MRI of the Knee

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

1

Outline

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

2

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

3

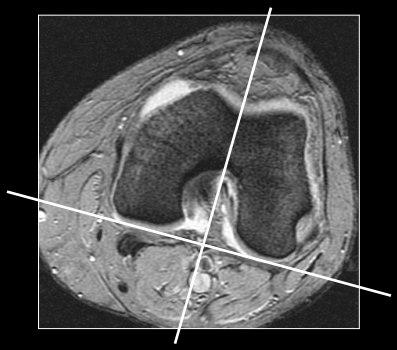
MRI Pulse Sequences

- 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

4

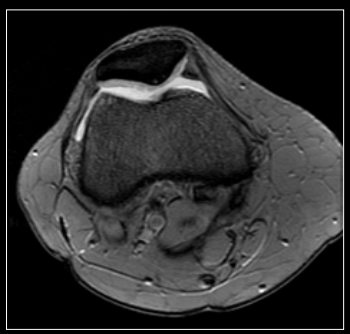
MRI Acquisition Planes

- 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

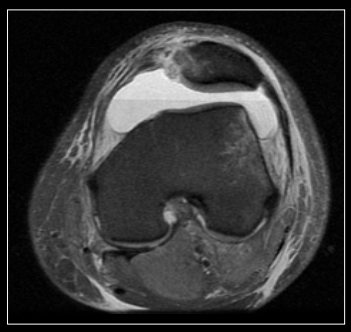


5

Axial Images



Axial MPGR



Axial T2 FS

6

Coronal Images

Coronal T1

Coronal T2 FS

7

Sagittal Images

Sagittal PD

Sagittal T2 FS

8

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

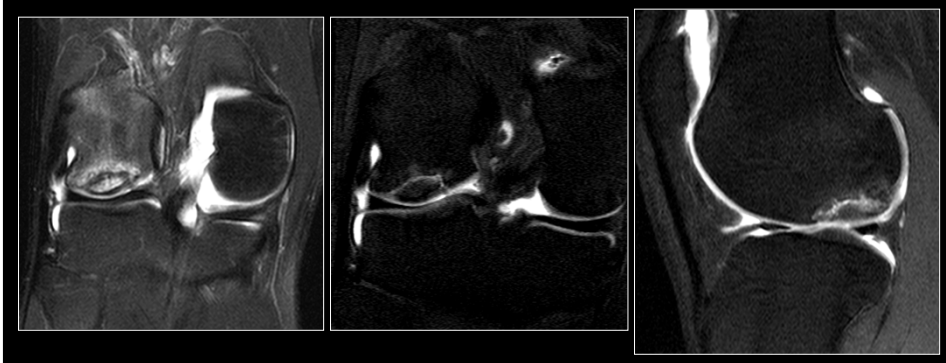
9

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

10

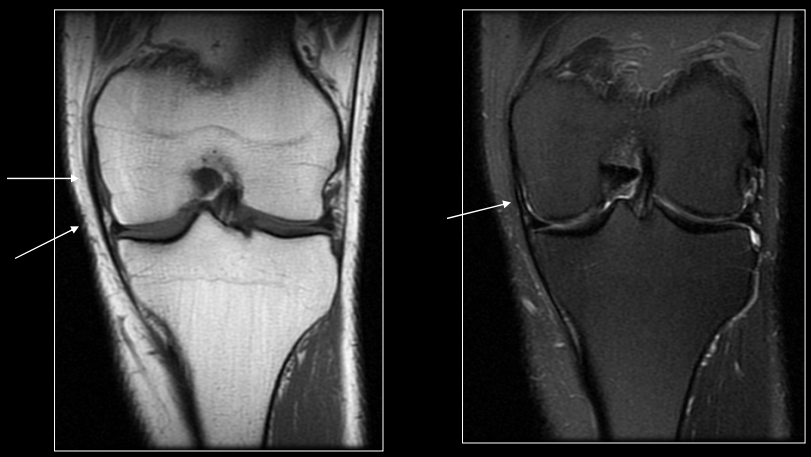
MR Arthrogram Knee
Loose Osteochondral Lesion



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

11

Normal Anatomy: Medial Collateral Ligament (MCL)



Coronal T1 | Coronal T2 Fat Sat

12

Normal Anatomy: Lateral Collateral Ligament (LCL or FCL)

Coronal T1

Coronal T2 Fat Sat

13

Normal Anatomy: Anterior Cruciate Ligament (ACL)

Sagittal PD

Sagittal T2 Fat Sat

14

Normal Anatomy: Posterior Cruciate Ligament (PCL)

