Musculoskeletal Ultrasound Section

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Advanced Concepts in Sports Medicine
November 2015

Goals

Demystify musculoskeletal (MSK) ultrasound

Become well-acquainted with knee and shoulder ultrasound anatomy

Teach ultrasound-guided injection techniques

Knee Ultrasound

Anatomy, Pathology and Applications in Orthopedic Practice

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Disclosures

- Speaker: Sonosite, Arthrex
- Royalties: None
- Stock Options: None

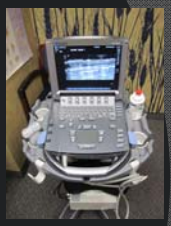
I do not intend to discuss any off-label use/ unapproved use of drugs or devices

Knee Ultrasound Learning Objectives

- What can you see?
- How do you see it?
- Recognizing pathology
- Therapeutic uses

Ultrasound Components

- Machine
  - Generates electrical signal for transducer
- Transducer
  - Converts electrical signal into sound waves and vice versa
  - Detects differential reflection by tissues to produce screen image
- Gel
  - Couples transducer to the soft tissues thus allowing transmission of sound waves



Uses for Ultrasound

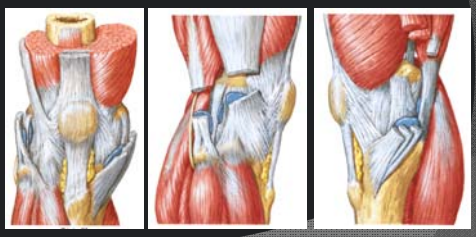
- Allows identification of normal and pathological anatomy
- Facilitates therapeutic interventions
  - Needle placement

No Ionizing radiation!

Real-time, dynamic imaging!

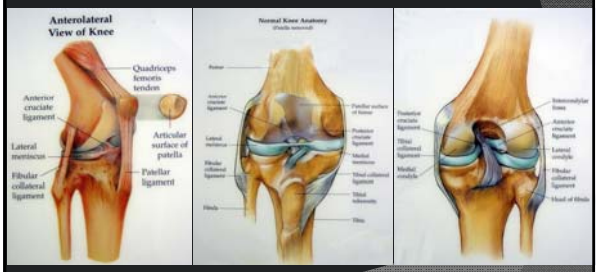
What Can You See?

Soft tissue anatomy (Muscles, Tendons, Bursae)

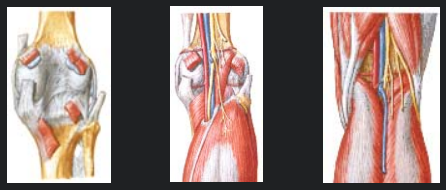


Meniscal Anatomy

Bone and Ligament Anatomy

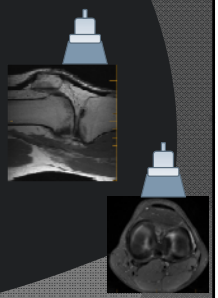


Neurovascular Structures



How do you see it?

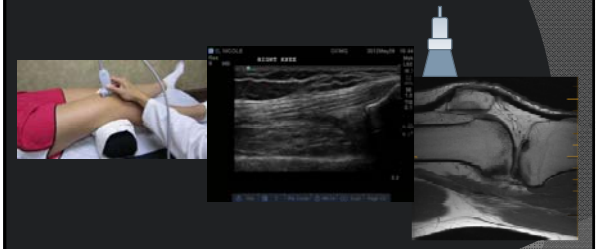
- Anterior, Medial, Lateral and Posterior approaches
- "Longitudinal" (or long axis): Transducer in-line or parallel with the long axis of the structure being examined
- "Transverse" (or short axis): Transducer perpendicular to the long axis or the structure being examined



Ultrasound Examination: Anterior

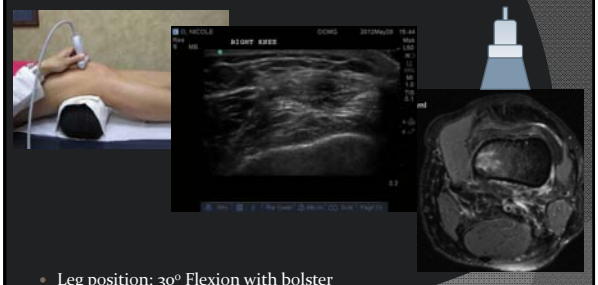
- Quadriceps tendon
- Patellar tendon
- Patella
- Trochlea
- Femoral condyles
- ACL

