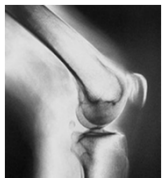
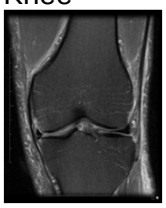
MRI of the Knee

Jennifer Swart, M.D.
Musculoskeletal Radiology
South Texas Radiology Group

Financial Disclosure

Dr. Jennifer Swart has no relevant financial relationships with commercial interests to disclose.

Outline

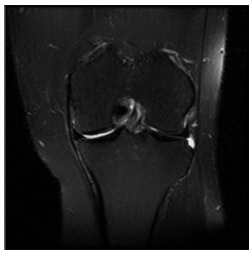
- Coils, Patient Positioning
- Acquisition Parameters, Planes and Pulse Sequences
- Knee Arthrography
- Normal Anatomy
- Abnormal Anatomy (Injury Patterns)
- High Field MRI (3.0T Magnets)

Imaging Details

- Supine Positioning
- Slight external rotation
- Dedicated knee coil
  - 8 channel
- 14 to 16 cm field of view
- 2.5 to 5 mm slice thickness
- Rarely use intravenous gadolinium
- Exam time 15 minutes

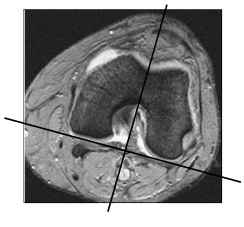
MRI Pulse Sequences

- T1 weighted Sequences
  - Fat sensitive
  - Good anatomic resolution
- Proton Density Sequences
  - Fat and fluid sensitive
  - Best anatomic resolution
- T2 Fat Saturated Sequences
  - Fluid sensitive, all else dark
  - Pathology sequence
  - Poor anatomic resolution

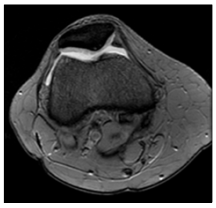


MRI Acquisition Planes

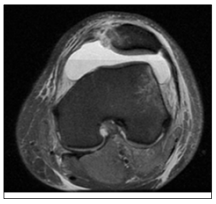
- Scout Image
  - Find the knee in the magnetic field
- Axial Images
  - Parallel to tibial plateau
- Coronal Images
  - Parallel to posterior margin of femoral condyles
- Sagittal Images
  - Perpendicular to sagittal plane



Axial Images

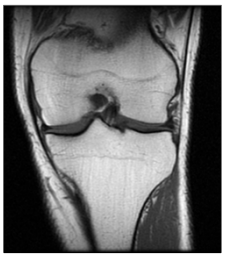


Axial MPGR

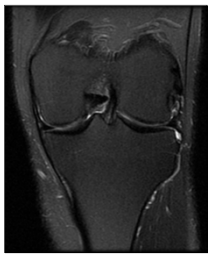


Axial T2 FS

Coronal Images

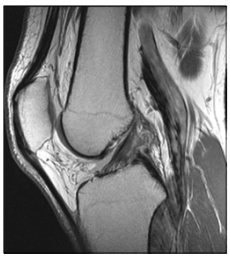


Coronal T1

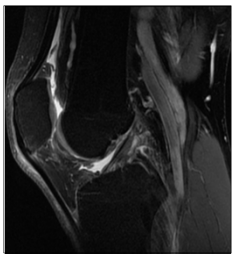


Coronal T2 FS

Sagittal Images



Sagittal PD



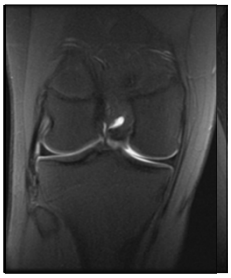
Sagittal T2 FS

MR Knee Arthrography

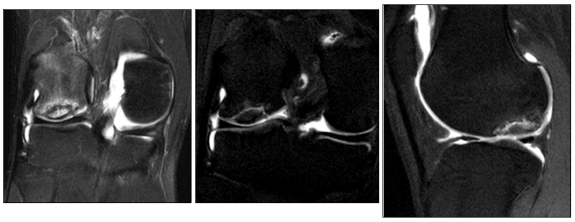
- Infrequently Performed
- Allows T1 weighted imaging for best spatial resolution
- Mainly used in cartilage and post-operative meniscus assessment
- Fluoroscopically guided
- Anterior approach with 25 g needle
- 20-30cc Dilute Gadolinium injected
- MR performed within 45 minutes after exercise