Sagittal PD

Sagittal T2 Fat Sat

15

Normal Anatomy: Medial Meniscus

Sagittal PD

Sagittal T2 Fat Sat

16

Normal Anatomy: Lateral Meniscus

Sagittal PD

Sagittal T2 Fat Sat

17

Normal Anatomy: Coronal Plane Menisci

Coronal T1

Coronal T2 Fat Sat

18

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

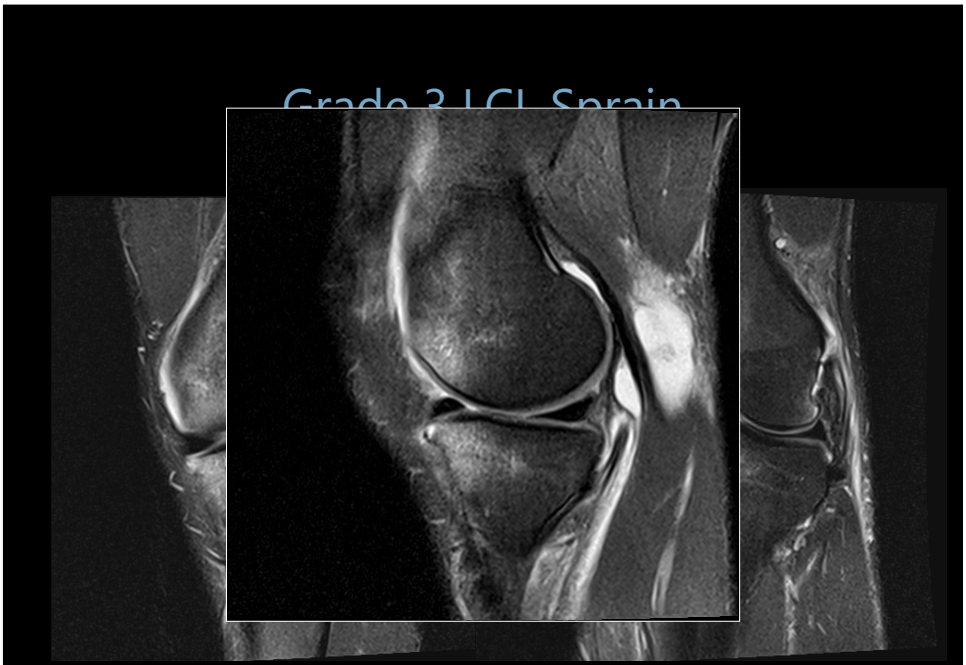
19

Grade 2 MCL Sprain

Coronal T1

Coronal T2 Fat Sat

20



Coronal T2 fat sat

