

[www.mskmasters.com](http://www.mskmasters.com)  
 "A systematic scan protocol clearly presented, and easily imitated."

Part of the complete MSK Masters Series available through [mskmasters.com](http://mskmasters.com), this high quality video lecture presents the complete hand and wrist scanning protocol in a step-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. Supra-patellar imaging with an emphasis on interface identification for ultrasound guided knee injections is one highlight of this common extremity imaged with sonography. Patellar tendon, medial and lateral meniscus, the medial and lateral collateral ligaments, along with pes anserine bursa, biceps femoris tendon and popliteal fossa and Baker's cyst are covered.

Visit [www.mskmasters.com](http://www.mskmasters.com) for the complete MSK Masters Series! Also, 4th Revision 2015 Sonography of the Extremities now available. The straight-forward, highly illustrated, step-by-step, MSK protocol manual that takes you through scan protocols like no other text. The MSK "How to" book!

Downloadable PDF Handouts Available at:

Randy E. Moore DC RDMS RMSK  
**SONOGRAPHY OF THE EXTREMITIES**  
 TECHNIQUES AND PROTOCOLS  
 The Knee: Above Below and All Around

# The Knee



## The Knee

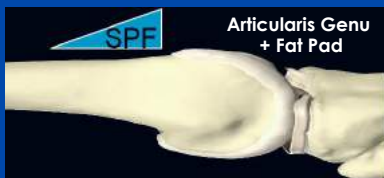
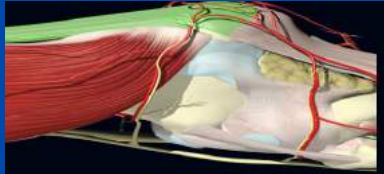
MRI and Ultrasound are modalities of choice to evaluate the knee.

MRI is preferred for chronic symptoms of *internal derangement.*

Ultrasound is the better choice when clinical presentation suggests *tendon disease, bursal inflammation, ligament injury or capsular effusion.*

## The Knee Anterior Imaging

## The Knee Quadriceps Tendon Longitudinal



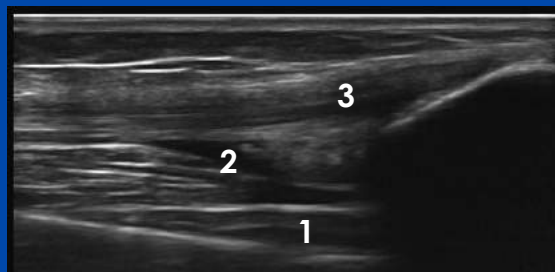
Identifying three interfaces is helpful in using supra-patellar pouch/bursa for intra-articular injections.

OA with minimal bursal effusion  
Ultrasound guidance adds increased accuracy

Check tendon pattern !

[J Clin Ultrasound](#). 2012 Jan;40(1):20-5. doi: 10.1002/jcu.20890. Epub 2011 Oct 28

## The Knee Quadriceps Tendon Longitudinal



3 interfaces identified

1 = Femur/Fat Pad

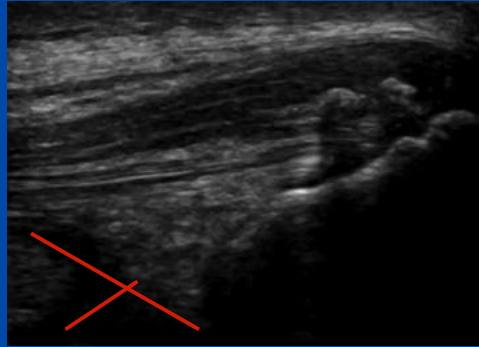
2 = Suprapatellar Pouch

3 = Quad Tendon

Supine patient & LAX probe  
A bolus for 30° flexion.  
Landmarks : patella and femur

Quad Contraction  
enhances bursal interface

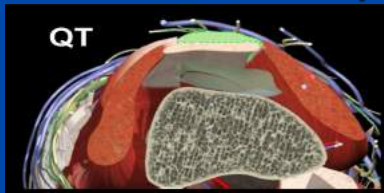
### The Knee Suprapatellar Bursa Measurement Lines



#### Measurements

Thickness: 2.5mm  
Length: 22.5mm

### The Knee Quadriceps Tendon Transverse



Three specific interfaces identified  
Deep to Superficial

Quad Tendon

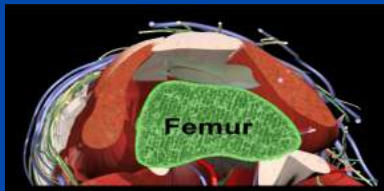


Supra-patellar Bursa



Femur

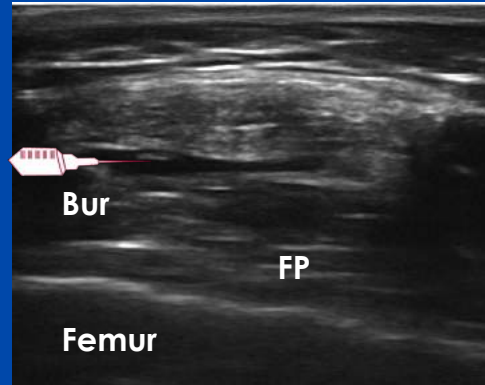
Needle advance:  
Lateral to Medial  
In-Plane



### The Knee Quadriceps Tendon Transverse

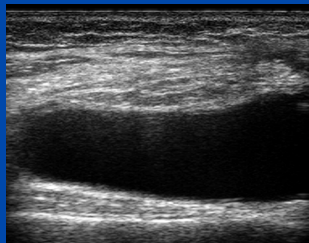


Supine patient  
SAX probe  
A bolus for 30° flexion.

