

# Hands On Diagnostics Annual Symposium 2017

September 21-23, 2017

## Peripheral Nerve Sonography

Presented by  
Randy E. Moore DC RDMS RMSK  
[www.mskmasters.com](http://www.mskmasters.com)

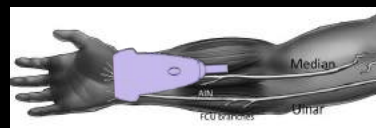
MSK Registry Review  
Wrist and Hand

### Pearls for Nerve Identification

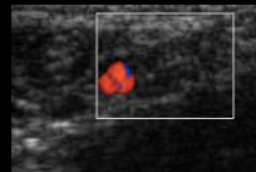
Activation of Adjacent Tendons



“Rapid Scan” Technique



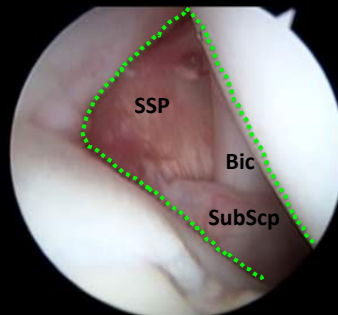
Doppler Exam



MSK Registry Review

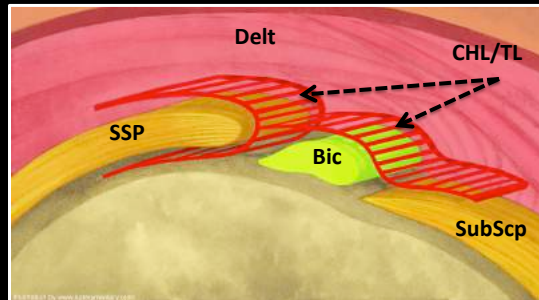
## The Rotator Interval

MSK Registry Review  
**Rotator Interval : Surgical Anatomy**



**A triangular space between the  
Supraspinatus and Subscapularis tendons .**

## Rotator Interval : Sonographic Anatomy



The rotator interval is associated with the GH capsule.

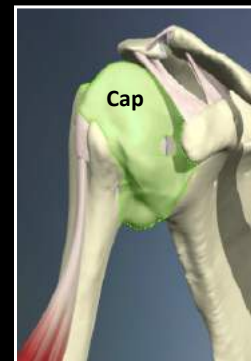
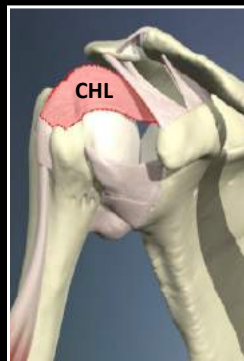
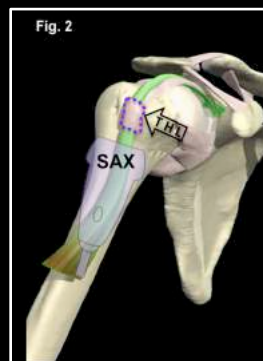
A triangular space between...

Supraspinatus (SSP) and Subscapularis tendons (SubScp) .

Margins are defined by a number of landmarks ,  
most notably the Biceps (Bic) tendon, but also Coraco-Humeral  
Ligament (CHL), and Transverse Humeral Ligament (TL).

The interval integrity is important to shoulder stability !!

## Rotator Interval : Sonographic Anatomy



### Imaging the Rotator Interval

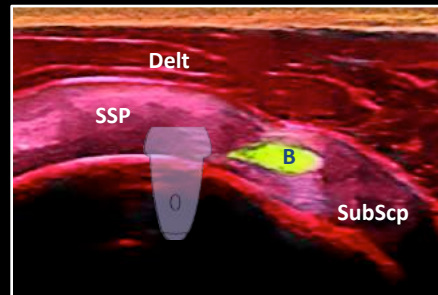
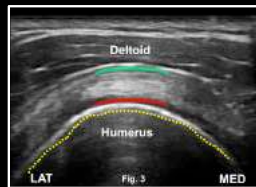
Evaluating the combined interface of ...

Transverse Humeral Ligament (purple hilite THL)

Coraco-Humeral ligament (red hilite CHL), and

The Gleno-Humeral capsule (green hilite CAP)

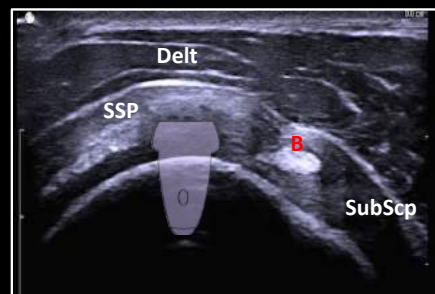
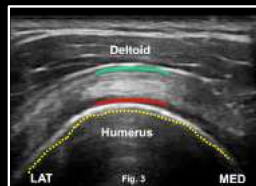
**Rotator Interval Image: Short Axis**



**From the SAX Supraspinatus image (“tire on the rim”)  
Translate/Slide the probe medially toward the Coracoid...  
but not TO the Coracoid.**

**Followed by a slight inferior/downward rotation to visualize the Biceps (B)**

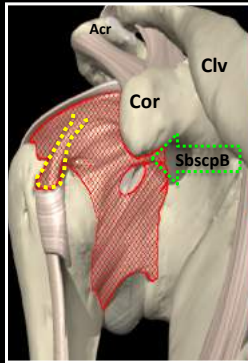
**Rotator Interval Image: Short Axis**



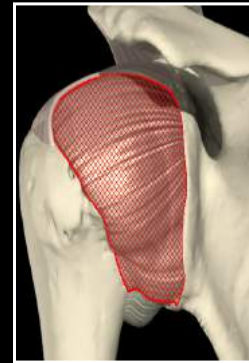
**From the SAX Supraspinatus image (“tire on the rim”)  
Translate/Slide the probe medially toward the Coracoid...  
but not TO the Coracoid.**

**Followed by a slight inferior/downward rotation to visualize the Biceps (B)**

MSK Registry Review  
**Gleno-Humeral Capsule**



Anterior GH  
Capsule



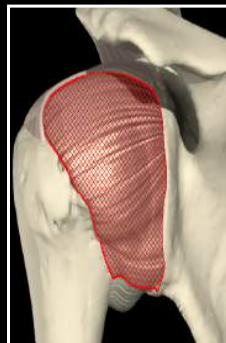
Posterior GH  
Capsule

**The capsule is attached proximally to the *fibro-cartilaginous* Glenoid Labrum, and the *bony* Glenoid Rim.  
 Two openings exist... One for the Biceps tendon,  
 and one for the Subscap Bursa**

MSK Registry Review  
**Gleno-Humeral Capsulitis**



Anterior GH  
Capsule



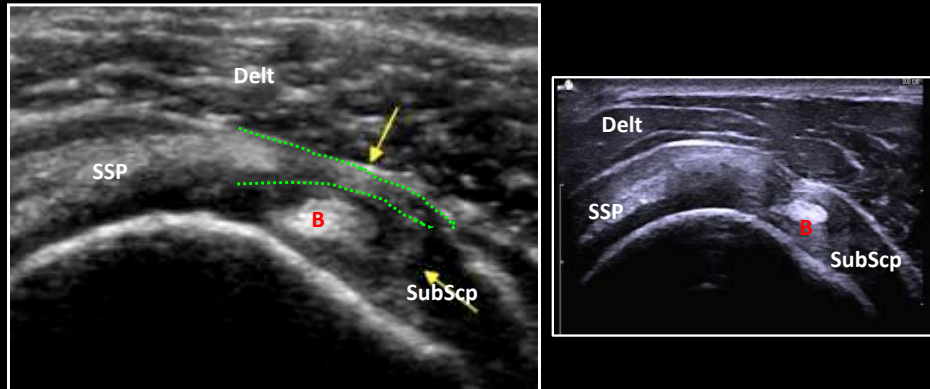
Posterior GH  
Capsule



Contracted  
Capsule

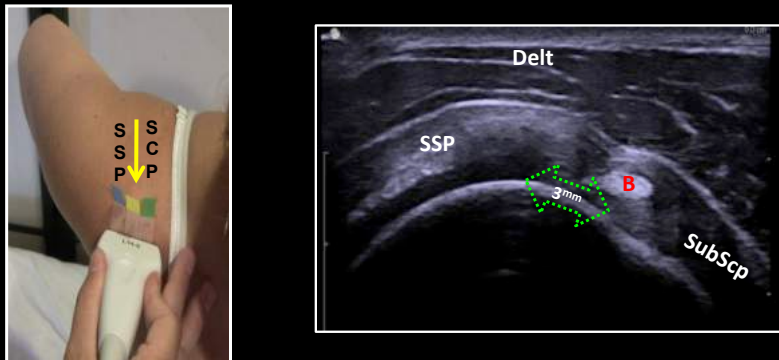
**"frozen shoulder," adhesive capsulitis is characterized by a painful, gradual loss of range of motion from inflammation, progressive fibrosis, and ultimate contracture of the gleno-humeral joint capsule and CHL thickening.**

### The Rotator Interval: Thickening of the combined Interface (THL...CHL...Capsule)



Evaluating increased echogenicity and thickening of ...  
the combined interface of CHL/TL AND the capsule  
Measuring contra-lateral interval thickness usually necessary