Quadriceps Tendon - Longitudinal



- Leg position: 30º Flexion with bolster
- Tip: Superior to patella
- MRI equivalent: Sagittal plane

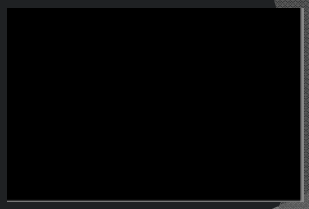
Quadriceps Tendon - Transverse



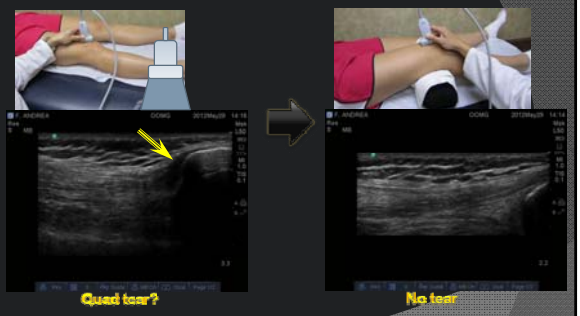
- Leg position: 30º Flexion with bolster
- Tip: Find longitudinal view and turn probe 90º
- MRI equivalent: Axial plane

Anisotropy

- Effect primarily seen with tendons and ligaments
- Artifact produced when sound waves are angled/ non-orthogonal relative to the long axis of a structure
- Corrected by fine movement or re-angulation of transducer or proper patient positioning

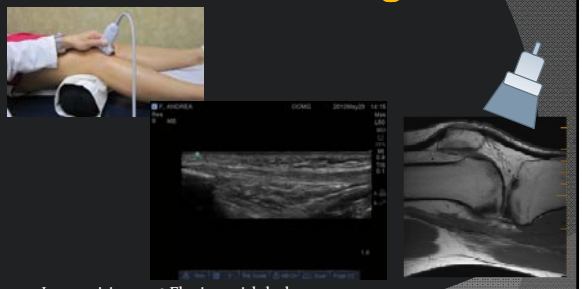


Anisotropy: Technique Matters!



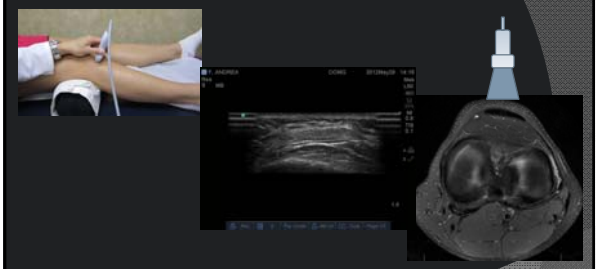
- Proper Leg position: Knee flexed 30 degrees
- Transducer angled perpendicular to tendon fibers = no anisotropy = no tear!

Patellar Tendon - Longitudinal



- Leg position: 30° Flexion with bolster
- Tip: Inferior to patella
- MRI equivalent: Sagittal plane

Patellar Tendon - Transverse

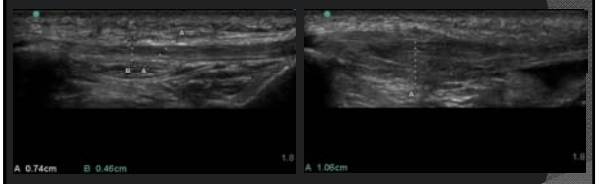


- Leg position: 30° Flexion with bolster
- Tip: Find longitudinal view and turn probe 90°
- MRI equivalent: Axial plane

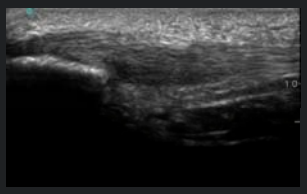
#1 Identify Normal

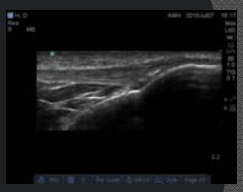
#2 Recognize Pathology

Patellar Tendonosis



Patellar Tendon – Long / Sup vs Inf





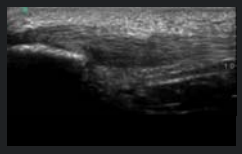
Origin

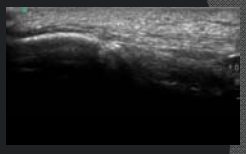
Insertion

- Origin: More common area of tendonopathy
- Insertion: May see evidence of Osgood-Schlatter