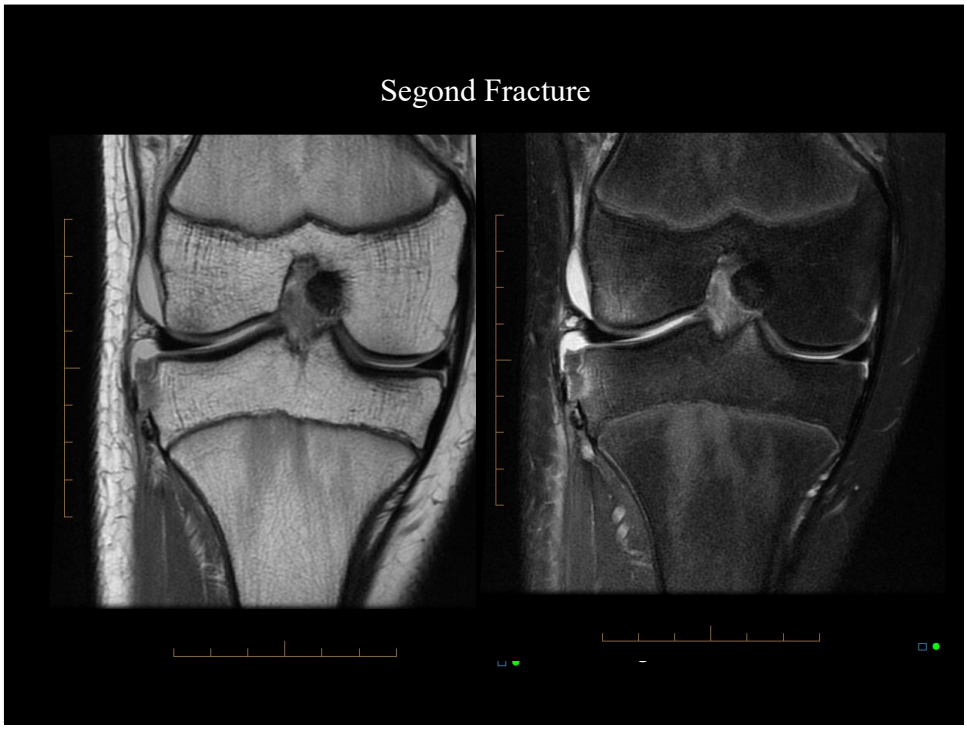
21

Acute Interstitial ACL Tear

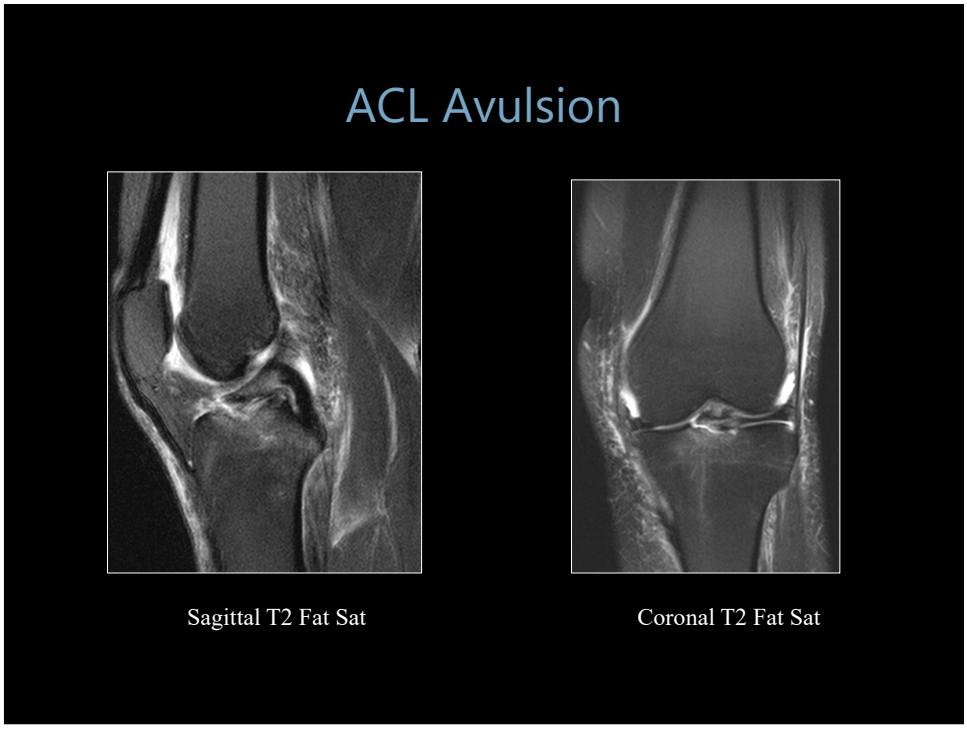
Sagittal PD

Sagittal T2 Fat Sat

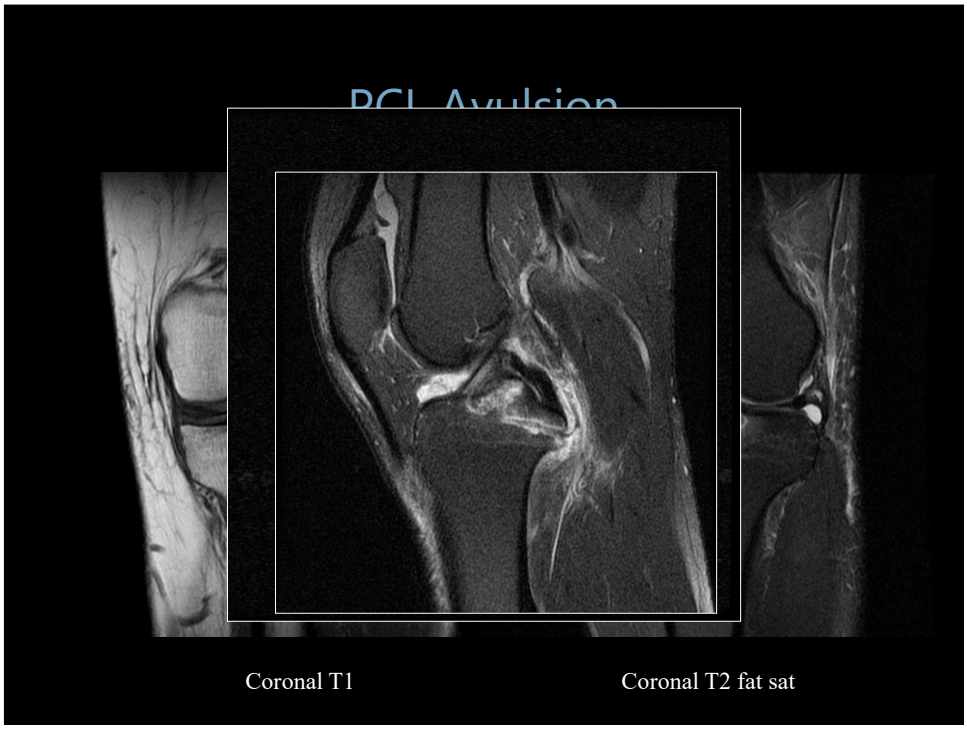
22



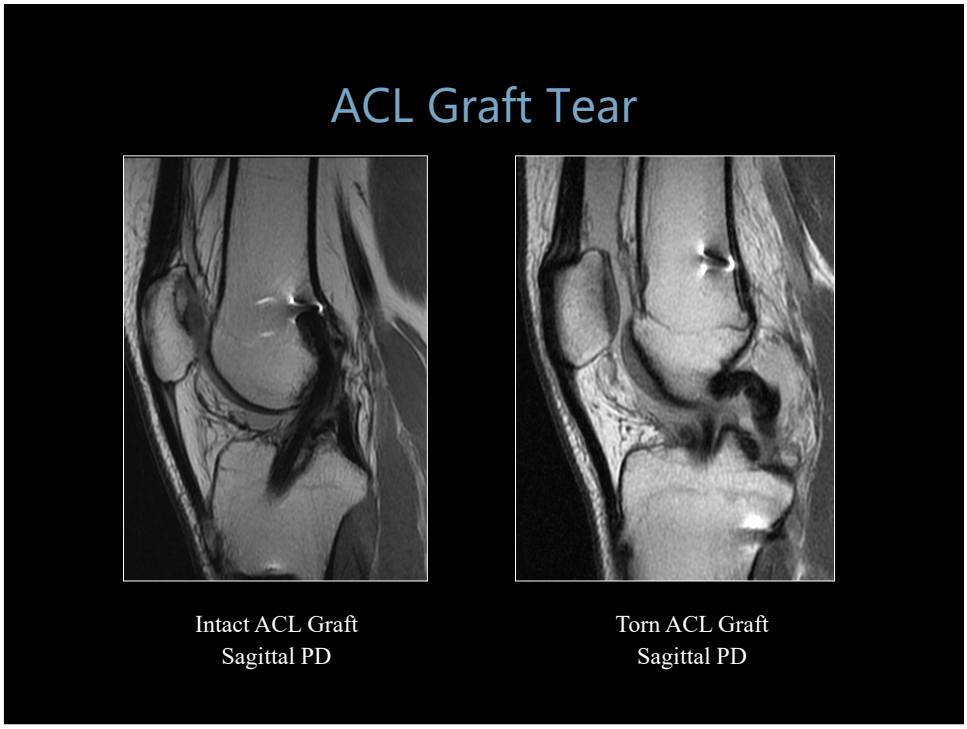
23



24



25



26

Chronic ACL Tear

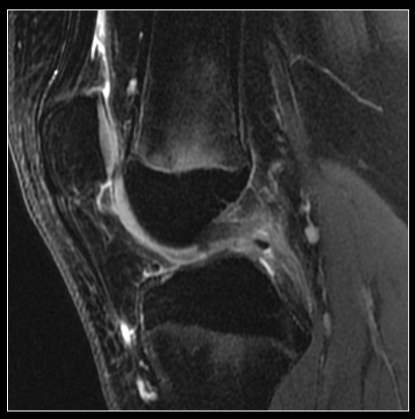
Sagittal PD

Sagittal T2 Fat Sat

27

Acute PCL Tear

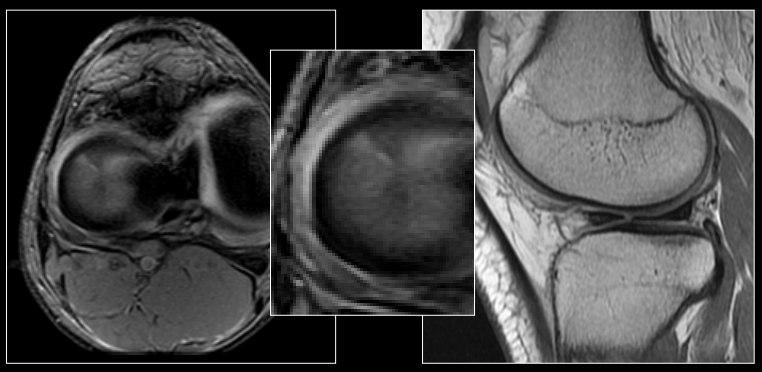
Sagittal PD



Sagittal T2 Fat Sat

28