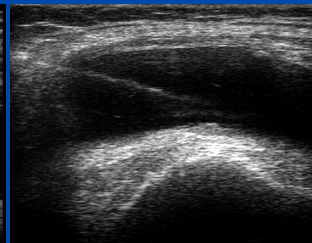


Needle advance  
Lateral to Medial  
In plane

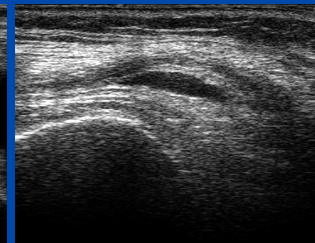
### The Knee Suprapatellar Bursal Aspiration



LAX  
Pre-Aspiration

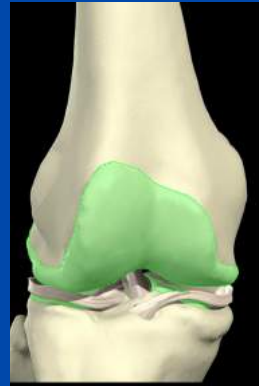
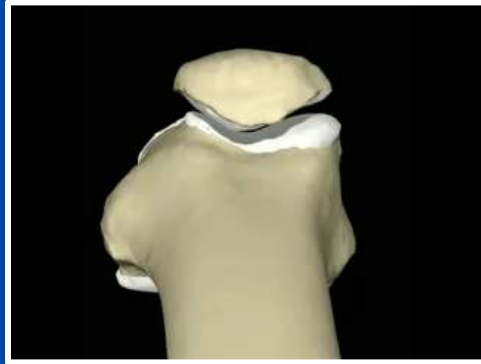


SAX  
Needle advanced



SAX  
Post aspiration

The Knee  
“Sunrise” View for Osteoarthritis



Full flexion of the knee exposes the hyaline cartilage covering the Femoral Trochlea

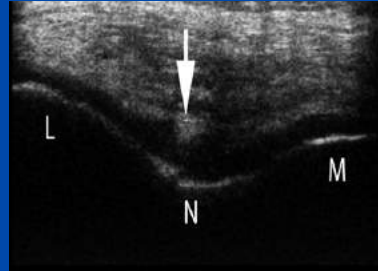
The Knee  
“Sunrise” View for Osteoarthritis



Supine patient with full flexion.  
Supra-patellar ... SAX Probe  
Cortical outline of Femoral Trochlea  
and ANECHOIC hyaline cartilage  
should be smooth, homogeneous

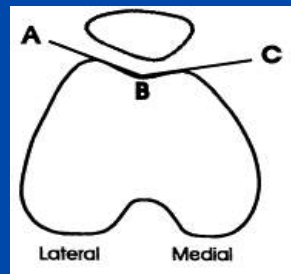
## US Data: Femoral Trochlea

Cartilage Clarity/ Thickness



Sulcus Angle: ~ 130 degrees  
Patello-Femoral joint conformation

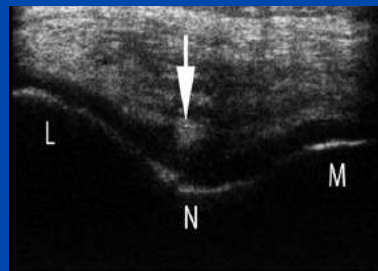
Deeper ( less than 130° ) Early life  
Flatter ( more than 130° ) Later life



Slide Courtesy  
Victor Ibrahim, MD

## US Data: Femoral Trochlea

Cartilage Clarity/ Thickness



Sulcus Angle: ~ 130 degrees  
Patello-Femoral joint conformation

Deeper ( less than 130° ) Early life  
Flatter ( more than 130° ) Later life



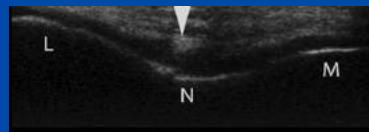
Slide Courtesy  
Victor Ibrahim, MD

## Femoral Trochlea : Evaluation

- 20 Symptomatic
- 20 Asymptomatic
- No difference in thickness
- Positive Trend:
- Cartilage Clarity
- more indicative of OA



Asymptomatic



Symptomatic

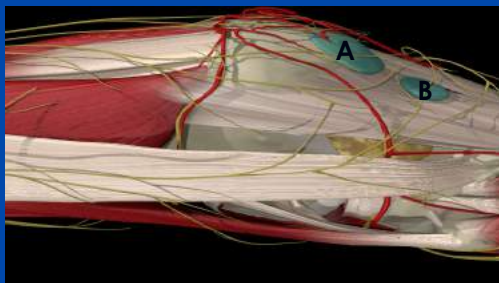


Loss of clarity

Kazam JK et al J Ultrasound Med. 2011 Jun;30(6):797-802.

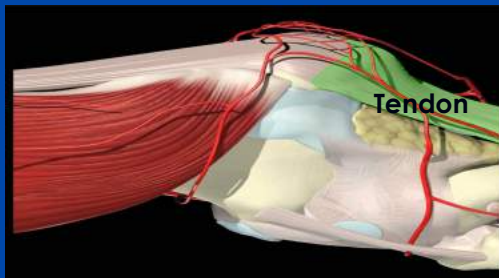
Slide Courtesy  
Victor Ibrahim, MD

## The Knee Patellar Ligament/Tendon Longitudinal



Two  
Subcutaneous bursae.  
A = PRE patellar  
attached to patella

B = INFRA patellar  
Sub-Q, but distal.