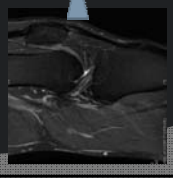
Courtesy of A. Hirahara, MD

Partial Patellar Tendon Tear Treated with ACP



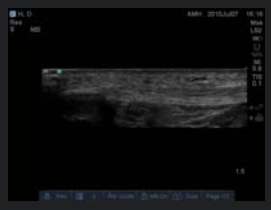


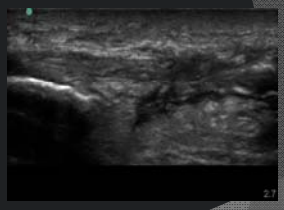
3 Months



Courtesy of A. Hirahara, MD

Patellar Tendon Rupture



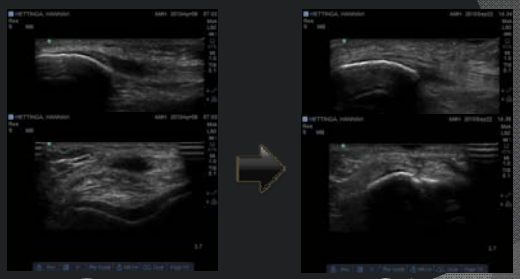


Normal

Rupture

Courtesy of A. Hirahara, MD

Patellar Tendon Repair



Courtesy of A. Hirahara, MD

Trochlea

- Leg position: Full Flexion
- Tip: Superior to patella
- MRI equivalent: Axial plane

Femoral Condyles - Anterior

- Leg position: Full Flexion
- Tip: Superior to patella
- MRI equivalent: Sagittal plane

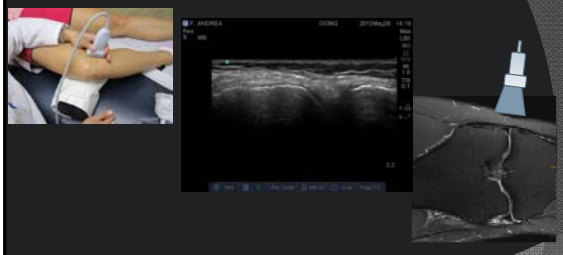
ACL

- Leg position: Full Flexion
- Tip: Transpatellar tendon, tilt probe in plane with ligament
- MRI equivalent: Sagittal plane

Ultrasound Examination: Medial

- MCL
- Medial Meniscus
- MPFL
- Pes anserine insertion/ bursae

MCL



- Leg position: 30° Flexion; Hip externally rotated
- Tip: Find medial epicondyle and follow to joint
- MRI equivalent: Coronal plane

MCL Tear at Insertion

Normal Rupture

Courtesy of A. Hirahara, MD

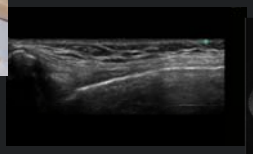
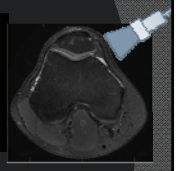
MCL Insufficiency

Courtesy of A. Hirahara, MD

Medial Meniscus

- Leg position: 30º Flexion; Hip externally rotated
- Tip: After finding medial meniscus, follow joint anterior / posterior
- MRI equivalent: Coronal plane

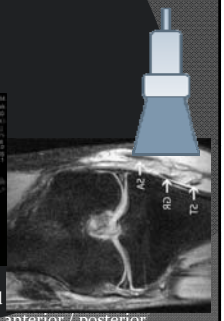
MPFL

- Leg position: 30º Flexion; Hip externally rotated
- Tip: Find patellar insertion and follow towards adductor tubercle
- MRI equivalent: Axial "oblique"

Pes Anserine Insertion





- Leg position: 30º Flexion; Hip externally rotated
- Tip: After finding medial meniscus, follow joint anterior / posterior
- MRI equivalent: Coronal plane