Radial Lateral Meniscus Tear

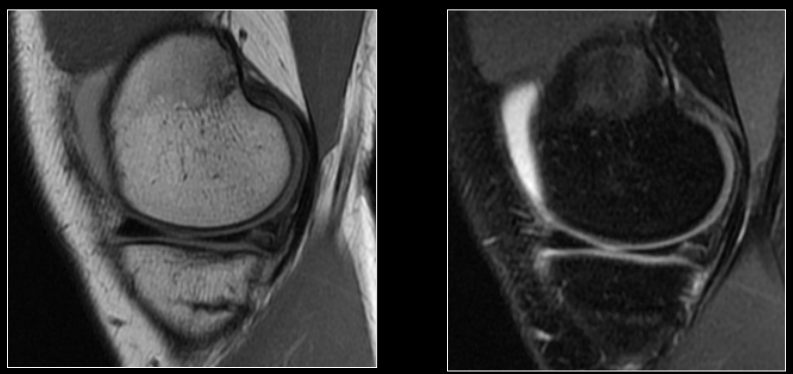


Axial MPGR

Sagittal PD

29

Complex Medial Meniscus Tear

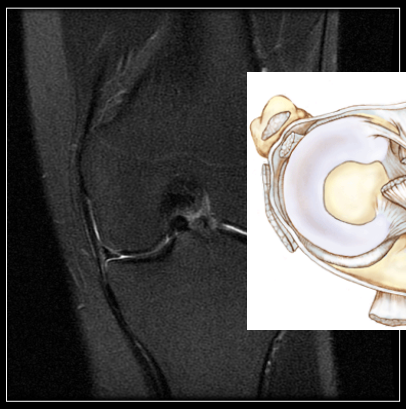


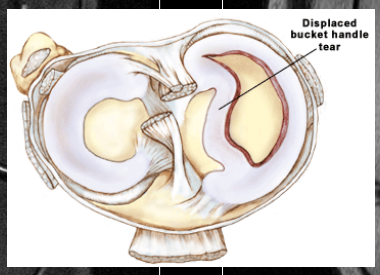
Sagittal PD

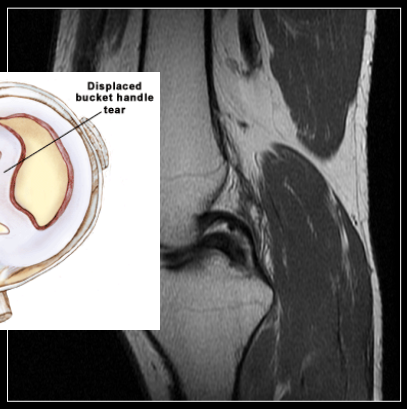
Sagittal T2 Fat Sat

30

Bucket Handle Medial Meniscus Tear







Coronal T2 Fat Sat

Sagittal PD

31

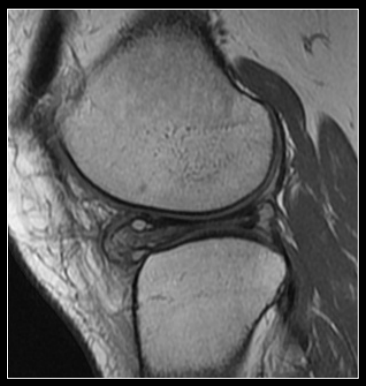
Flipped Locked Lateral Meniscus Tear