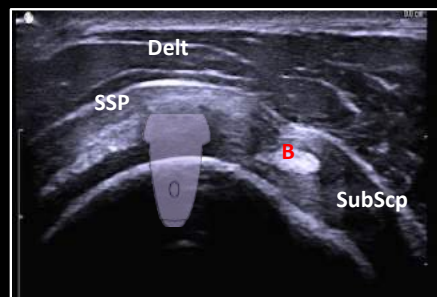
### Rotator Interval: Width/Margin



A narrow sonolucent region on either side of short axis biceps tendon  
Increase in SSP and/or Subscap margin is suggestive  
of interval compromise/instability.  
Accepted normal width/margin is 3<sup>mm</sup> on either side of biceps

**Rotator Interval Image: Short Axis**

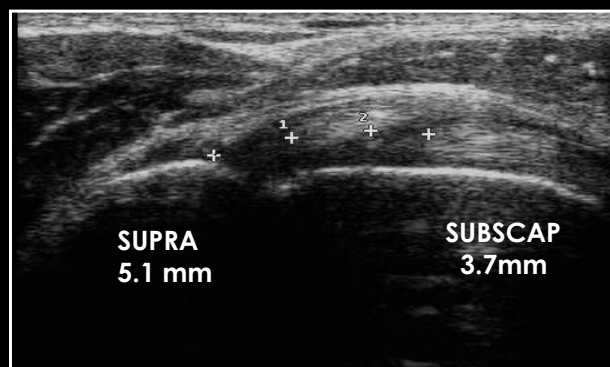
Abnormalities... “tears” are associated with instability  
of the long head of the biceps brachii tendon...  
THL and CHL ligament compromise allows biceps instability



**Rotator Interval Width**

3mm/3mm

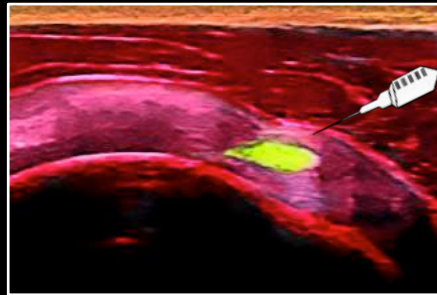
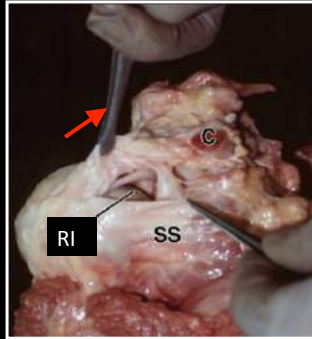
*Suggestive of Rotator Interval Instability*



MSK Registry Review

## Rotator Interval: Gleno-Humeral Jt. Access

Common access portal in surgery and interventional radiology...  
And ultrasound guided procedures !



MSK Registry Review

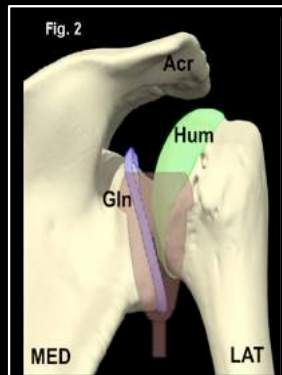
## Gleno-Humeral Joint Imaging Protocol : Posterior



The humeral dome and the apex of the glenoid are visible.  
The posterior capsule spans the joint space.  
Decubitus patient with adducted arm enhances visibility

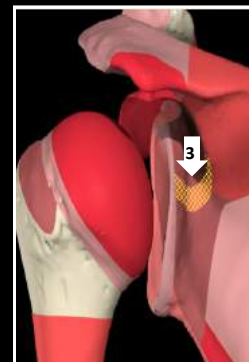
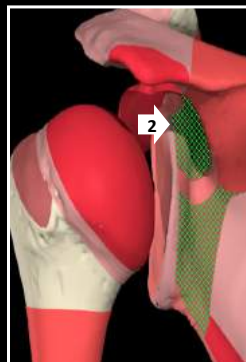
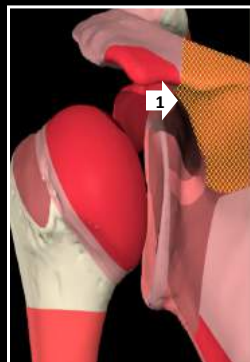


## Glenoid Labrum Imaging Protocol : Posterior



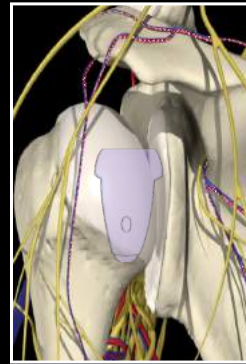
A soft fibro-cartilaginous ring attached to the bony glenoid.  
providing increased depth and ligament attachment.  
Only peripheral labral defects are visible. MRI is more suitable

## Spino-Glenoid Notch



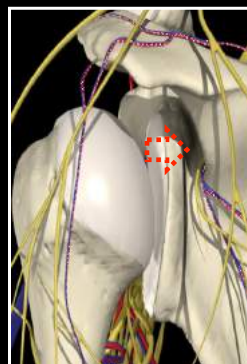
1. Lateral margin of scapular spine merges with...
2. Dorsal aspect of scapular neck forming "notch"
3. Ligament spans notch and...Suprascapular AVN bundle pass thru... from top to bottom

**Spino-Glenoid Notch Imaging Protocol : Posterior**



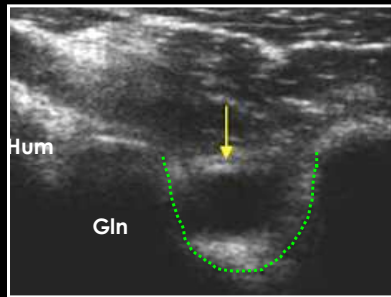
**Medial probe translation from Gleno-Humeral image will reveal the notch**

**Spino-Glenoid Notch Imaging Protocol : Posterior**



**Medial probe translation from Gleno-Humeral image will reveal the notch**

### Spino-Glenoid Notch: Dorsal Ganglion Cyst



**Dorsal Ganglion:**  
Located in notch  
SSN compression  
may mimic TOS



**Labral Cyst:**  
Not in notch  
Overlying joint space

### Suprascapular Nerve Pathology

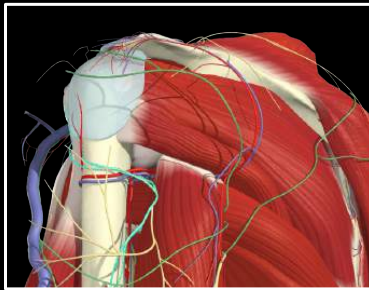
- Clinical : Poorly localized pain in posterior shoulder and/or upper back
  - Weakness raising arm
  - Infraspinatus atrophy

#### MRI :

- “Denervation edema” in area of Spino-glenoid Notch

MSK Registry Review  
**Quadrilateral or Quadrangular Space**

- \*Clinically important anatomic space in the *posterior arm*
- \* Provides anterior regions of axilla a passageway to the posterior regions.
- \***Axillary nerve** and **Posterior Circumflex Humeral artery** can be compressed or damaged due to space-occupying lesions or trauma.
- \*Symptoms include axillary nerve related weakness of the deltoid muscle