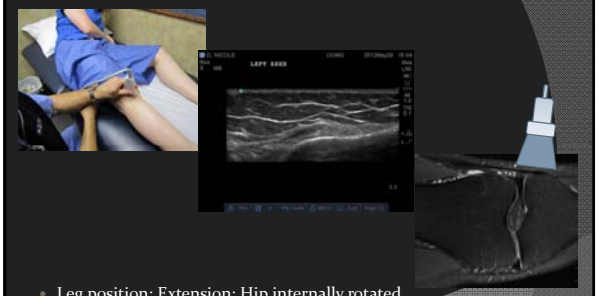
Ultrasound Examination: Lateral

- LCL
- ITB
- Lateral meniscus
- Popliteus

LCL

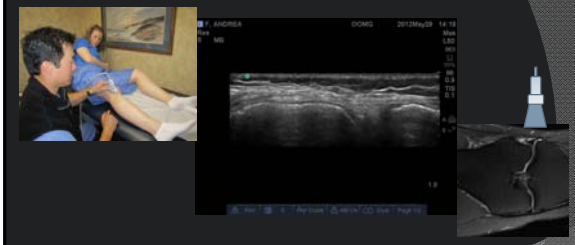
- Leg position: 30° Flexion; Hip internally rotated
- Tip: Find fibular head and follow to lateral epicondyle
- MRI equivalent: Coronal plane

IT Band



- Leg position: Extension; Hip internally rotated
- Tip: Find Gerdy' s tubercle and follow proximally
- MRI equivalent: Coronal plane

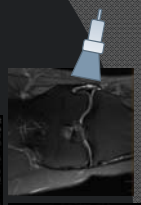
Lateral Meniscus



- Leg position: Extension; Hip internally rotated
- Tip: Find lateral joint line. Stay perpendicular to joint line
- MRI equivalent: Coronal plane

Popliteus





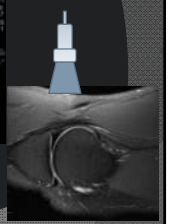

- Leg position: 30º Flexion; Hip internally rotated
- Tip: Angle probe, find groove in condyle laterally under LCL
- MRI equivalent: Coronal plane

Ultrasound Examination: Posterior

- Menisci (Posterior Horns)
- Femoral Condyles
- PCL
- Gastrocnemius
- Hamstrings
- Popliteal artery & vein

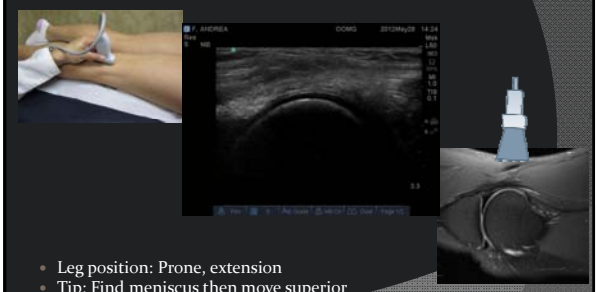
Posterior Horn Meniscus





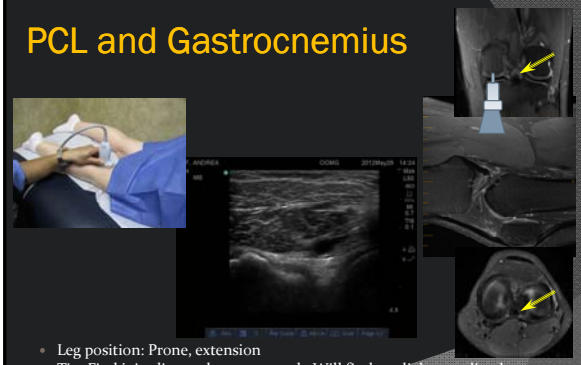
- Leg position: Prone, extension
- Tip: Find joint line and move over medial knee
- MRI equivalent: Sagittal plane

Posterior Condyles



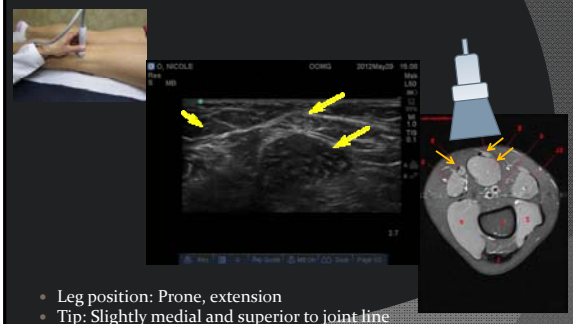
- Leg position: Prone, extension
- Tip: Find meniscus then move superior
- MRI equivalent: Sagittal plane