Sagittal PD

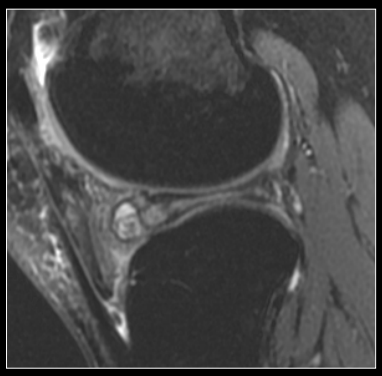
Sagittal T2 Fat Sat

32

Discoid Lateral Meniscus Tear



Sagittal PD

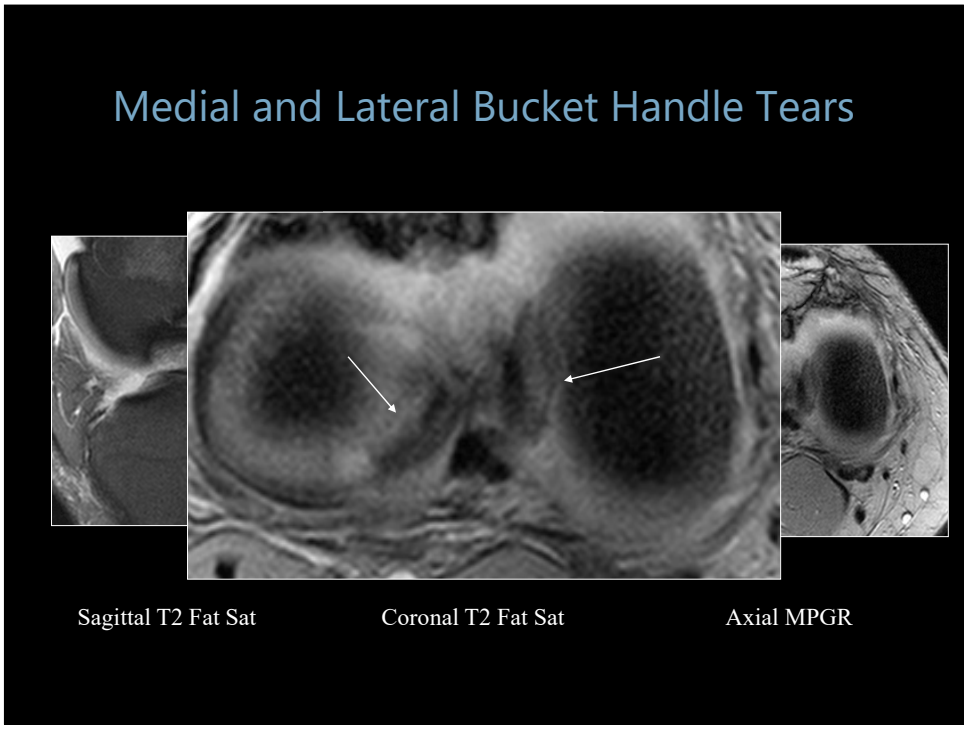


Sagittal T2 Fat Sat

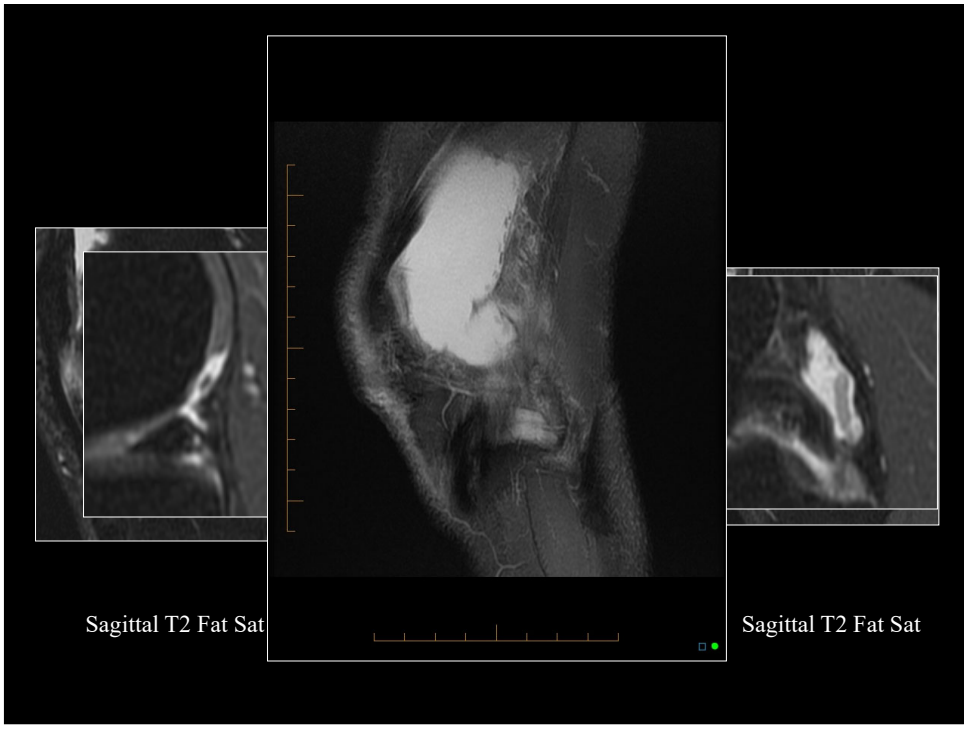
33

Parameniscal Cyst presenting as mass - percutaneous aspiration and rupture

34



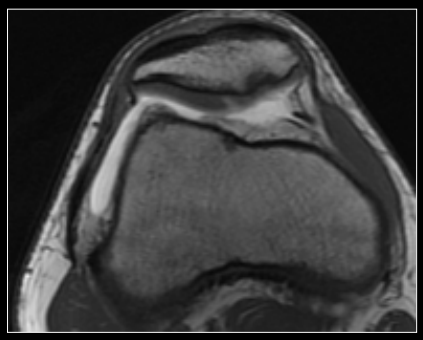
35



36

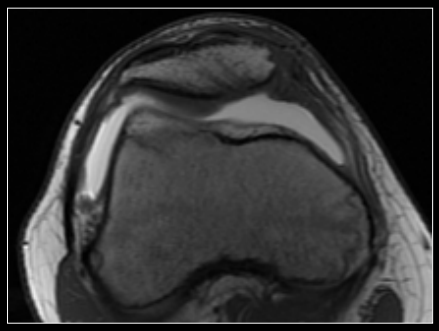
Post Intervention Cartilage Assessment