MSK Registry Review  
**Quadrilateral or Quadrangular Space**

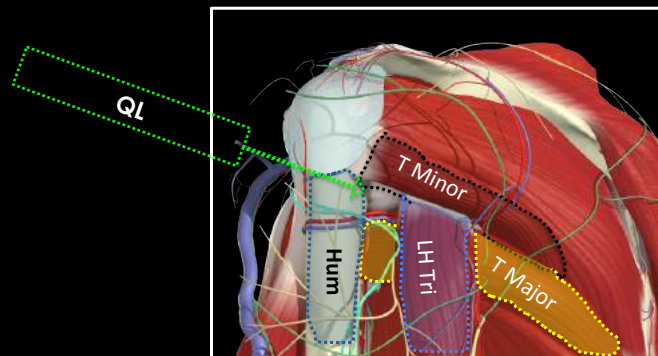
**Boundaries of QL Space**

**Superior Border:** Teres Minor

**Inferior Border:** Teres Major

**Medial Border:** Long Head of Triceps

**Lateral Border:** Surgical Neck of Humerus



Tmajor  
appears as two  
sections  
Bc it is DEEP  
to LH Tri

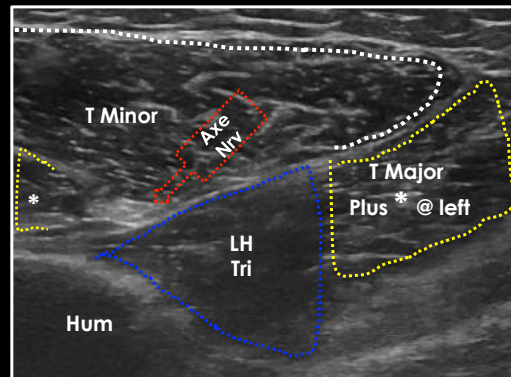
### Boundaries of QL Space

**Superior Border:** Teres Minor

**Inferior Border:** Teres Major

**Medial Border:** Long Head of Triceps

**Lateral Border:** Surgical Neck of Humerus



**Tmajor**  
appears as two  
sections  
Bc it is DEEP  
to LH Tri

### Peripheral Nerves Elbow

# Distal Biceps Tendon

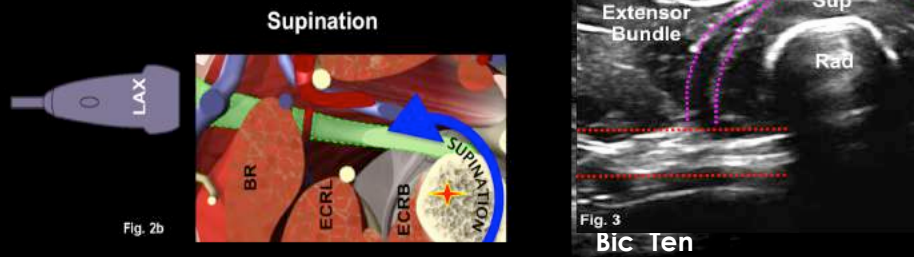
## Lateral Approach

### Lateral Approach to the Distal Biceps Tendon

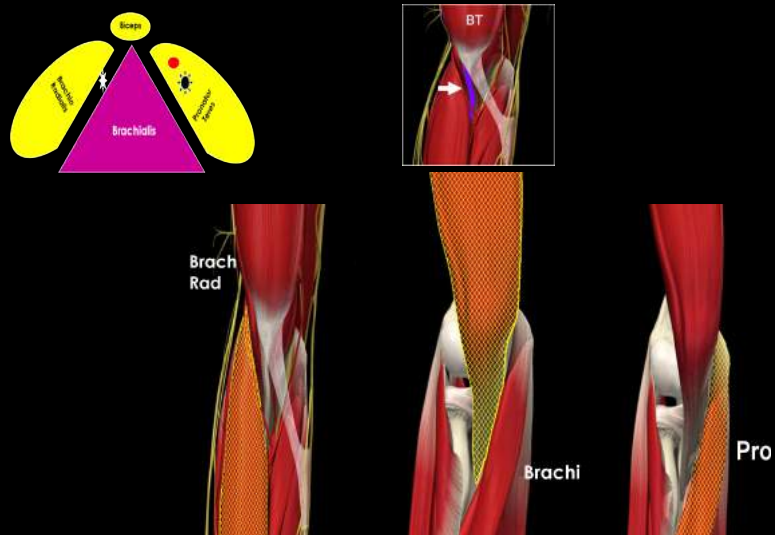


**90° elbow flexion**  
**Sufficient hand supination to expose tendon**  
**Longitudinal/Coronal**  
**Probe slightly distal from Radial Head**

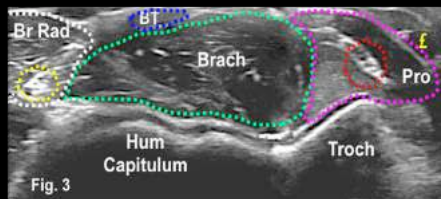
## Lateral Approach : Image Orientation



## Anterior Elbow “Pyramid” The Surrounding Musculature



## Anterior Elbow "Pyramid"



Brach = Brachialis

Br Rad = Brachio-radialis

Pro = Pronator

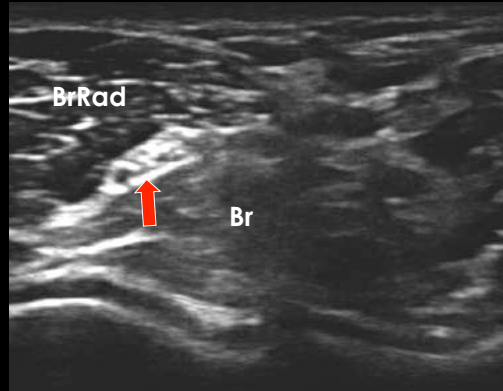
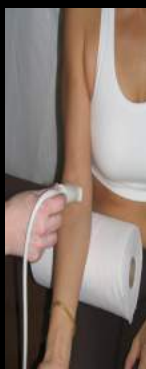
BT = Biceps Tendon

Radial Nerve = Yellow dotted outline

Brachial Nerve = Red dotted outline

£ = Brachial Artery

## Radial Nerve...Cutaneous Sensory ...and Posterior Inter-osseous branches

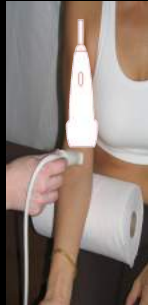


SAX Probe  
At the  
joint space

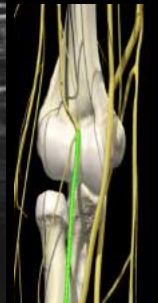
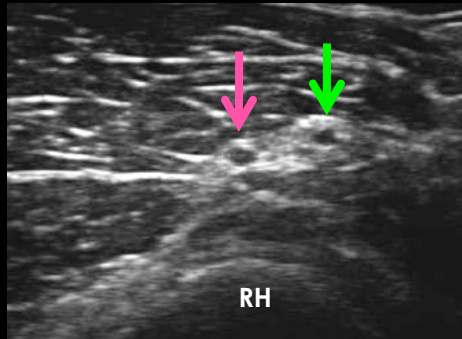
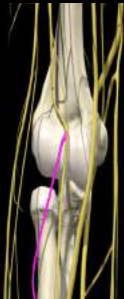
The hyperechoic RADIAL NERVE is identified  
between the Brachioradialis and the Brachialis



## The Cutaneous Sensory ...and Posterior Interosseous ( PIN )

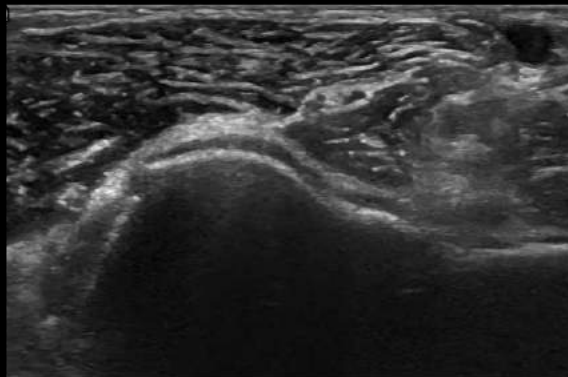


*Slight Distal/Lateral  
Probe translation  
from RN*

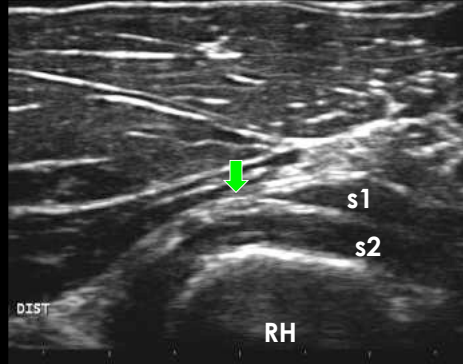


Radial Head becomes the only bony landmark.  
The PIN splits laterally  
The Cutaneous Sensory nerve splits medially  
Both are HYPOECHOIC due to anisotropy

## Radial Nerve Splitting Moving probe distally across joint space

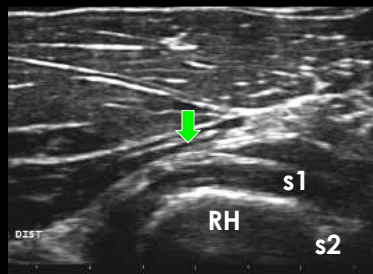


## Posterior Interosseous ( PIN )



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

## Posterior Interosseous ( PIN )

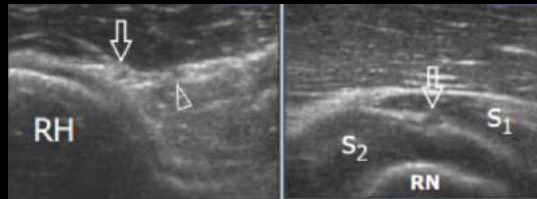


### Common Site of PIN Entrapment

**Arcade of Frohse**, sometimes called the  
“supinator arch”, is the most superior part of the  
superficial layer of the supinator muscle, and is a  
*fibrous arch* over the *posterior inter-osseous nerve*.

MSK Registry Review

**Posterior Interosseous Nerve ( PIN )**  
**Compression at Radial Head**  
**"Radial Tunnel" Syndrome**  
Anterior Forearm Pain



PIN passing between two bellies of the  
Supinator..."Radial Tunnel"



MSK Registry Review

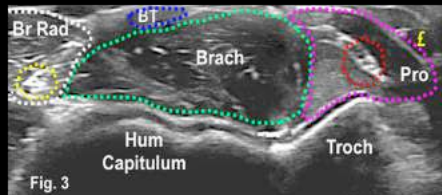
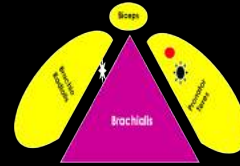
**Nerves Located at the Elbow**

**Median Nerve**



MSK Registry Review  
**Nerves Located at the Elbow**

**Median Nerve**



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

MSK Registry Review  
**Nerves Located at the Elbow**

**Ulnar Nerve**

Med

Lat



P to A view of Right Elbow

## Ulnar Nerve Short Axis



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

## Ulnar Nerve Short Axis



Fig. 2

Probe position is SAX  
Bridging the Ulnar groove.