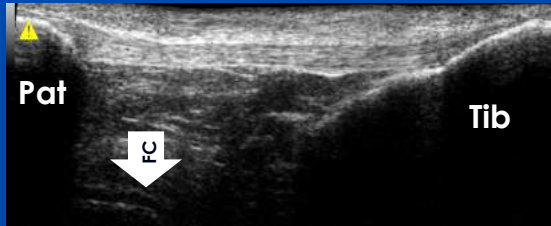


one Deep Infrapatellar





## The Knee Patellar Tendon Longitudinal



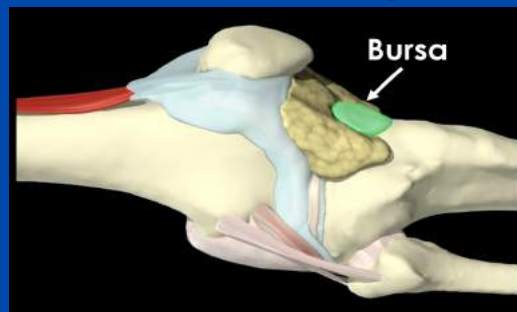
### Panoramic View

Supine patient  
SAX probe  
A bolster for 30° flexion

Patella and Femur visualized

Tibial insertion typically  
not seen on LAX

## The Knee Patellar Tendon Longitudinal



### Deep Infrapatellar Bursa

Deep to Patellar ligament  
Anterior to Tibia

Inflamed and painful  
with Osgood-Schlatter's

## The Knee Patellar Tendon Longitudinal



### Panoramic View

\* = Deep Infrapatellar bursa

## 3 Patellar Bursae

### 2 Subcutaneous ( top of the tendon )

\*Prepatellar- attached to patella

*Housemaid's Knee*

\*Infrapatellar-Sub-Q - distal on the tendon

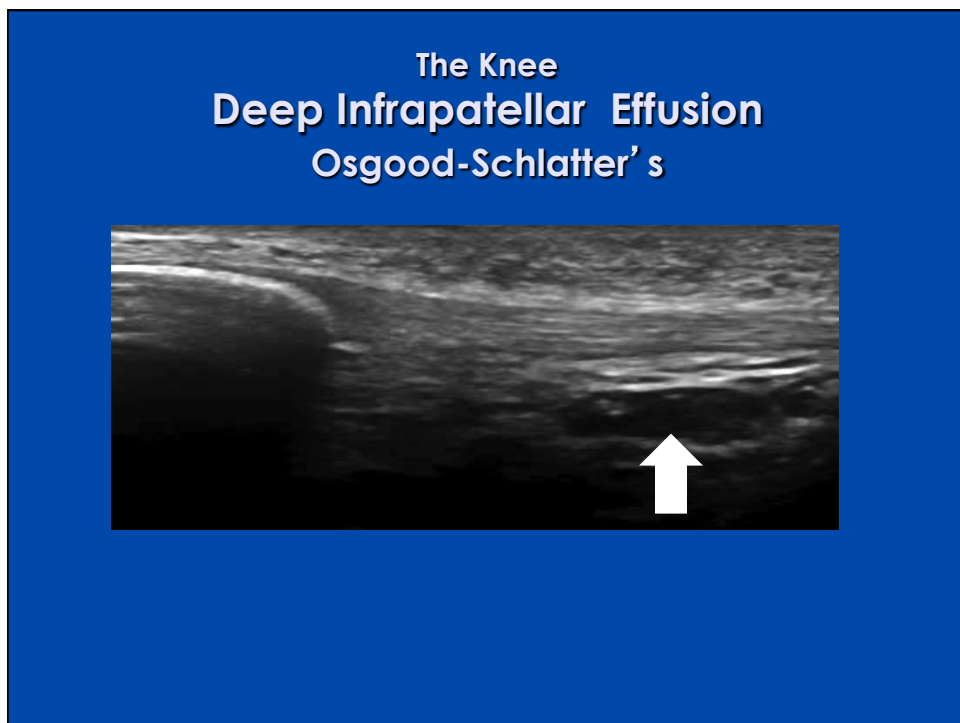
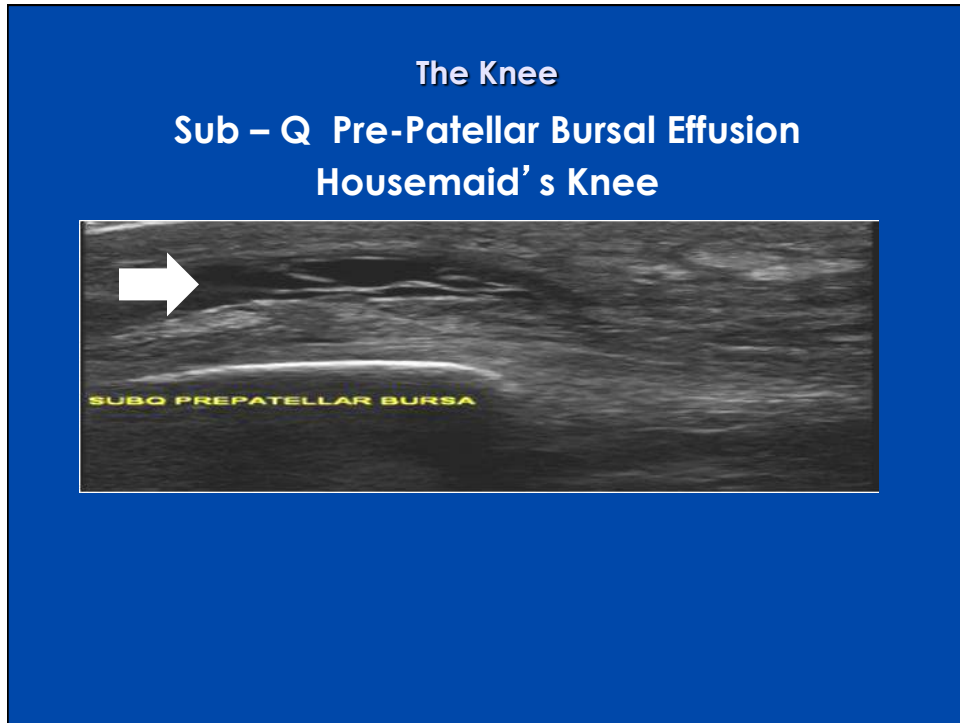
*Vicar's Knee*

### 1 Deep Infrapatellar (beneath the tendon)

*Osgood-Schlatter's disease*

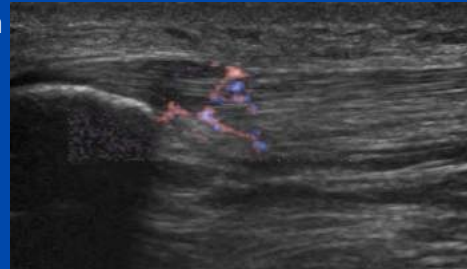
Pathologic due to a traction avulsion injury  
at the tendon insertion on the tibial tubercle.