Pre-Microfracture



Axial T1 Post Arthrogram

Post-Microfracture



Axial T1 Post Arthrogram

37

Baker's Cysts

Sagittal PD

Sagittal T2 Fat Sat

38

Baker's Cyst Rupture

Sagittal PD

Sagittal T2 Fat Sat

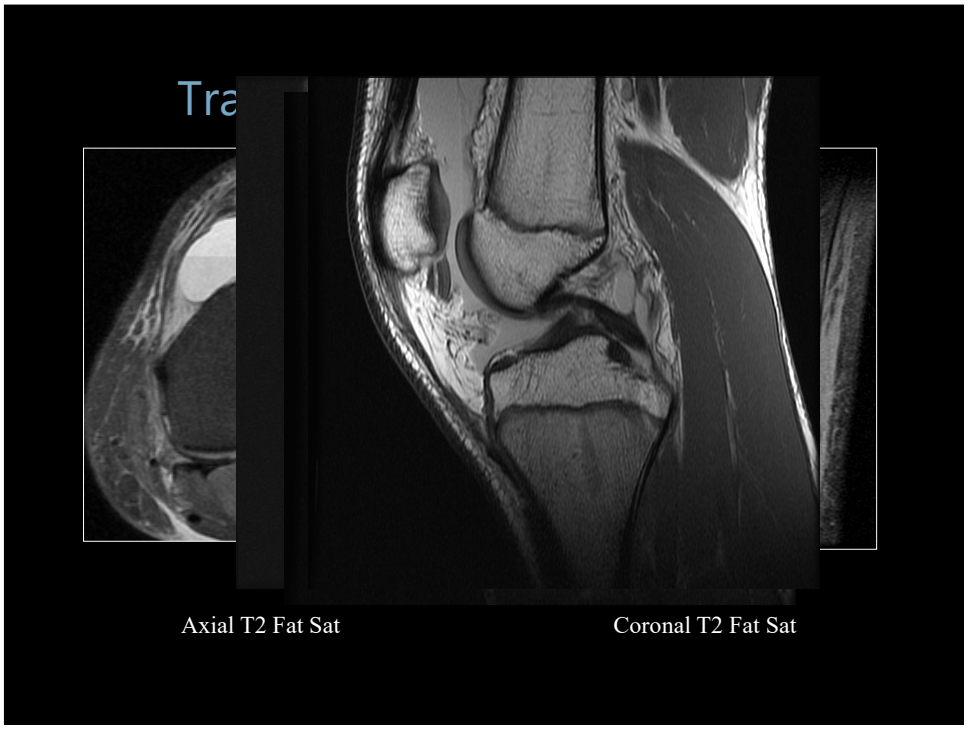
39

IT Band Friction Syndrome

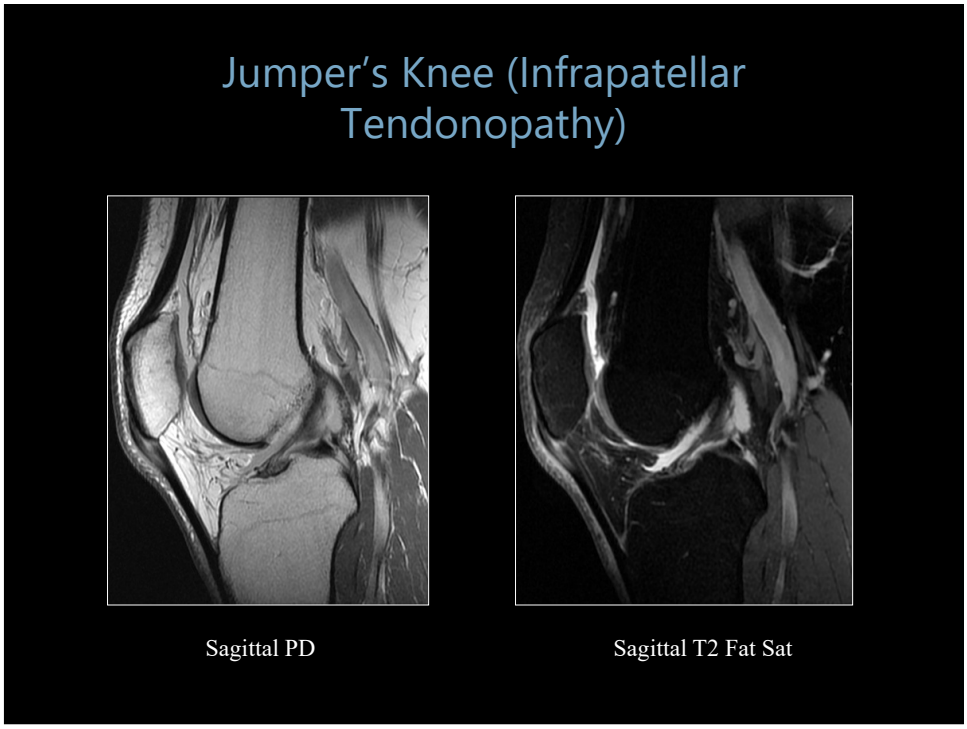
Coronal T1

Coronal T2 Fat Sat

40



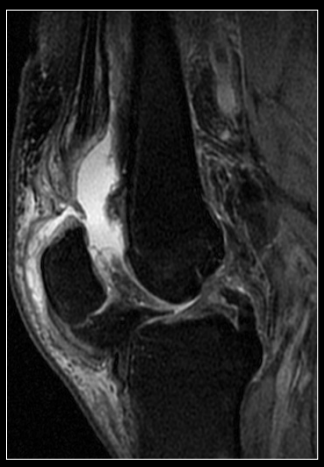
41



42

Quadriceps Tendon Rupture