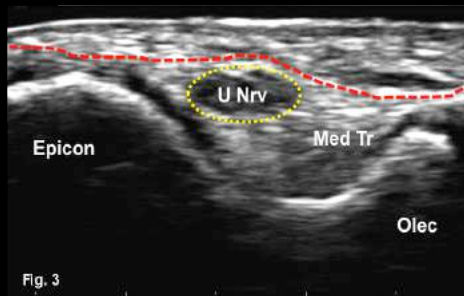


Fig. 3

The Sub-Q nerve is typically  
a hypoechoic oval ...  
“starry night” internal echoes  
adjacent to medial epicondyle

Adjacent Muscle: Medial Triceps (MT)

MSK Registry Review

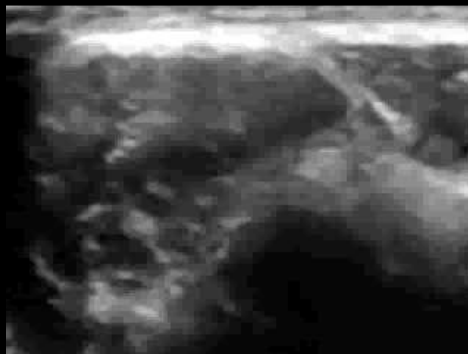
## Ulnar Nerve Dynamic Imaging Subluxing Nerve



**Note! In severe cases the Medial Triceps can also  
sublux/dislocate out of the groove  
“Snapping Triceps”**

MSK Registry Review

## Ulnar Nerve Dynamic Imaging Subluxing Ulnar Nerve with Medial Triceps



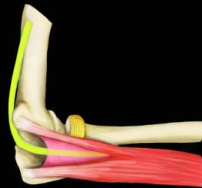
MSK Registry Review  
Nerves Located at the Elbow

**Ulnar Nerve Entrapment "Cubital Tunnel Syndrome"**  
**Most common site of Ulnar Nerve Compression...**

**3cm distal from Ulnar Groove ...**  
**as the nerve passes UNDER the roof of the cubital tunnel.**

The "roof" is a membrane/aponeurosis called...  
**Osborne's Fascia or Osborne's Ligament.**

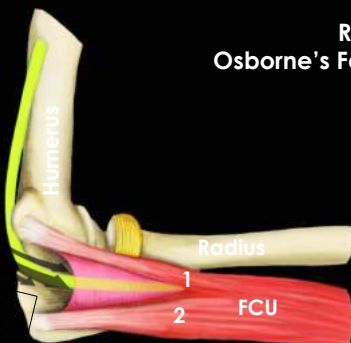
The membrane is located between the two heads  
of the Flexor Carpi Ulnaris muscle



Nerves Located at the Elbow

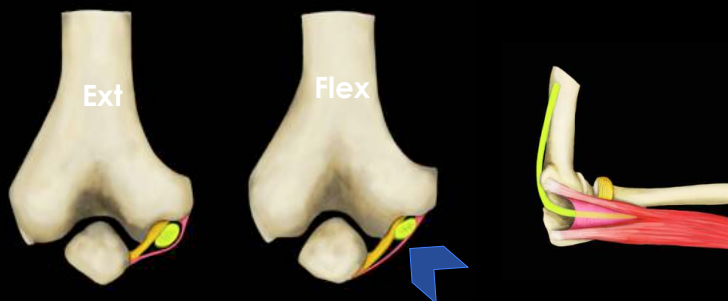
Ulnar Nerve Entrapment "Cubital Tunnel Syndrome"  
Most common site of Ulnar Nerve Compression is...  
As the nerve passes **UNDER** the roof of the cubital tunnel.

The "roof" is a membrane/aponeurosis called...  
**Osborne's Fascia or Osborne's Ligament**  
The membrane is located between the two heads  
of the Flexor Carpi Ulnaris muscle



**Remember !!**  
**Osborne's Fascia aka... Osborne's**  
**Ligament**

**Mechanism of Ulnar Nerve entrapment/compression  
under Osborne's Fascia/Ligament...Flexion !**



**Right Elbow P to A View**  
Yellow =UCL the "floor"  
of Cubital Tunnel  
Pink = Osborne's Fascia "the roof"  
Green = Ulnar Nerve

MSK Registry Review

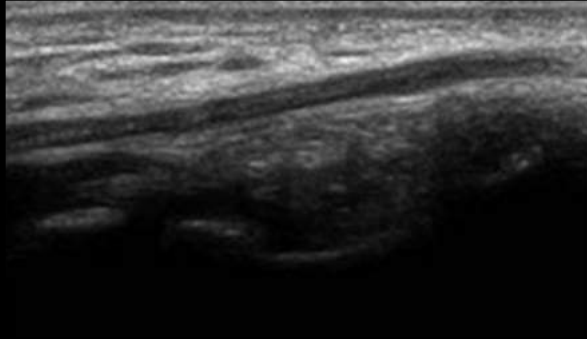
**Evaluating Ulnar Nerve Proximal to Ulnar Groove**



MSK Registry Review

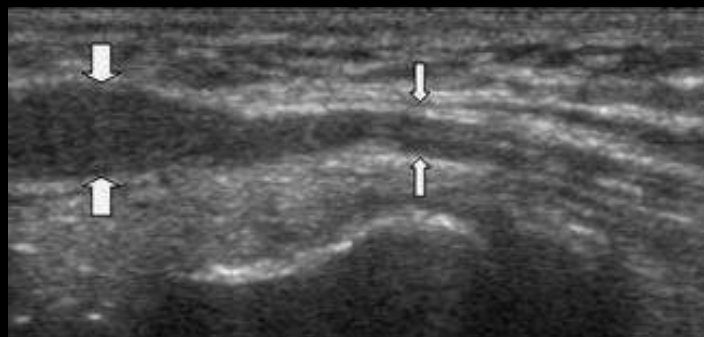
Evaluating Ulnar Nerve Proximal to Ulnar Groove

**Longitudinal Normal Ulnar Nerve**  
**Uniform thickness... "ribbon-like"**



MSK Registry Review

**Pre-cubital tunnel entry... stenotic dilation**  
**of Ulnar Nerve**



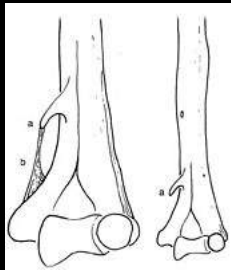
Proximal

Distal

Pre-cubital tunnel entry... Ulnar Nerve Entrapment

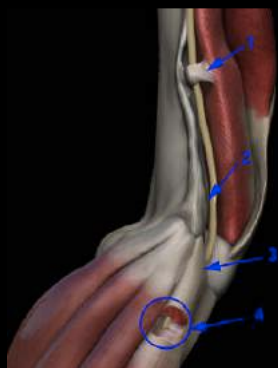
**Struther's Ligament**

- An anatomic rarity... 13.5 % of population
- Located +/- 8cm proximal to Ulnar Groove
- A Bony "supra-condylar" spur may form...above medial epicondyle
- 



Proximal

**Review of Possible Ulnar Nerve Entrapment Sites**

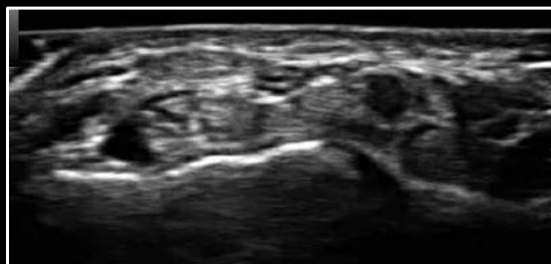


1. 1. Ligament of Struther's
2. 2. Posterior to medial epicondyle
3. 3. Entrance to cubital tunnel
4. "Osborne's Fascia/Ligament"
5. 4. Flexor/Pronator Aponeurosis
- 6.

## Peripheral Nerves Wrist and Hand

MSK Registry Review  
Wrist and Hand

### Palmar Transverse: Median Nerve Localization



Ask the patient to slowly flex and extend the thumb to activate the FPL (Flexor Pollicis Longus)

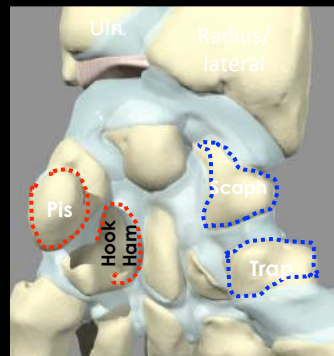
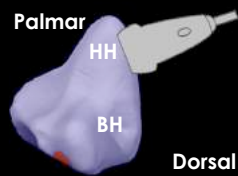
The hyper-echoic FPL tendon is seen pushing the hypo-echoic, ovoid nerve superficially and right.