PCL and Gastrocnemius



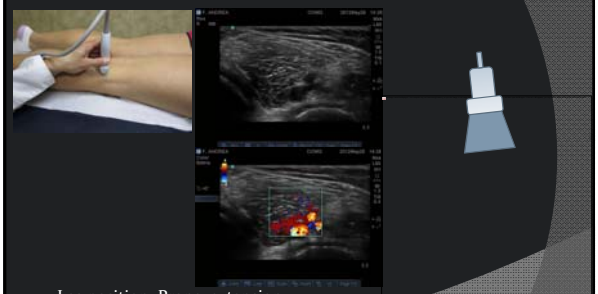
- Leg position: Prone, extension
- Tip: Find joint line and move central. Will find medial to popliteal a.
- MRI equivalent: Sagittal plane

Hamstrings



- Leg position: Prone, extension
- Tip: Slightly medial and superior to joint line
- MRI equivalent: Axial plane

NV Structures - Transverse



- Leg position: Prone, extension
- Tip: Center of posterior knee. Compression to identify artery/vein.
- MRI equivalent: Axial plane

Therapeutic Uses

- Injections
  - Steroids
  - HA
  - PRP
  - Stem cells
- Aspiration
  - Hematoma
  - Joint effusions
  - Cysts

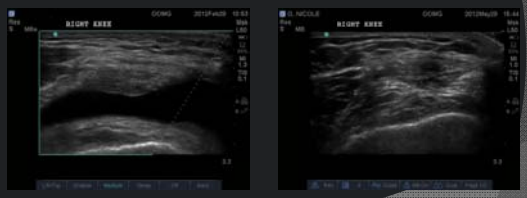
Summary

- Ultrasound utilizes sound waves to allow dynamic, real-time imaging without radiation
- Allows identification of normal and pathological anatomy
- Facilitates therapeutic intervention
- Dramatically improves accuracy of needle placement and can benefit patient outcomes

Thank You

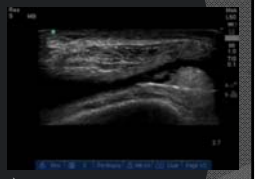
Ultrasound Improves Injection Accuracy

- FACT: Anatomical or landmark based injections often miss their intended target.
- FICTION: Other physicians may miss, but I don't



Accuracy of Knee Injections

- 7-29% of knee injections are NOT intra-articular
  - Jackson(2002)
- Needle placement accuracy ranges from 39-100%
  - Avg 22.2% miss rate
  - Berkoff (2012)
- Sibbitt et al. (2009)
  - 43% reduction in procedural pain ($p < 0.001$)
  - 59% reduction ($p < 0.001$) in absolute pain scores at 2 weeks vs. anatomical-guided injections



Ultrasound-Guided Knee Injections

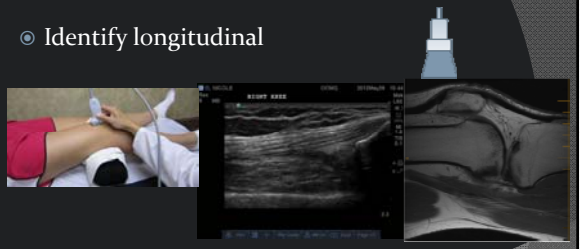
- FICTION: Using ultrasound in my office takes too long
- FACT: Proper US incorporation for in-office injections adds negligible time

Ultrasound-Guided Knee Injections

- FICTION: Using ultrasound in my office takes too long
- FACT: Proper US incorporation for in office injections adds negligible time

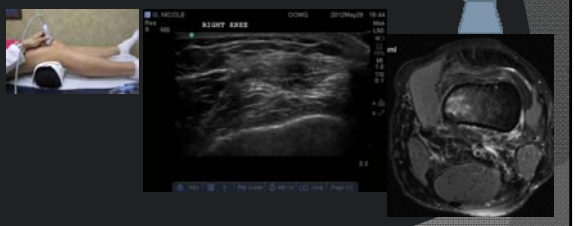
Knee Injections: In-Plane Technique

- Identify longitudinal



Knee Injections: In-Plane Technique

- Swivel Transverse



Knee Injections

- Superolateral approach into pouch
- Beware of pre-femoral fat pad