Look Proximal... Distal...  
Above & Below the tendon.



## The Knee Patellar Tendon: “Jumper’s Knee”

**Cause:**  
repeated eccentric contraction  
of Quads... when landing  
from a jump.  
Characterized as  
“tendinitis” of  
deep side proximal  
region of tendon



US low sensitivity  
MRI=US Specificity

Doppler flow may be seen

Scandinavian Journal of Medicine & Science in Sports, 6: 291–296. doi: 10.1111/j.1600-0838.1996.tb00473.x SLIDE COURTESY VICTOR IBRAHIM, MD

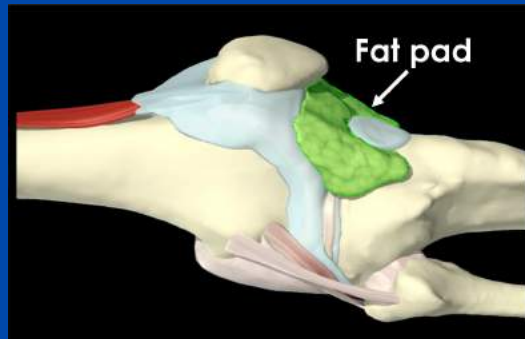
## US Data: Patellar Tendon

- Thickness: 3.0-3.4 mm
- Fibrillar Pattern
- Continuity of Fibers



slide courtesy  
Victor Ibrahim, MD

The Knee  
Patellar Tendon Transverse and Fat Pad



Hoffa's fat pad is intra-articular but extra-synovial  
Highly vascular

Enlarged medial and/or lateral portions  
may extend to the mid-joint line

The Knee  
Patellar Tendon Transverse and Fat Pad



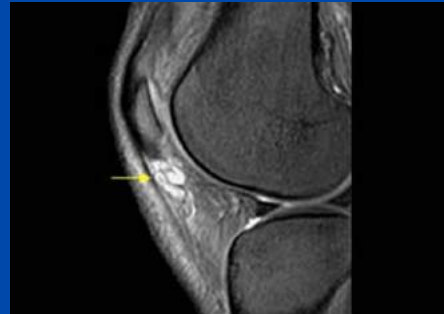
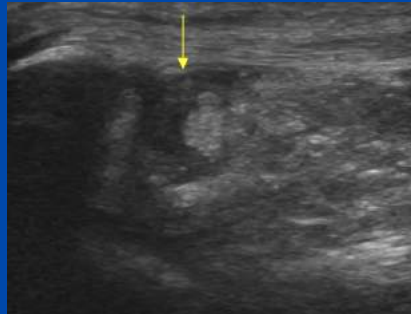
Supine patient  
SAX probe



Tendon is broad, dense and echogenic  
Fat Pad is "marbled"...mixed echoes

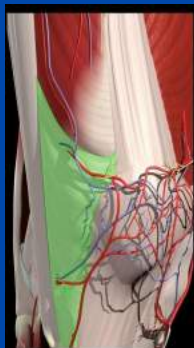
The pad is pulled into the joint  
during extension

### The Knee Hoffa's Impingement Syndrome

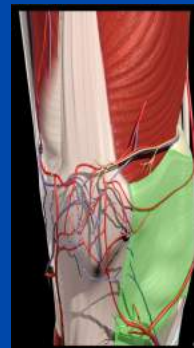


Hypoechoic edema and calcification  
Contra-lateral image/measurement suggested

### The Knee Patellar Retinaculæ



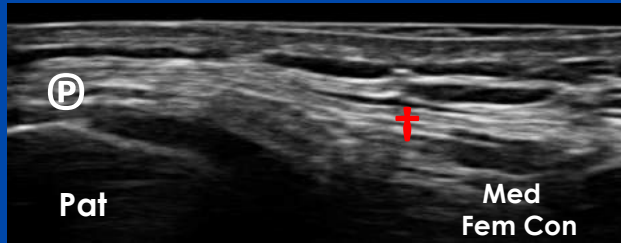
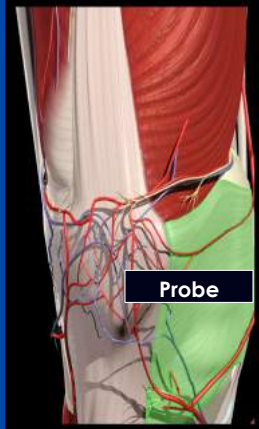
Lateral



Medial

Broad "sheet-like" ligaments stabilizing the patella  
Bi-laminar...two layers  
Lateral : origin is ITB and VL  
Medial: origin is Sartorius and VM