MR Arthrogram Images

- Distended joint, gadolinium fills tears in structures that line the joint
- Sequences: T1 axial, coronal, sagittal with fat saturation
  - Only bright structure is gadolinium
- Coronal T1 no fat saturation
- Sagittal T2 with fat saturation

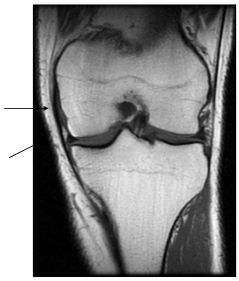


MR Arthrogram Knee
Loose Osteochondral Lesion

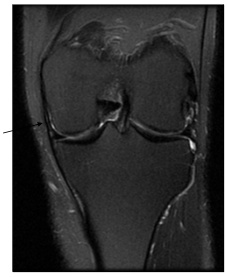


Coronal T2 Fat Sat Coronal T1 Post Gad Fat Sat Sagittal T1 Post Gad Fat Sat

Normal Anatomy: Medial Collateral Ligament (MCL)

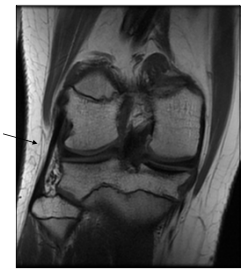


Coronal T1

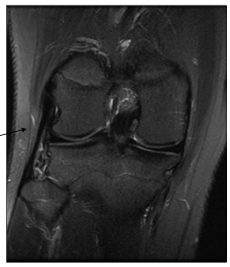


Coronal T2 Fat Sat

Normal Anatomy: Lateral Collateral Ligament (LCL or FCL)

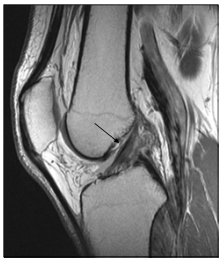


Coronal T1

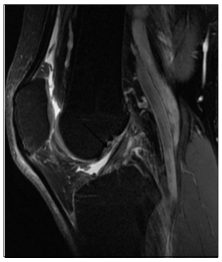


Coronal T2 Fat Sat

Normal Anatomy: Anterior Cruciate Ligament (ACL)

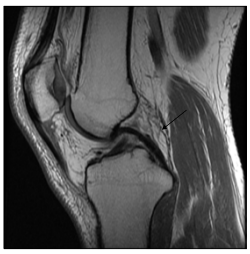


Sagittal PD

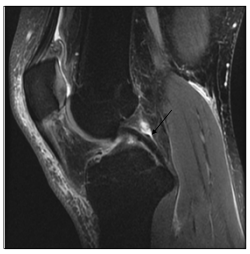


Sagittal T2 Fat Sat

Normal Anatomy: Posterior Cruciate Ligament (PCL)