## Medial and Lateral Boundaries of the Carpal Tunnel

Transverse Carpal Ligament forming the base and sides

Laterally: by the **Scaphoid and Trapezium tubercles**

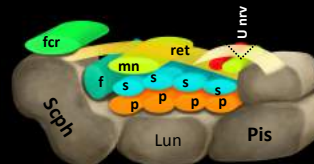
Medially: by the **Hook of the Hamate and the Pisiform**



## Proximal and Distal Borders of Carpal Tunnel

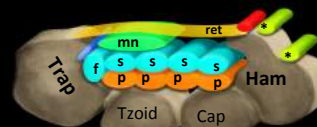
### Proximal/Entry

Scaphoid and Pisiform



### Distal/Exit

Hook of Hamate and Trapezium



## Carpal Tunnel: The Occupants

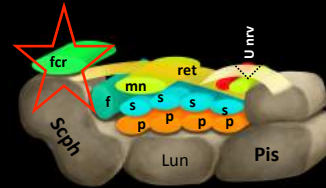
9 Tendons...1 Nerve

Flexor Digitorum Superficialis , Flexor Digitorum Profundus, Flexor Pollicis Longus

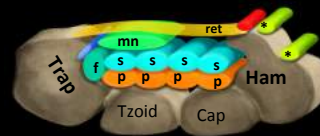
FDS-4  
FDP-4  
FPL-1 = 9 Tendons  
Median Nerve

**Flexor Carpi Radialis (FCR)**  
**NOT !!**  
**in the Carpal Tunnel**

It is superficial to retinaculum



Proximal entry carpal tunnel

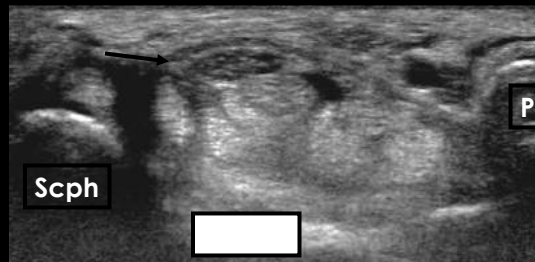
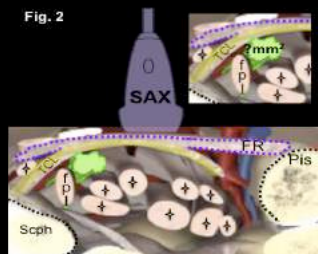


Distal exit carpal tunnel

MSK Registry Review  
Wrist and Hand

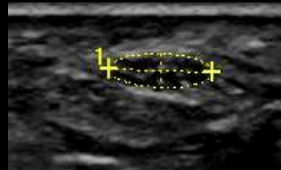
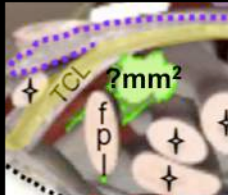
## Median Nerve Cross- Sectional Area Wrist to Forearm Ratio : Step One

Fig. 2



Identify the hypoechoic nerve.  
at the Carpal Tunnel entry....  
Scaphoid and Pisiform  
are bony landmarks

### Median Nerve Cross- Sectional Area Wrist to Forearm Ratio : Step One



Elliptical measurement  
yields x-sectional value

Do not compress nerve !  
Reduce probe pressure

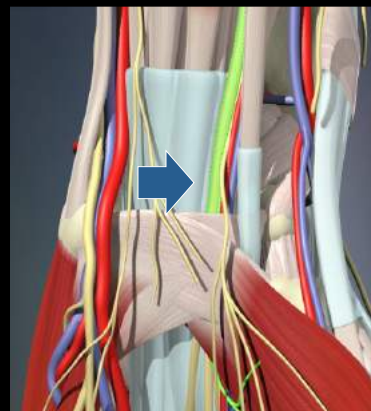
Irregular contours can  
be traced manually

### Median Nerve Cross- Sectional Area Wrist to Forearm Ratio : Step Two



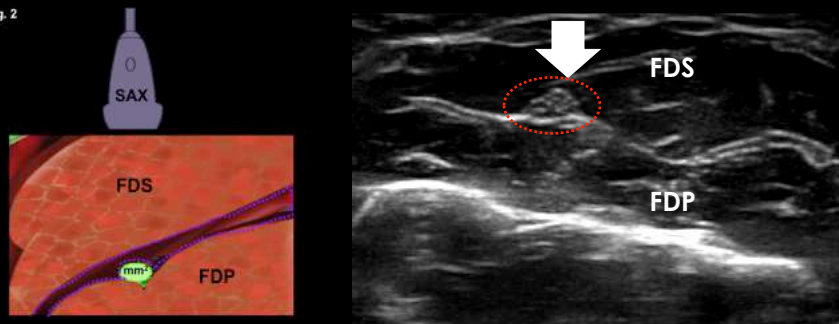
From distal image  
Trace MN proximally

12cm ...4.7 inches



### Median Nerve Cross- Sectional Area Wrist to Forearm Ratio : Step Two

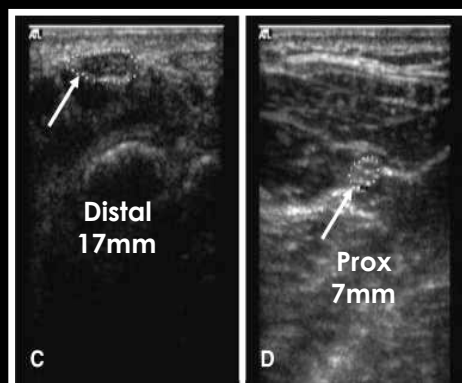
Fig. 2



Trace MN proximally  
12cm or 4.7 inches

The MN is seen between  
the FDS and the FDP  
Flexor Digitorum Superficialis & Profundus

### Median Nerve Cross- Sectional Area Wrist to Forearm Ratio Calculation



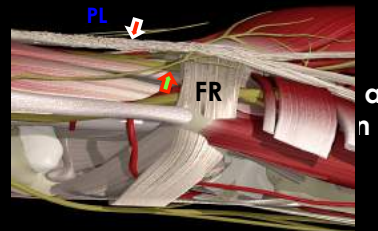
Ratio = 2.4  
7mm 17mm

> 1.4 positive  
for  
Carpal Tunnel

Source: [Clinical Neurophysiology 2008; 119:1353-1357](https://doi.org/10.1016/j.clinph.2008.01.101) (DOI:  
10.1016/j.clinph.2008.01.101 )

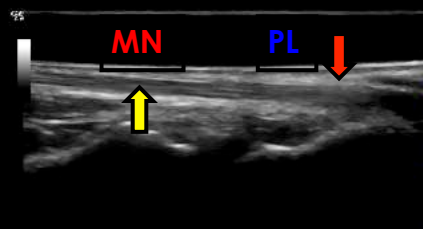
## Median Nerve Longitudinal

Slightly off midline toward radial margin



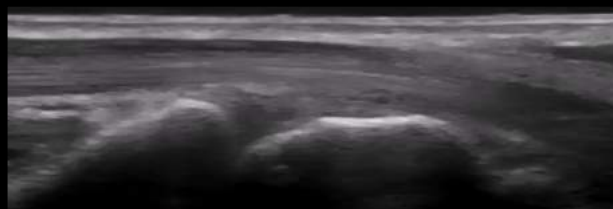
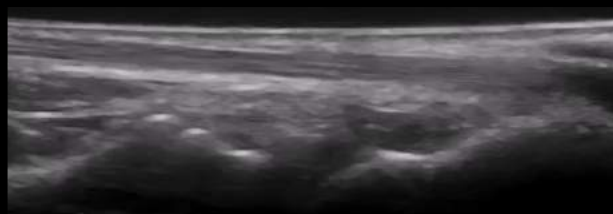
Palmaris Longus (PL) passes superficial to the Flexor Retinaculum (FR).

The most superficial structure of the volar wrist.  
Absent in 20 % of population



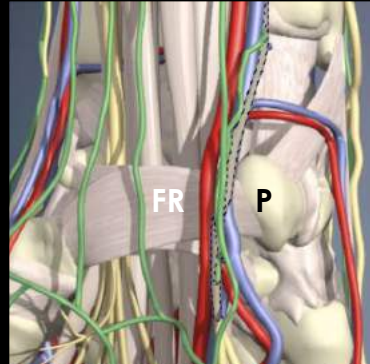
MSK Registry Review  
Wrist and Hand

**Median Nerve Has little or NO EXCURSION with finger flexion !**



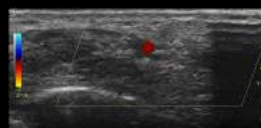
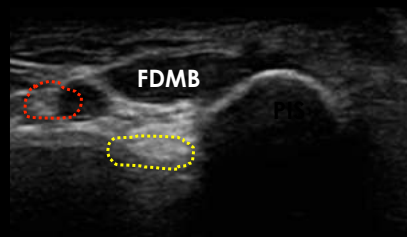


### Ulnar Nerve Transverse In Guyon's Canal



Ulnar Nerve is adjacent to the Ulnar Artery  
and superficial to Flexor Retinaculum FR  
Probe is moved in short axis plane to  
medial/ulnar side of palmar wrist.