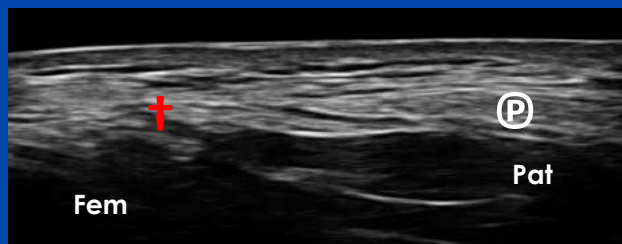
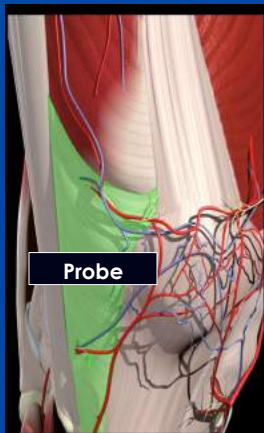
### The Knee Medial Patellar Retinaculum



Dense, compact fibers of patellar tendon (Ⓟ)  
Bi-laminar retinaculum (†)

Dynamic stress **LATERALLY** (lateral facet not as  
Bi-laminar texture is normal)

### The Knee Lateral Patellar Retinaculum

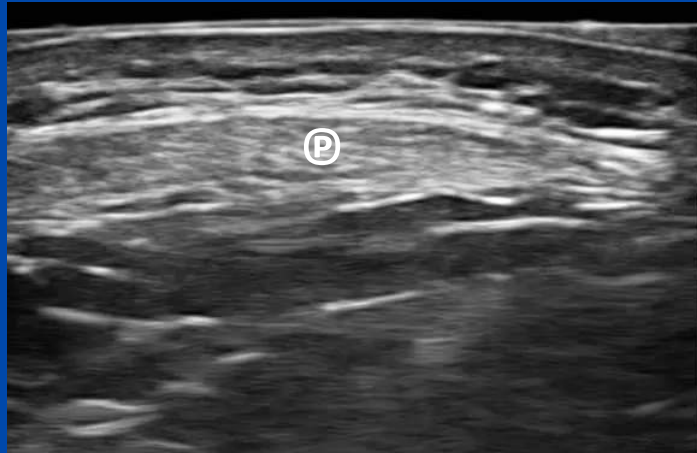


Dense, compact fibers of patellar tendon (Ⓟ)  
Bi-laminar retinaculum (†)

Supine patient. **SAX** probe. Patella and Femur landmarks  
Dynamic stress **MEDIALY**  
Bi-laminar texture is normal

## The Knee

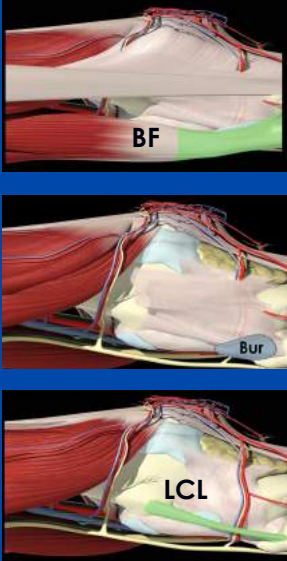
### Patellar Retinaculum : Probe Translation



## The Knee Lateral Imaging



The Knee  
**Lateral Collateral Ligament Longitudinal**




The Biceps Femoris overlies the LCL

Both attach on the fibula  
Imaging challenge is to not mistake BF for LCL

Biceps Femoris  
↑  
LCL Bursa  
↑  
LCL

The Knee  
**Lateral Collateral Ligament Longitudinal**

The Biceps Femoris overlies the LCL



Both attach on the fibula  
Imaging challenge is to not mistake BF for LCL

↑  
↑

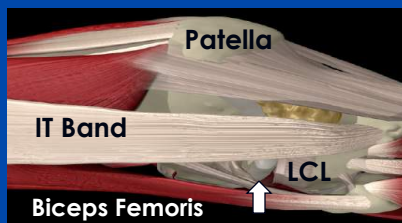
The Knee  
Lateral Collateral Ligament Longitudinal



Semi-Decubitus patient  
with bolus on medial aspect of knee

Slight flexion “folds” the Biceps Femoris  
downward/posteriorward

The Knee  
Lateral Collateral Ligament Longitudinal



Visualize fibular attachment  
where most LCL  
pathology occurs.

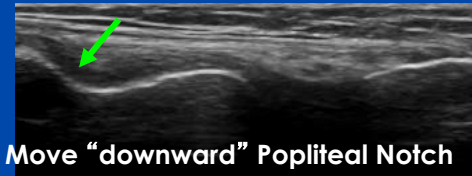


Visualize all 3 bony landmarks

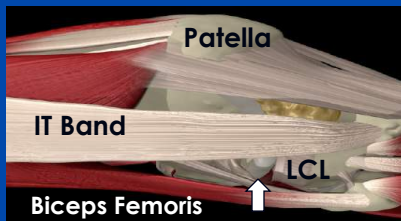
LCL is extra-capsular

Deep to LCL : Popliteus (a) ...Popliteal-Lat Fem Condyle bursa (b)  
...  
Menisco-Femoral ligament (c)

### Suggested Navigation to the LCL

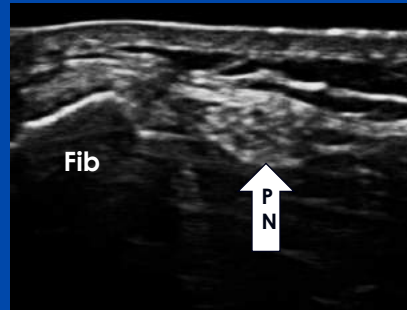
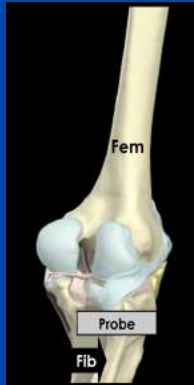
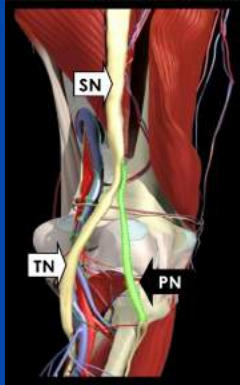