Sagittal PD



Sagittal T2 Fat Sat

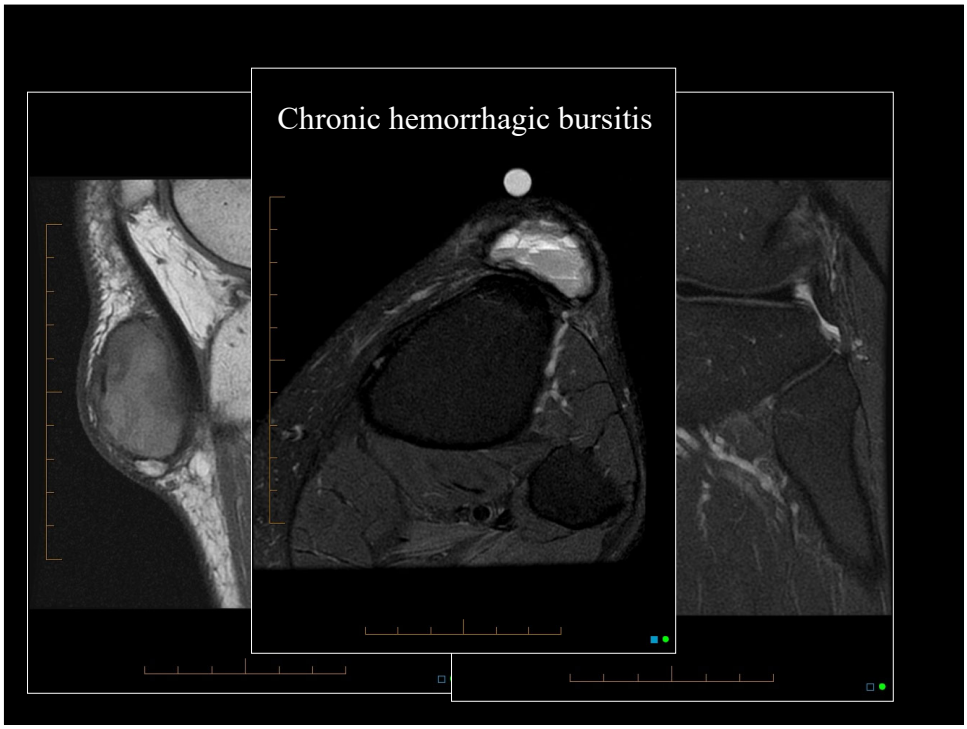
43

Infrapatellar Tendon Rupture

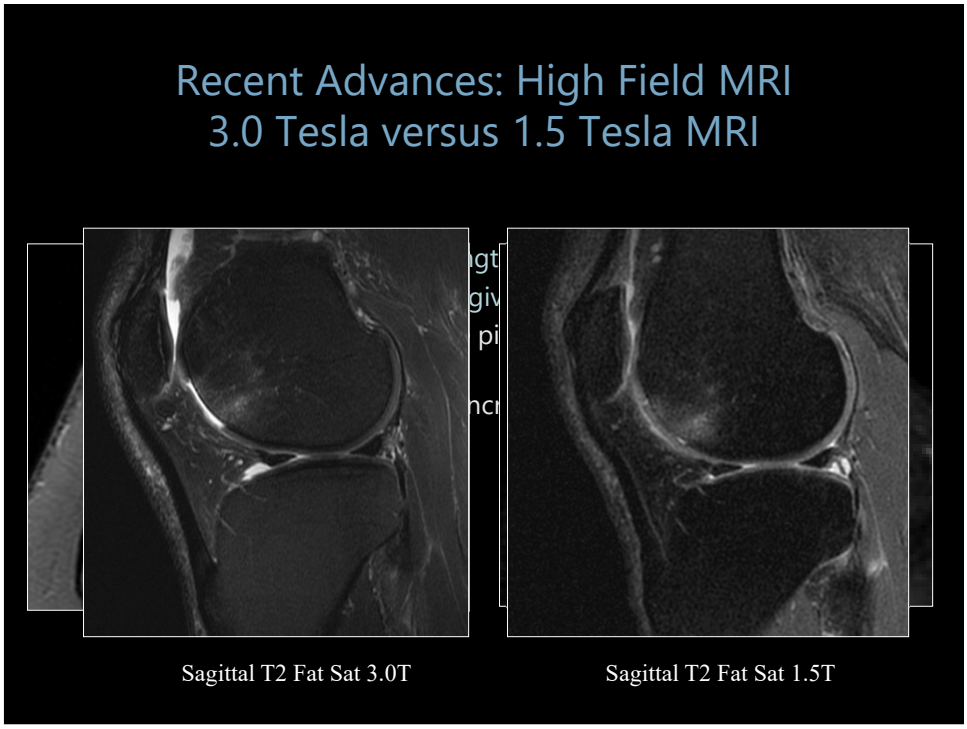
Sagittal PD

Sagittal T2 Fat Sat

44



45



46

Exostotic Osteochondroma

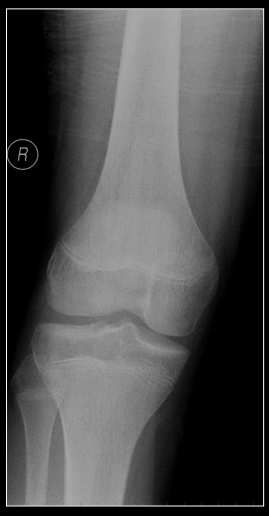
- Decrease NEX / imaging time (decrease spatial resolution)

Coronal T2 Fat Sat

Sagittal T2 Fat Sat

47

Fractures



Radiograph

Coronal T2 Fat Sat

48

Fractures