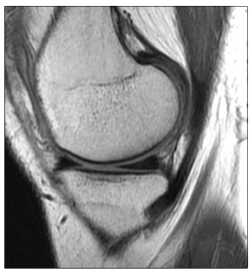


Sagittal PD

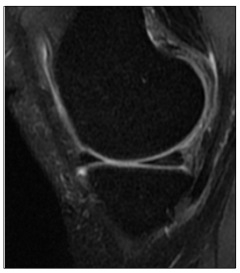


Sagittal T2 Fat Sat

Normal Anatomy: Medial Meniscus

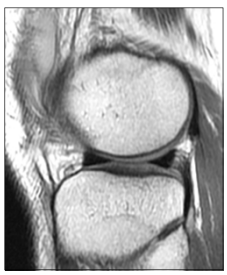


Sagittal PD

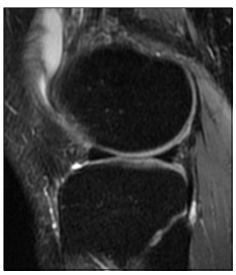


Sagittal T2 Fat Sat

Normal Anatomy: Lateral Meniscus

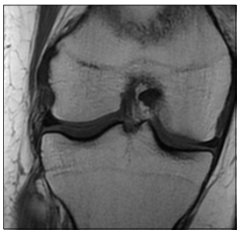


Sagittal PD

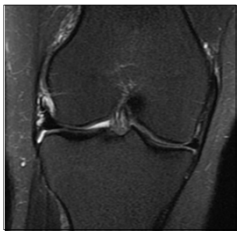


Sagittal T2 Fat Sat

Normal Anatomy: Coronal Plane Menisci



Coronal T1

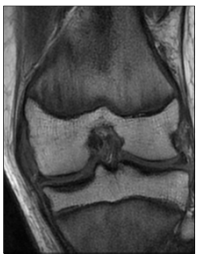


Coronal T2 Fat Sat

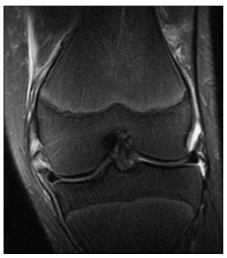
Interpreting Knee MR

- Systematic, disciplined approach is crucial
  - Don't go for the money
- Structured Report
  - Menisci
  - Cruciates
  - Extensor Mechanism
  - Collaterals
  - Cartilage
  - Fluid
  - Bone Marrow
- Look for Injury Patterns
- Address the clinical question

