as SAX image.

Pre-stenotic dilatation of ulnar nerve using LAX



Thank You !