### The Knee Lateral Collateral Ligament Longitudinal



Normal LCL  
Slide probe slightly distal  
fibula is most superficial  
of 3 landmarks

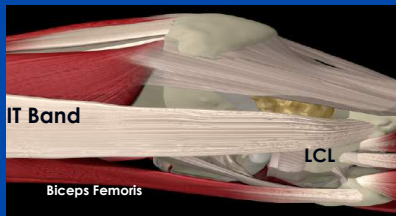
### The Knee Peroneal Nerve



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

### The Knee Lateral Collateral Ligament Longitudinal



**Fig. 1: Pre-PRP Ultrasound Image**  
Longitudinal image of LCL demonstrating dark/hypoechoic ligament (outlined by white arrows). Intra-substance bright/hyperechoic lesion/scar (white star)

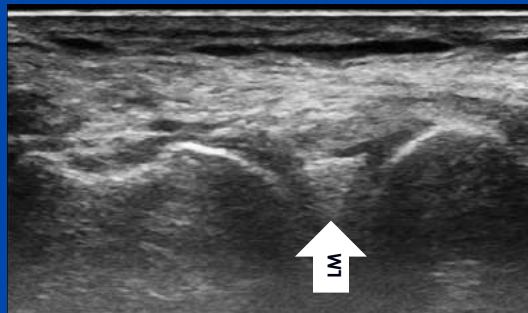
The Knee  
Lateral Meniscus Longitudinal



Lateral meniscus is more uniform in width than medial meniscus, covering more of the Tibial plateau

A “window” to view LM posterior horn is between ITB & Biceps Femoris

The Knee  
Lateral Meniscus Longitudinal



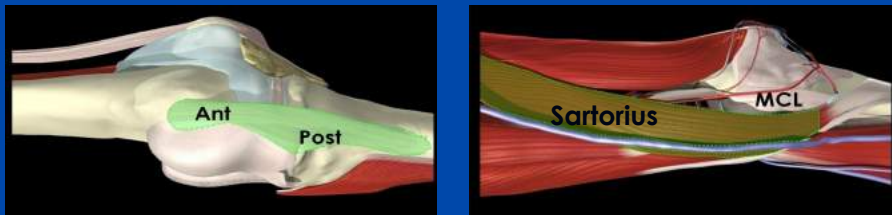
Lateral decubitus  
a bolus for  
varus stress

Extended knee  
Probe postero-lat  
slightly oblique.

Meniscus is hyperechoic  
triangle between the  
femoral condyle  
and tibia.

## The Knee Medial Imaging

### The Knee Medial Collateral Ligament Longitudinal



A flat band-like ligament nearly 9cm in length

Anterior and posterior portions give it a “tri-laminar” appearance, best seen at it’s proximal portion

Sartorius is adjacent posteriorly to MCL in LAX

## The Knee Medial Collateral Ligament Longitudinal



Supine patient  
with external  
rotation



Med  
Condyle

Tib

Trace the ligament proximally  
and distally

MCL is "tendon-like"...fibrillar

Dynamic valgus stress may  
reveal defects

## The Knee Medial Collateral Ligament

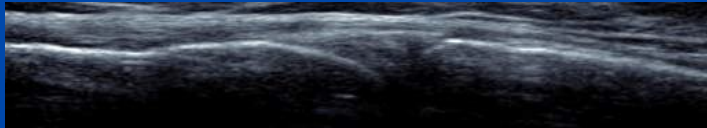


Multiple defects in MCL

Menisco-femoral portion  
and Tibial side

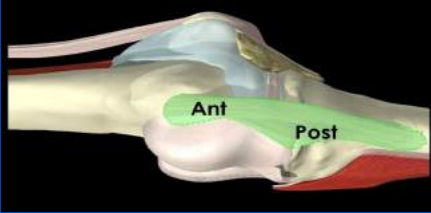
**The Knee  
US Data: Medial Knee**

- Medial Collateral Ligament
- Proximal Thickness      Distal Thickness
- 3.5mm                              2.0mm




- Pes Anserine Bursa: 2mm
- Medial Meniscus: Homogeneity/Stability

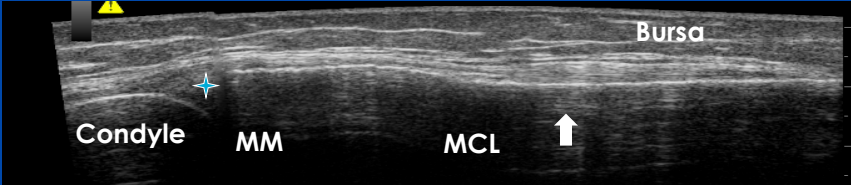
**The Knee  
MCL Longitudinal Distal Attachment**  
Not to be confused with the overlying Pes Anserinus Tendon



**Deep**



**Superficial**




Bursa is often seen deep to the “Goose’s Foot”.  
If distended, distinguish from a medial meniscal cyst



### The Knee

#### Pes Anserine Bursa Interface

Linear band superior to MCL




The image contains three anatomical and diagnostic views. The top left is a sagittal view of the knee joint with the anterior and posterior cruciate ligaments labeled 'Ant' and 'Post'. The top right is a lateral view of the knee showing the Sartorius muscle and its insertion point. The bottom image is a longitudinal B-mode ultrasound of the knee joint, with a white arrow pointing to a linear band of tissue superior to the medial collateral ligament (MCL).

### Pes Anserine Bursitis

Presence of Bursa is Minimal in Healthy Adults

Sonopalpation critical

US Exam: Measuring bursa, Addressing adjacent structures

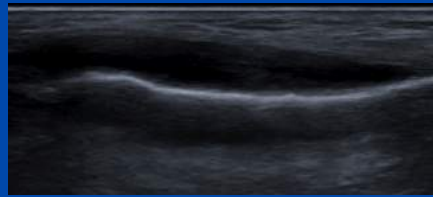


The image contains two diagnostic images. The top right is a coronal MRI scan of the knee joint, showing a bright signal in the region of the pes anserine bursa. The bottom right is a B-mode ultrasound image showing the pes anserine bursa and its relationship to the underlying structures.