Grade 2 MCL Sprain

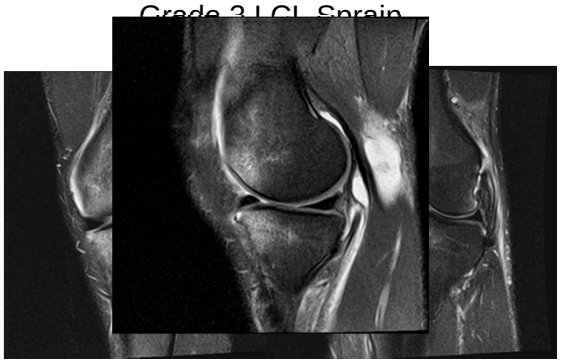


Coronal T1



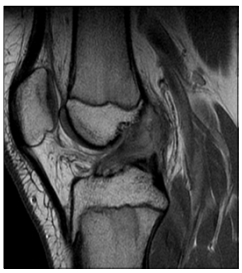
Coronal T2 Fat Sat

Grade 3 LCL Sprain

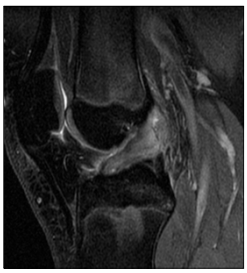


Coronal T2 fat sat

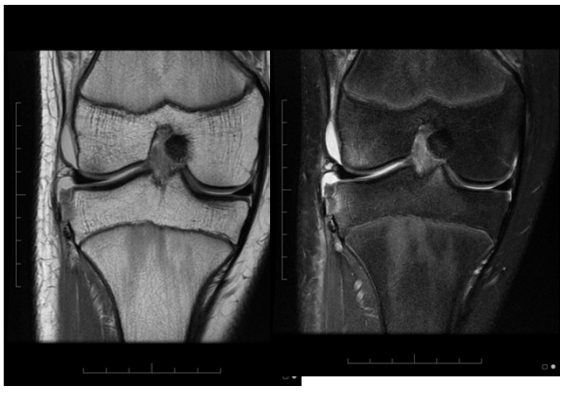
Acute Interstitial ACL Tear



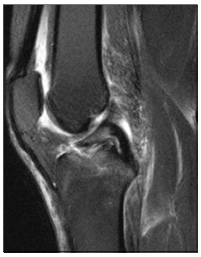
Sagittal PD



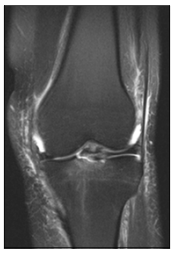
Sagittal T2 Fat Sat



ACL Avulsion

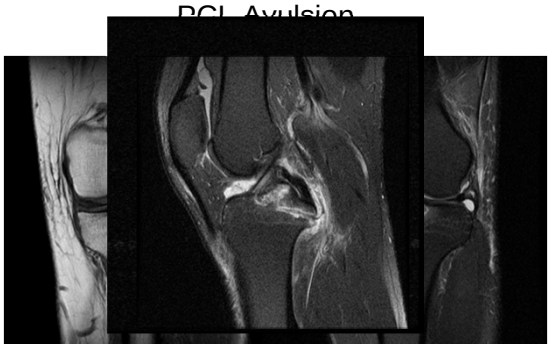


Sagittal T2 Fat Sat



Coronal T2 Fat Sat

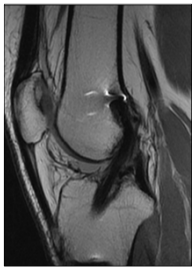
PCL Avulsion



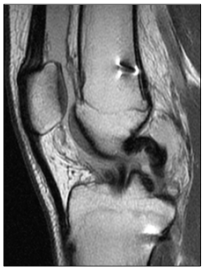
Coronal T1

Coronal T2 fat sat

ACL Graft Tear

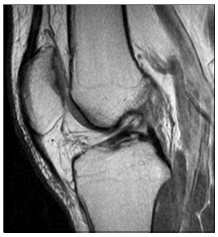


Intact ACL Graft
Sagittal PD

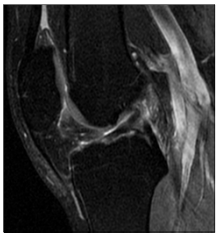


Torn ACL Graft
Sagittal PD

Chronic ACL Tear

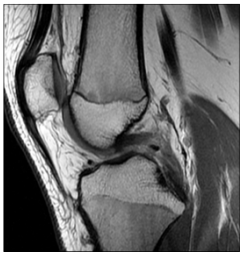


Sagittal PD

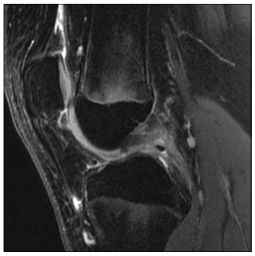


Sagittal T2 Fat Sat

Acute PCL Tear

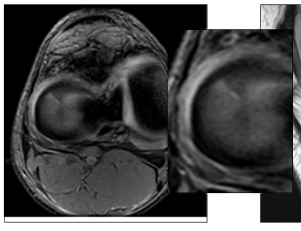