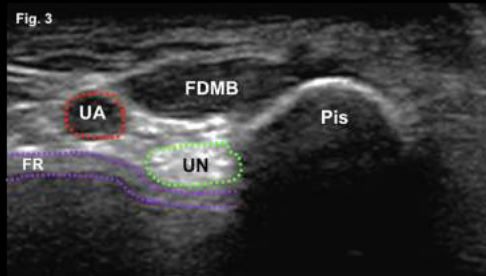
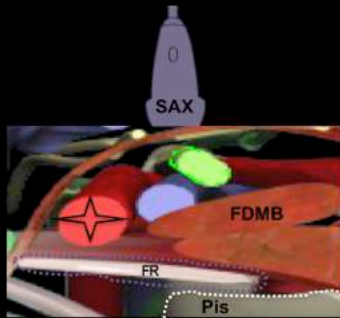
### Ulnar Nerve SAX In Guyon's Canal



Ulnar Nerve can be identified  
using color flow or doppler

Pis : Pisiform  
Red Hilite : Ulnar Artery (pulsatile, non-compressible)  
Yellow Hilite : Ulnar Nerve  
FDMB = Flexor Digiti Minimi Brevis

### Ulnar Nerve Transverse In Guyon's Canal



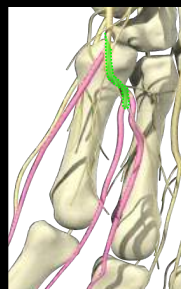
Ulnar Nerve is adjacent the artery and superficial to Flexor Retinaculum  
Bony landmark is the Pisiform

### Ulnar Nerve Branches Distal to Guyon's Canal

The canal/tunnel extends from Pisiform to distal margin of Hamate



Ulnar Nerve



Digital (motor)



Cutaneous (sensory)

The Ulnar Nerve divides into 2 terminal branches.  
The "proper" digital nerve (motor)  
The cutaneous branch (sensory)

### Ulnar Nerve Branches Distal to Guyon's Canal

The canal/tunnel extends from Pisiform to distal margin of Hamate

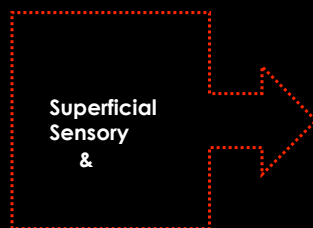
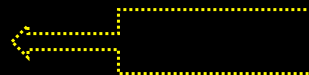
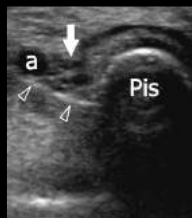
#### Ulnar Nerve

Digital (motor)

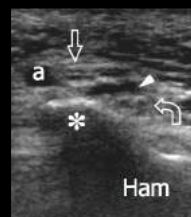
Cutaneous (sensory)

The Ulnar Nerve divides into 2 terminal branches.  
The "proper" digital nerve (motor)  
The cutaneous branch (sensory)

### Guyon's Canal Ulnar Nerve Branches



Sup. Sensory

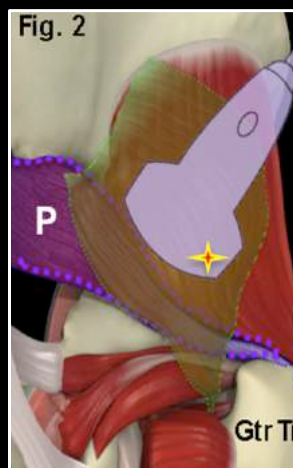


Deep Motor

## Peripheral Nerves Hip

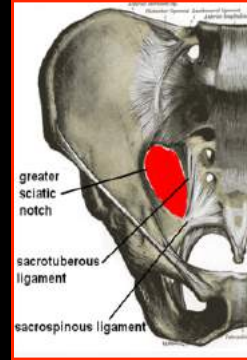
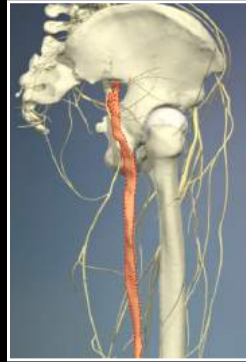
MSK Registry Review

### *Piriformis/Sciatic Nerve*



## MSK Registry Review

### Sciatic Nerve



**Largest nerve in the body. Exits the pelvis via the Greater Sciatic Foramen/Notch, whose borders are defined by bone laterally... and ligament medially  
Piriformis muscle occupies most of the opening**

## MSK Registry Review

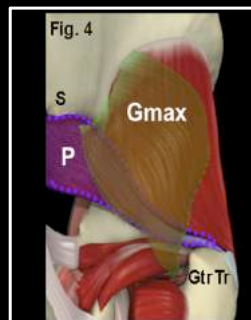
### Piriformis Imaging



**Probe Position #1**  
at Grtr. Troch  
SAX to Femur



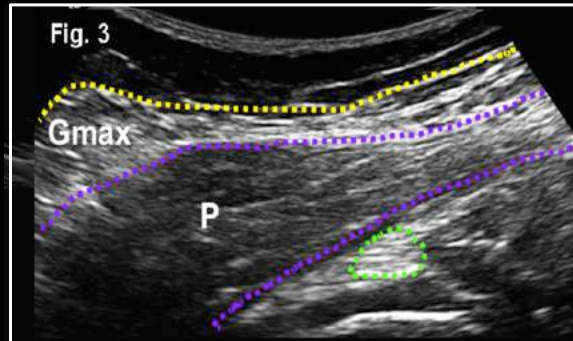
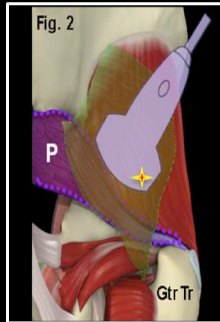
**Probe Position #2**  
Medial into Gmax  
Rotate, align w/ Piriformis



**Piriformis deep to Gmax**

**Probe Position #1**  
The “reference” end of the probe on the posterior aspect of the Greater Trochanter.

## Piriformis Imaging



Sciatic Nerve immediately deep to Piriformis  
Usually... but may pierce the muscle



Dynamic Maneuver : Internally/Externally rotate  
the hip/foot. Piriformis contracts/slides.  
Overlying Gmax stationary.

## Lateral Femoral Cutaneous Nerve Sonography

*Meralgia Paresthetica...*

*“thigh pain with anomolous/irregular perception”*

*Chronic neurologic disorder due to entrapment/  
compression at the level of the ASIS and Inguinal  
ligament*

*Seen with...*

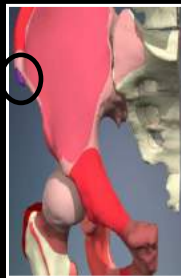
*weight gain  
diabetes  
“seat belt” injury  
repetitive motion*

## ***Lateral Femoral Cutaneous Nerve Anatomy***

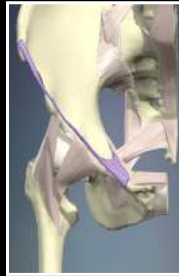
*Has an oblique path thru inguinal region  
medial to lateral toward the ASIS.*

***Distal to ASIS....***

- *LFCN passes under the Inguinal ligament*
- *and is “sandwiched” between two layers of fascia  
... superficial to the Sartorius muscle*



**ASIS**



**Inguinal  
Ligament**



**LFCN**



**Sartorius**

## ***Lateral Femoral Cutaneous Nerve Sonography***

### ***Interface Identification***

***LFCN is visualized between 2 hyperechoic fascial layers***

- ***Fascia Lata : Superficial “sheath” of thigh***
- ***Fascia Iliaca : Covering Iliacus and Psoas***

## ***Lateral Femoral Cutaneous Nerve Sonography***

### **Interface Identification**

***LFCN is visualized between 2 hyperechoic fascial layers***

- ***Fascia Lata*** : Superficial “sheath” of thigh
- ***Fascia Iliaca*** : Covering Iliacus and Psoas



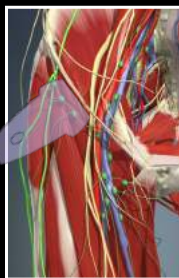
MSK Registry Review

### ***Lateral Femoral Cutaneous Nerve Sonography***

#### ***Supine Patient***

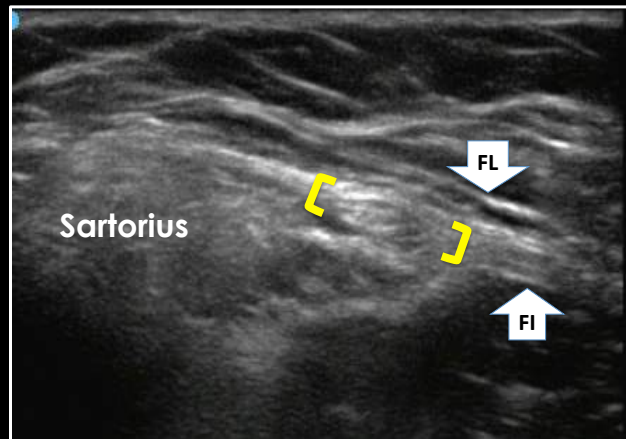
***SAX oblique probe at the ASIS parallel w Inguinal ligament***  
***Translate probe distal (viz fascia NOT ligament !)***

***Ellipsoidal LFCN between hyperechoic FL and FI***



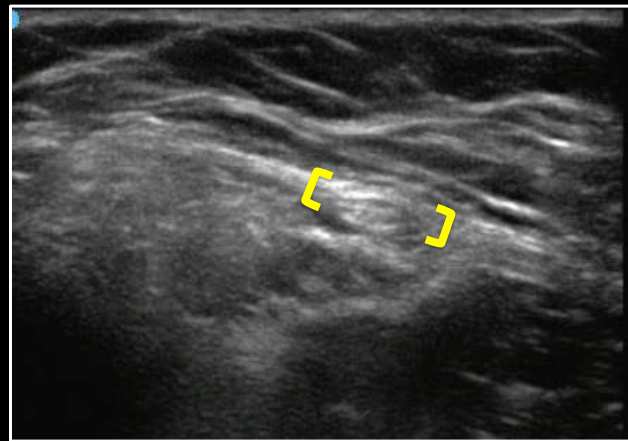


*Lateral Femoral Cutaneous Nerve Sonography*



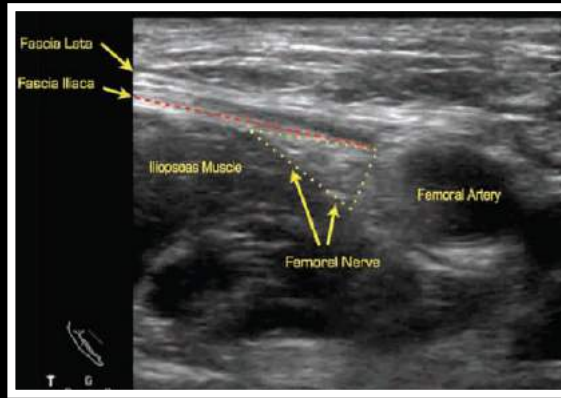
**The lateral femoral cutaneous nerve lying between the connective tissues of the fascia lata and fascia iliaca  
Medial to the sartorius muscle.**