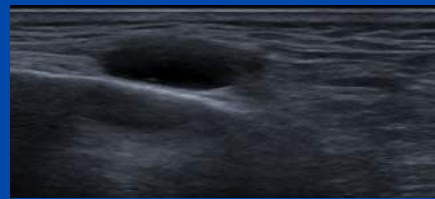
### The Knee Pes Anserine Bursal Effusion



Pes Tendon



Longitudinal View

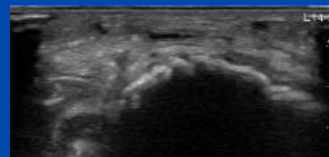


Short Axis View

### The Knee Periosteal Reaction/Inflammation Anterior Tibia



Longitudinal View

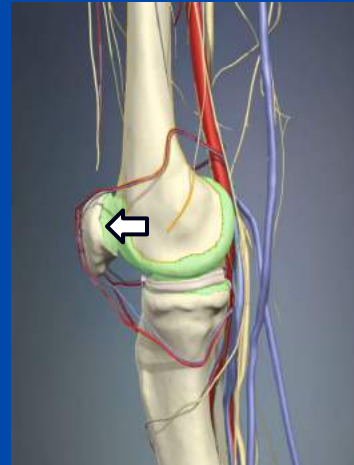


Short Axis View

### The Knee Medial Plica Syndrome

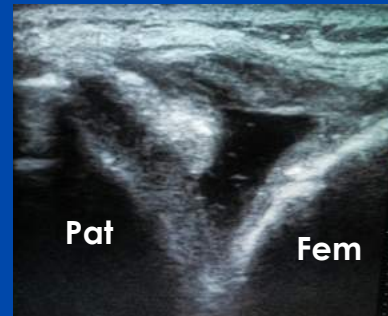
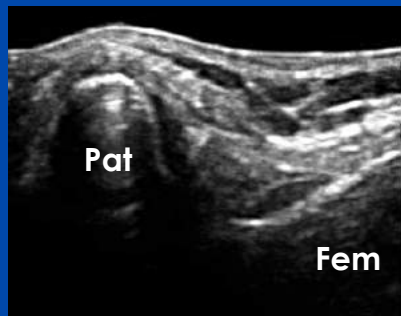


Young Adolescents  
30 ° Flexion  
Translate Patella Medially  
Loss of retro-patellar cartilage

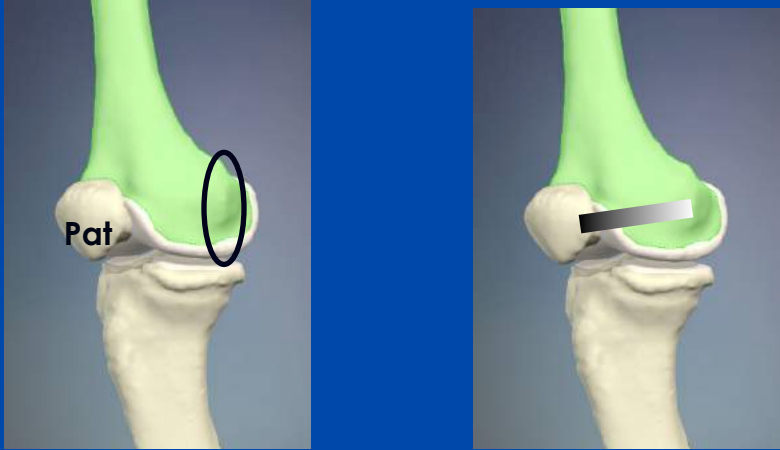


A ribbon-like fold of synovium  
Embryologic remnant  
Accumulation is retro-patellar

### The Knee Medial Plica Syndrome




**The Knee**  
**Medial Patello-Femoral Ligament**



A crucial medial stabilizer.  
Traverses from supero-medial patella to  
adductor tubercle of femur

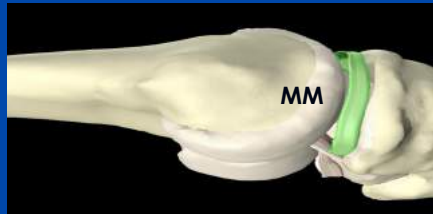
**The Knee**  
**Medial Patello-Femoral Ligament**



Axial probe placement at supero-medial patella,  
obliquely oriented onto adductor tubercle.

MPFL is the hyperechoic, middle portion of  
Medial Patellar Retinaculum

The Knee  
**Medial Meniscus Longitudinal**



From a postero-medial approach scan through superficial muscles to homogenously echogenic triangle of the deeper MM.

The Knee  
**Medial Meniscus Longitudinal**

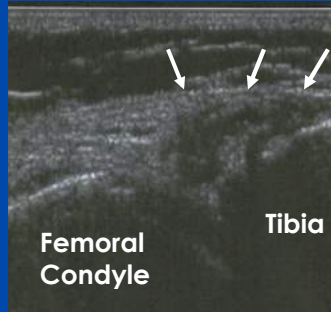


Patient supine  
 External rotation of leg  
 LAX probe

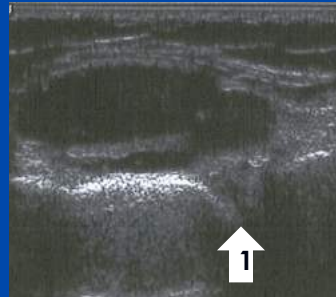
MCL is superficial to MM

Dynamic valgus stress  
 may demonstrate meniscal  
 excursion beyond  
 joint margin