Sagittal PD

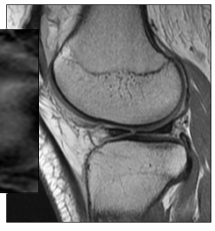


Sagittal T2 Fat Sat

Radial Lateral Meniscus Tear

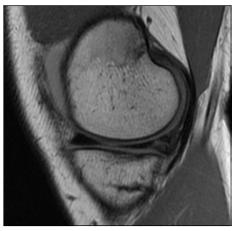


Axial MPGR

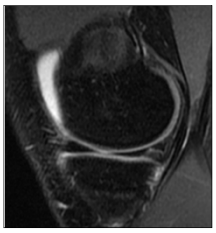


Sagittal PD

Complex Medial Meniscus Tear

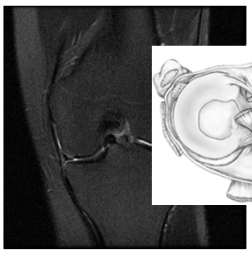


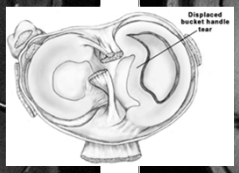
Sagittal PD

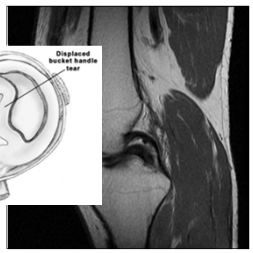


Sagittal T2 Fat Sat

Bucket Handle Medial Meniscus Tear



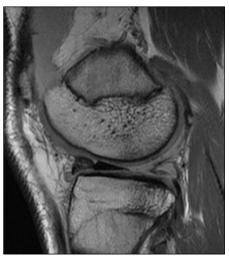




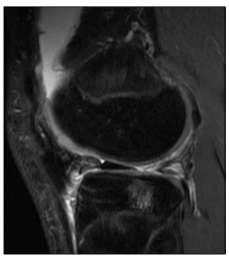
Coronal T2 Fat Sat

Sagittal PD

Flipped Locked Lateral Meniscus Tear

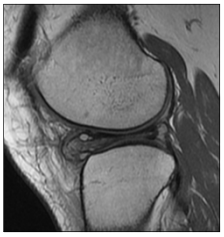


Sagittal PD

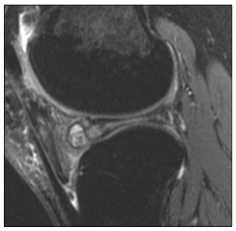


Sagittal T2 Fat Sat

Discoid Lateral Meniscus Tear

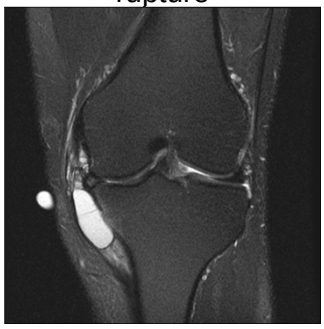


Sagittal PD

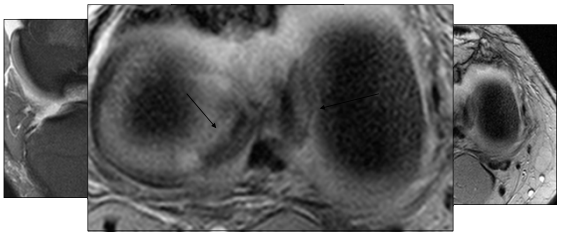


Sagittal T2 Fat Sat

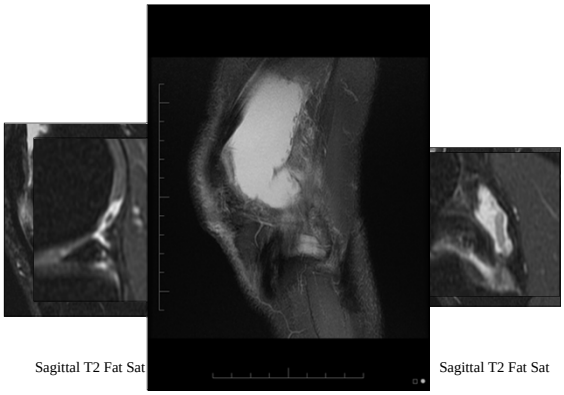
Parameniscal Cyst presenting as mass - percutaneous aspiration and rupture