*Lateral Femoral Cutaneous Nerve Sonography*



**The lateral femoral cutaneous nerve lying between the connective tissues of the fascia lata and fascia iliaca  
Medial to the sartorius muscle.**

*Lateral Femoral Cutaneous Nerve Sonography*



**The LCFN can be traced medial to lateral by identifying the femoral neurovascular bundle**

**Peripheral Nerves  
Knee**

## Tibio-Fibular Joint...the forgotten joint

aka...Proximal tibio-fibular articulation

A true cartilage lined joint

Has it's own articular capsule

Communicates w/ knee joint: 10%

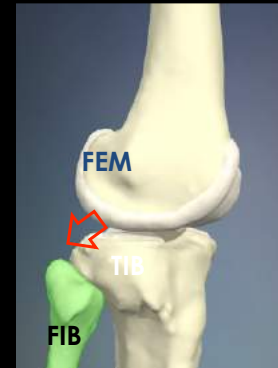
### Function:

Alleviate torsion stress

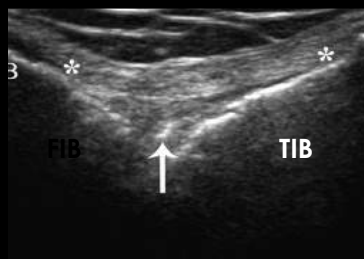
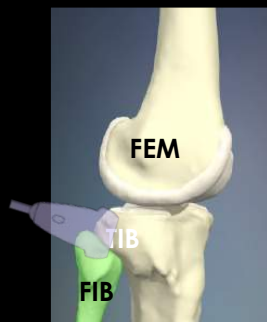
### Mechanism of Injury

Susceptible to indirect trauma  
resulting from severe ankle stress.

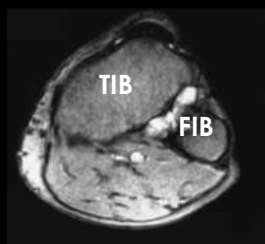
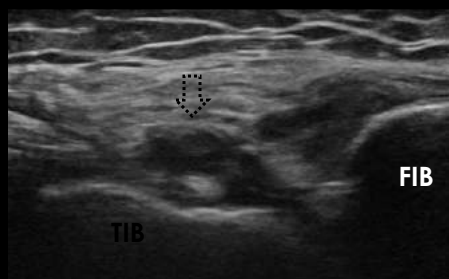
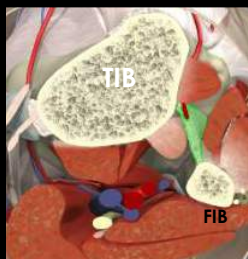
Direct trauma is an impact to lateral knee  
while weight-bearing and flexed.



## Tibio-Fibular Joint Image

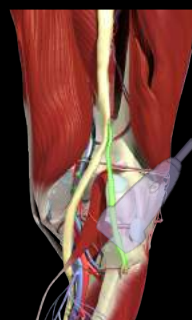


## Tibio-fibular Ganglion Cyst



## MSK Registry Review Knee Lateral Compartment Peroneal Nerve

Aka... Common Fibular Nerve

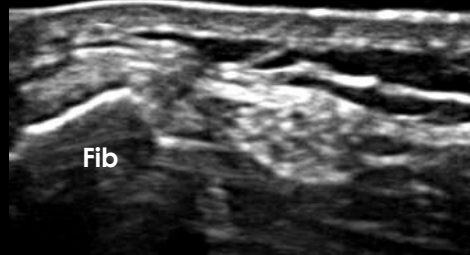
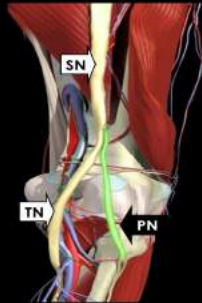


**SAX probe at postero-lateral Fibula demonstrates PN**  
Smaller of the two terminal branches of the Sciatic nerve.

SN= Sciatic Nrv    TN= Tibial Nrv    PN= Peroneal Nrv

MSK Registry Review  
Knee  
Lateral Compartment  
Peroneal Nerve

**Aka... Common Fibular Nerve**

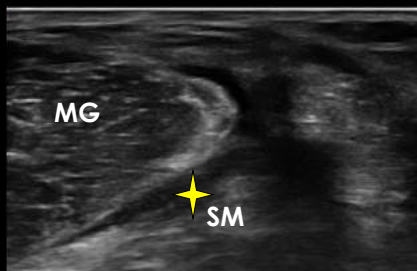


SAX probe at postero-lateral Fibula demonstrates PN  
Smaller of the two terminal branches of the Sciatic nerve.

**SN= Sciatic Nrv    TN= Tibial Nrv    PN= Peroneal Nrv**

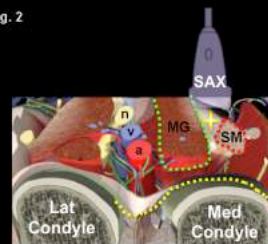
MSK Registry Review  
Knee  
Posterior Compartment

**Popliteal Fossa**



Medial Gastroc/Semimembranosus Bursa

Fig. 2



Baker's cysts have a "tell-tale"  
conformation by displaying  
a unique neck of origin.

As effusion  
enlarges between the  
Medial Gastrocnemius  
and Semi-Membranosus tendonn

## Popliteal Fossa

Medial Gastroc/Semimembranosus Bursa



True Baker's cyst ...

- \* is INTER-MUSCULAR
- \* originates on medial side
- \* has a distinct neck of origin

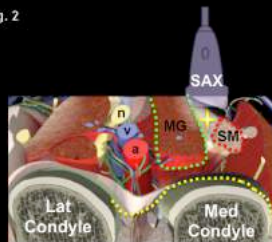


What is this lump! ...on my knee?

## Popliteal Fossa

Medial Gastroc/Semimembranosus Bursa

Fig. 2



True

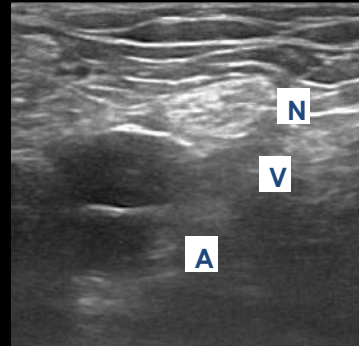
- \* it
- \* originates on medial side
- \* has a distinct neck of origin



## Popliteal Neuro-Vascular Bundle



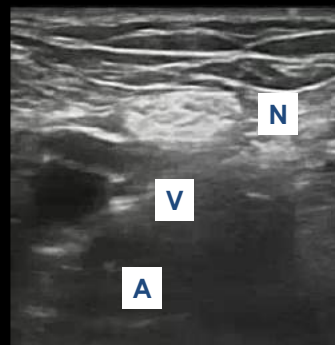
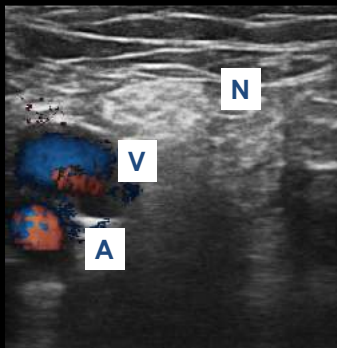
Prone patient position  
SAX probe @ crease  
scanning thru  
the joint space.



The Nerve...Vein... Artery  
in a "Stack" formation

## Popliteal Neuro-Vascular Bundle

The Nerve – Vein – Artery "Stack"

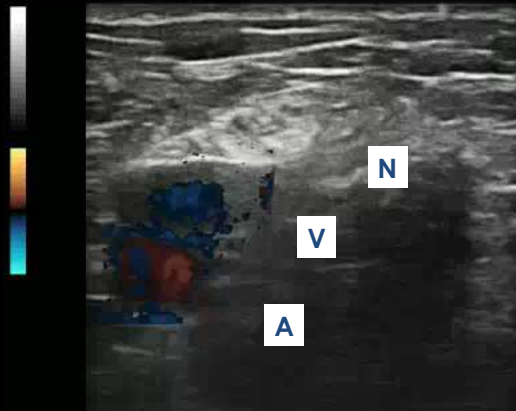


Sonopalpation allows localization of the...  
HYPER-echoic Tibial nerve  
Compressible Popliteal vein  
Non-compressible ... Pulsatile Popliteal artery

## Deep Vein Thrombosis (DVT)

Formation of  
a clot in a  
deep vein.

US Findings:  
Non-  
compressible...  
Popliteal Vein



## Tibial Nerve Neuro-fibromatosis and Thrombosis



Neurofibromatosis is a genetic disorder that causes tumors to form on nerve tissue.  
Neurofibromatosis is usually diagnosed in childhood or  
early adulthood.