## The Knee Meniscal Tears and Cysts



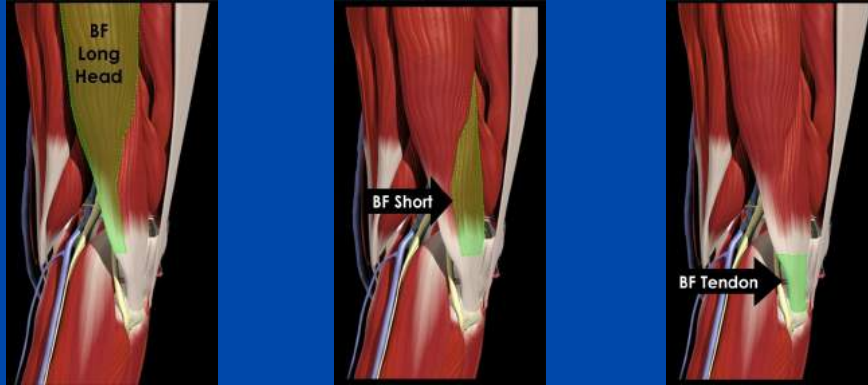
Meniscal tear with complex hypoechoic defects.



An intra-compartmental cyst adjacent to the meniscus (1) exhibiting a linear, anechoic cleft from a horizontal tear

## The Knee Posterior Imaging

### The Knee Postero-lateral : Biceps Femoris



One of the hamstring group

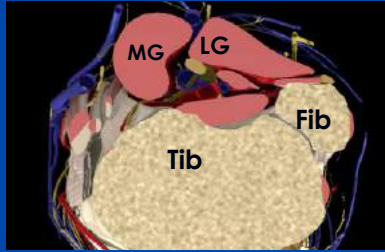
Tendon formed by Long and Short Head muscles  
Main attachment on posterior Fibula

### The Knee Postero-lateral : Biceps Femoris

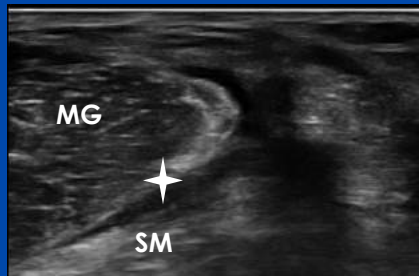


BF tendon attaches to Fibula  
Biceps muscle (short head) is deep to tendon as it is followed proximally (bfm)

## The Knee Popliteal Fossa in Cross-section



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 tendon



## The Knee Popliteal Fossa : Baker's Cyst



- True Baker's cyst ...
- \* is INTER-MUSCULAR
  - \* originates on medial side
  - \* has a distinct neck of origin



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



The Knee  
Popliteal Fossa : Baker's Cyst

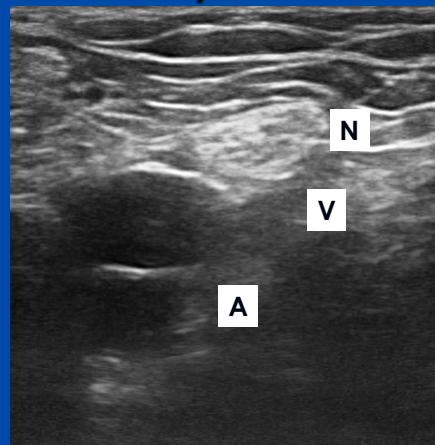


- True Baker's cyst ...
- \* is INTER-MUSCULAR
  - \* originates on medial side
  - \* has a distinct neck of origin

The Knee  
Popliteal Fossa : Baker's Cyst



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

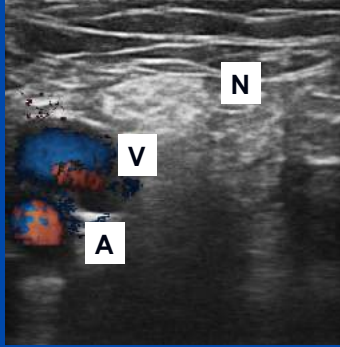
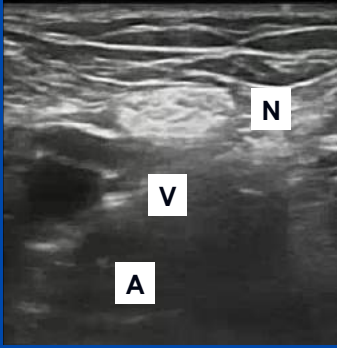


The medial Gastroc  
is seen In cross-section.  
The Nerve...Vein... Artery  
in a "Stack" formation

### The Knee

## Popliteal Fossa: Neuro-Vascular Bundle

The Nerve – Vein – Artery “Stack”

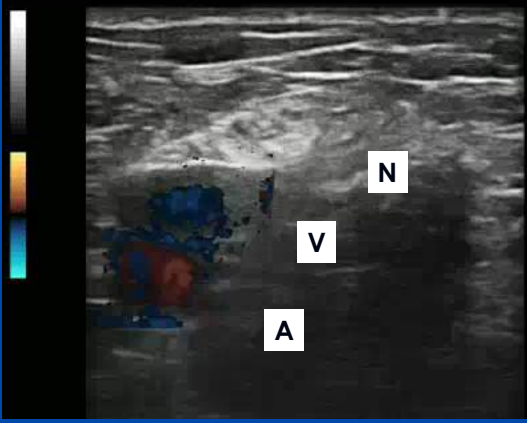
Sonopalpation allows localization of the...  
 HYPER-echoic Tibial nerve  
 Compressible Popliteal vein  
 Non-compressible ... Pulsatile Popliteal artery

### The Knee

## Deep Vein Thrombosis

Formation of a clot in a deep vein.

US Findings:  
Non-compressible...  
 Popliteal Vein



*Thank you !*