Medial and Lateral Bucket Handle Tears



Sagittal T2 Fat Sat Coronal T2 Fat Sat Axial MPGR



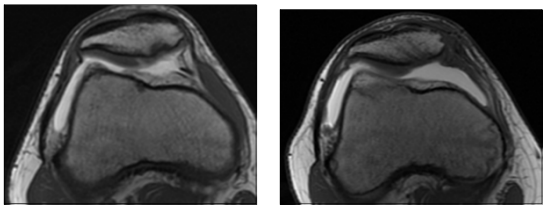
Sagittal T2 Fat Sat

Sagittal T2 Fat Sat

Post Intervention Cartilage Assessment

Pre-Microfracture

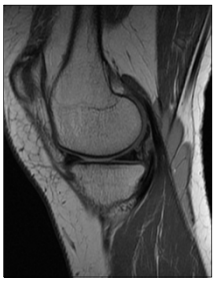
Post-Microfracture

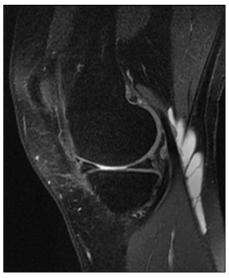


Axial T1 Post Arthrogram

Axial T1 Post Arthrogram

Baker's Cysts

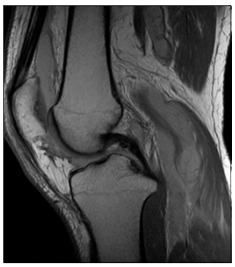




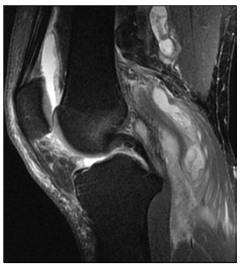
Sagittal PD

Sagittal T2 Fat Sat

Baker's Cyst Rupture

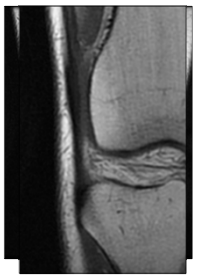


Sagittal PD

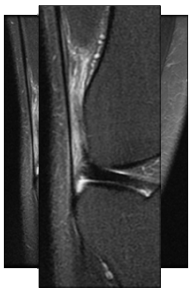


Sagittal T2 Fat Sat

IT Band Friction Syndrome

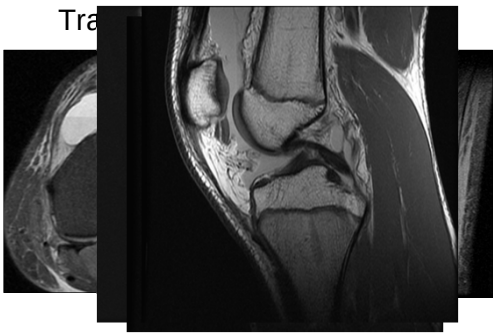


Coronal T1



Coronal T2 Fat Sat

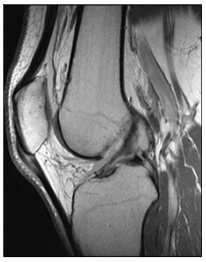
Tra



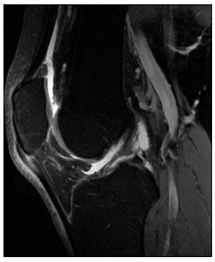
Axial T2 Fat Sat

Coronal T2 Fat Sat

Jumper's Knee (Infrapatellar Tendonopathy)

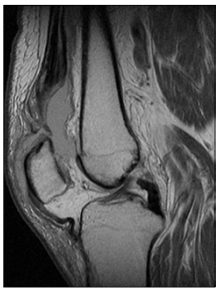


Sagittal PD

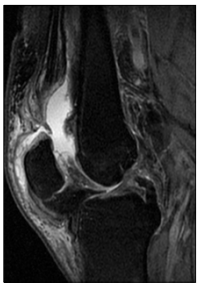


Sagittal T2 Fat Sat

Quadriceps Tendon Rupture

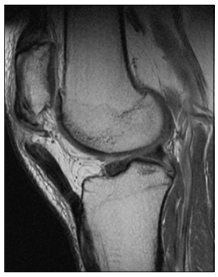


Sagittal PD

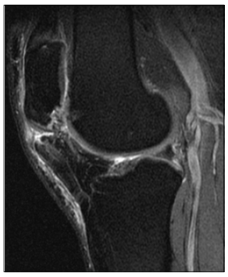


Sagittal T2 Fat Sat

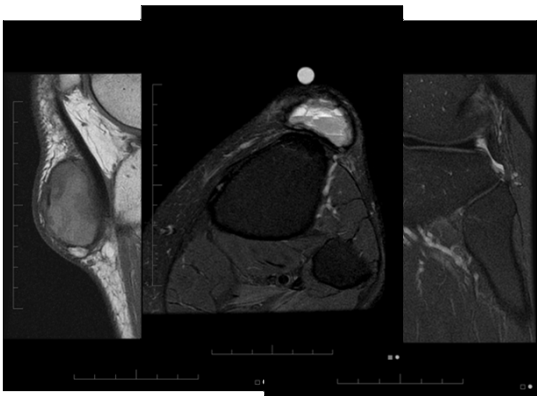
Infrapatellar Tendon Rupture



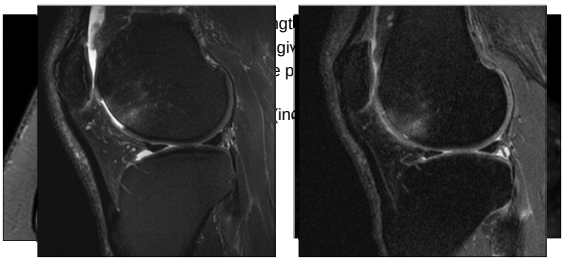
Sagittal PD



Sagittal T2 Fat Sat



Recent Advances: High Field MRI
3.0 Tesla versus 1.5 Tesla MRI

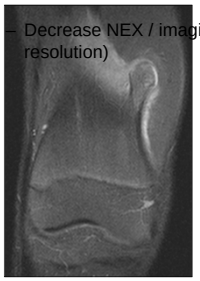


Sagittal T2 Fat Sat 3.0T

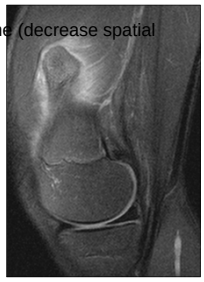
Sagittal T2 Fat Sat 1.5T

Exostotic Osteochondroma

– Decrease NEX / imaging time (decrease spatial resolution)