The tumors are usually noncancerous (benign), but sometimes can become cancerous  
(malignant).



## Peripheral Nerves Foot and Ankle

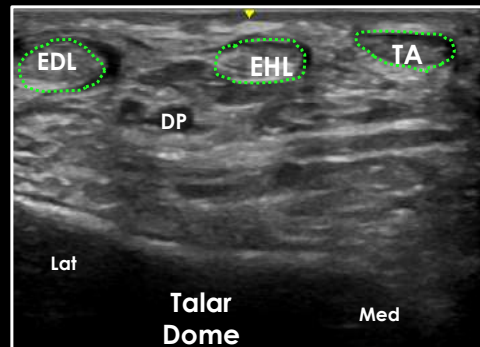


MSK Registry Review: Ankle and Foot  
Anterior Ankle Tendon Anatomy

### Imaging the Extensor Tendons



Supine patient  
SAX probe

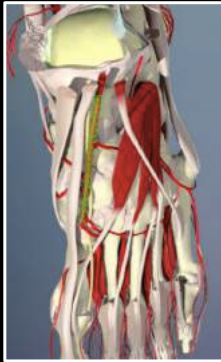


Visualize scalloping contour  
of Talar Dome

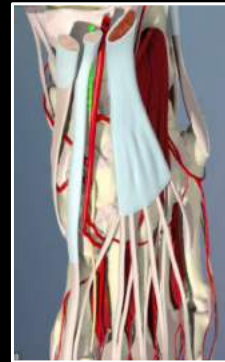
EDL and EHL often display  
**hypoechoic low-lying muscle**

### Deep Peroneal Nerve

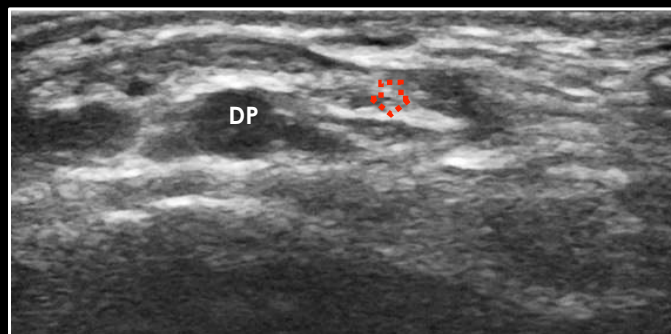
The Deep Peroneal nerve deep and medial to EHL  
and, adjacent to the non-compressible... pulsatile Dorsalis Pedis



**Anterior Tarsal Tunnel Syndrome**  
Dorsal osteophytes over  
tibio-talar or talo-navicular joints



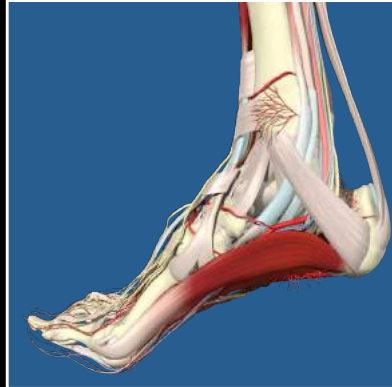
### Deep Peroneal Nerve



The fascicular pattern of the small nerve is medial to  
Dorsalis Pedis (DP) and deep to EHL

## The Medial Ankle

PQ



## The Tarsal Tunnel

Time to meet...

**Tom:** *Tibialis Posterior Tendon*

**Dick:** *Flexor Digitorum Longus Tendon*  
and ...

**Very:** Tibial veins and artery

**Nervous Harry:** Tibial Nerve and  
*Flexor Hallucis Longus Tendon*

### The Tarsal Tunnel Boundaries

- **Roof:** **flexor retinaculum**
- **Floor:** medial surfaces of the **tibia, talus, and calcaneus**

### Tarsal Tunnel Syndrome

The most common symptoms are pain and paresthesia in **the toes, sole, or heel** and the main finding at physical examination is the positive **Tinnet Sign** (distal paresthesias produced by percussion over the affected portion of nerve).



### Tarsal Tunnel Syndrome Tibial Nerve Branches

**Tibial Nerve**

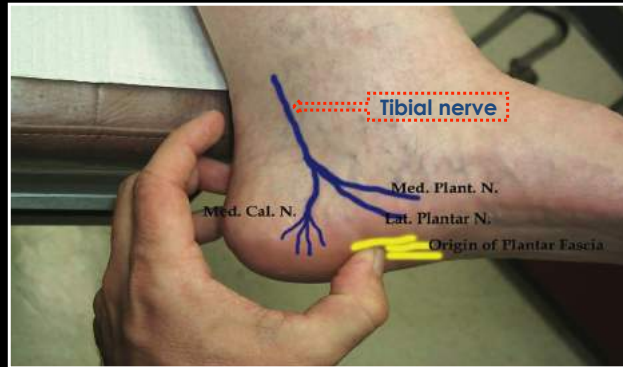
**Medial Calcaneal nerve**

**Medial plantar nerve**

**Lateral plantar nerve**

**Baxter's Nerve**  
One of the more elusive diagnostic considerations in heel pain is entrapment of **first branch of the lateral plantar nerve**

Tarsal Tunnel Syndrome  
**Tibial Nerve Branches**



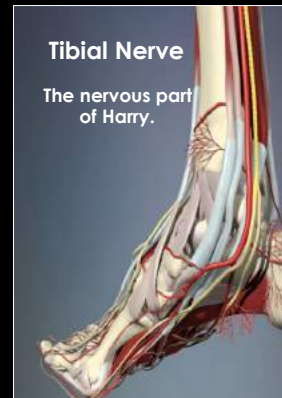
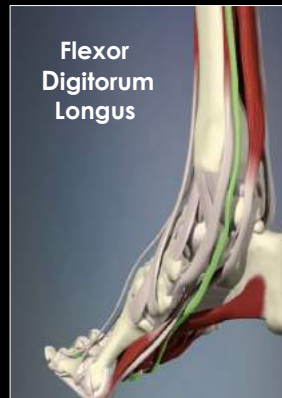
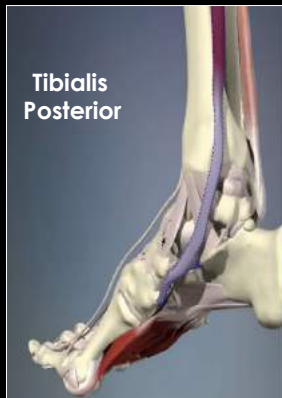
Tarsal Tunnel Syndrome  
**Pattern of sensory loss**



**"If a patient presents with numbness of the heel...what do you image?"**

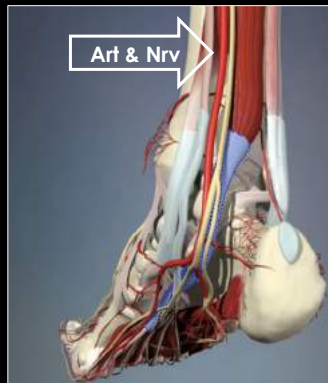


## The Tarsal Tunnel



**Moving posteriorly from the bony Medial Malleolus, cross-sectional display of the Tarsal Tunnel structures is seen**

## The Tarsal Tunnel: Flexor Hallucis Longus Tendon



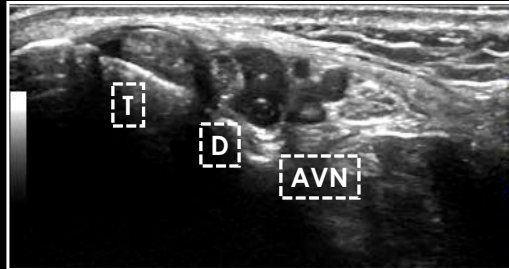
**Flexor Hallucis Longus (FHL blue hilite) is often poorly visualized due to it's position deep to Tibial artery and Tibial nerve.**

## Imaging the Tarsal Tunnel

### SAX at Posterior-Superior Medial Malleolus

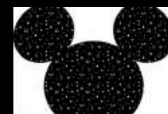
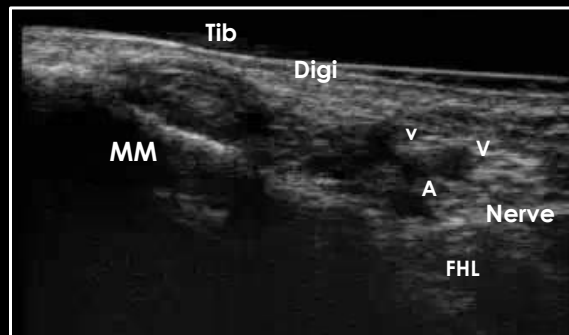


Supine patient  
External rotation of foot.  
Probe in SAX  
at or slightly proximal on MM.



The Flexor Hallucis  
(not visible)  
is deep to the  
artery-vein-nerve bundle

### Medial Ankle/Tarsal Tunnel SAX Dynamic with FHL



Reading left to right... Tib Posterior is next to malleolus. FDL is adjacent to PT. There may be two veins with the artery. Tibial nerve is posterior to vascular bundle.

Note! As the poorly visualized (due to anisotropy) Flexor Hallucis is activated the "starry night" appearance of the nerve is better demonstrated.

Medial Ankle/Tarsal Tunnel SAX  
**Ganglion Cyst Compressing Tibial Nerve**