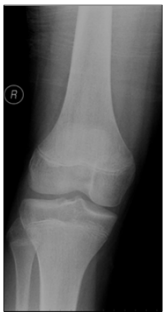


Coronal T2 Fat Sat

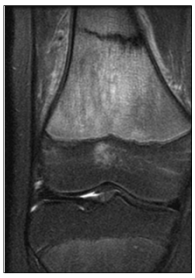


Sagittal T2 Fat Sat

Fractures

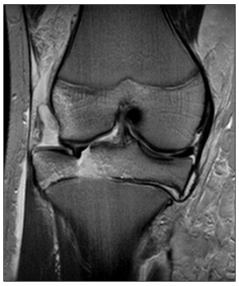


Radiograph

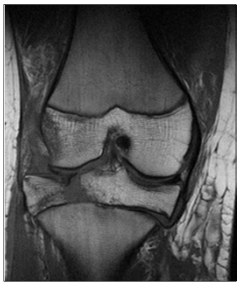


Coronal T2 Fat Sat

Fractures



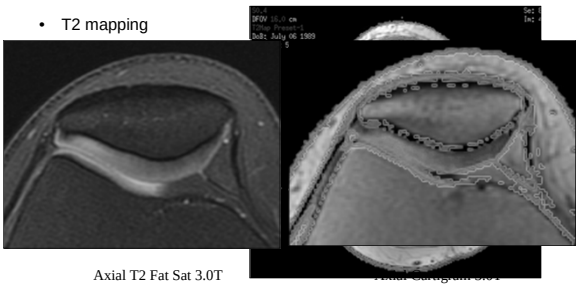
Coronal T2 Fat Sat



Coronal T1

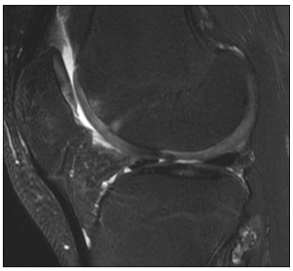
Cartilage Mapping

- T2 mapping

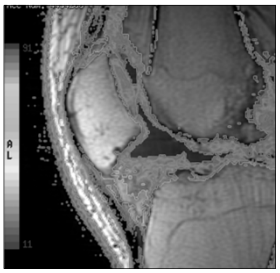


Axial T2 Fat Sat 3.0T

Cartilage Mapping

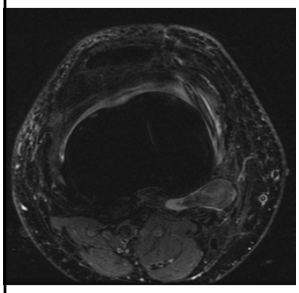


Sagittal T2 Fat Sat 3.0T

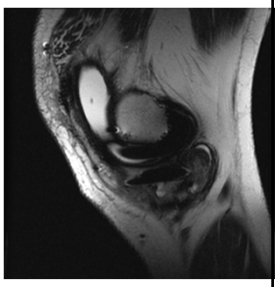


Sagittal Cartigram 3.0T

MARS (metal artifact reduction sequence)



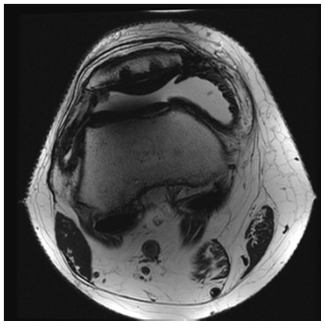
Axial STIR



Sagittal T2

MARS prosthesis imaging

Axial T2



Summary

- MRI plays an indispensable role in the evaluation of knee injuries.
- Intra-articular and Intravenous gadolinium are not routinely required in the assessment of knee injuries.
- High field MR systems increase diagnostic sensitivity, particularly of cartilage lesions.
- Accept nothing less than the interpretation of a specialized musculoskeletal radiologist.
- Always correlate imaging findings with clinical examination and discuss discrepancies with your radiologist.