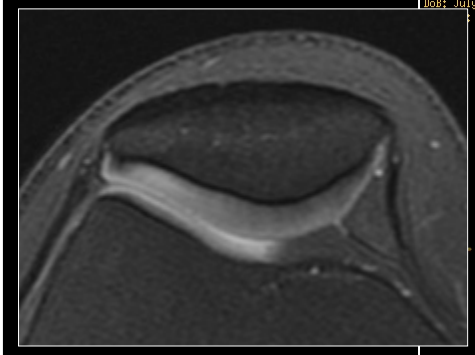
Coronal T2 Fat Sat

Coronal T1

49

Cartilage Mapping

- T2 mapping

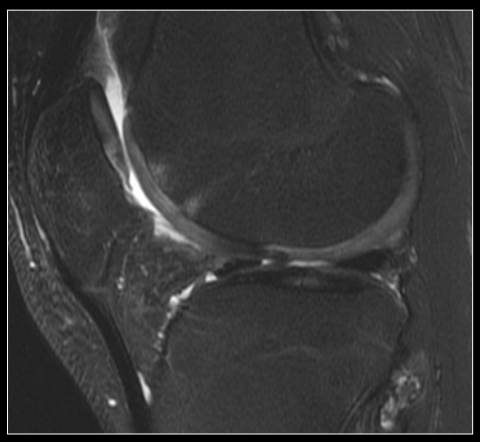


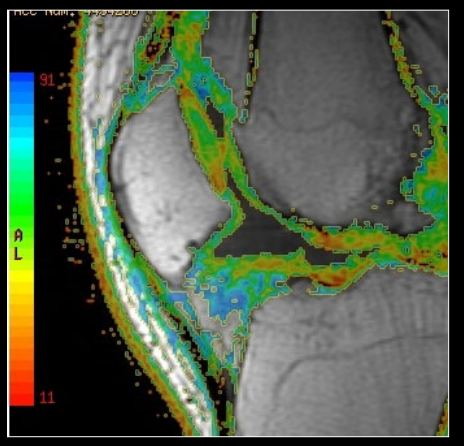
Axial T2 Fat Sat 3.0T

Axial Cartigram 3.0T

50

Cartilage Mapping



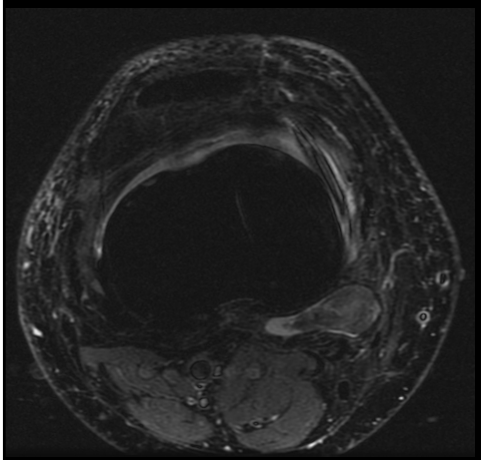


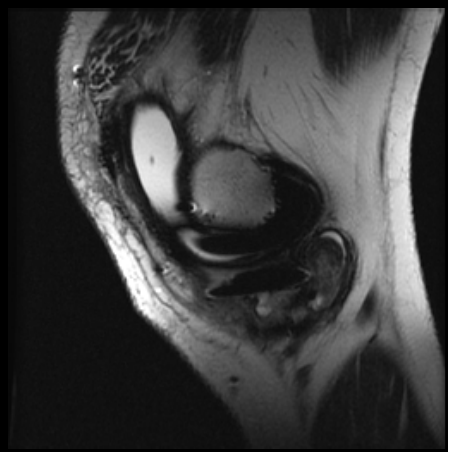
Sagittal T2 Fat Sat 3.0T

Sagittal Cartigram 3.0T

51

MARS (metal artifact reduction sequence)



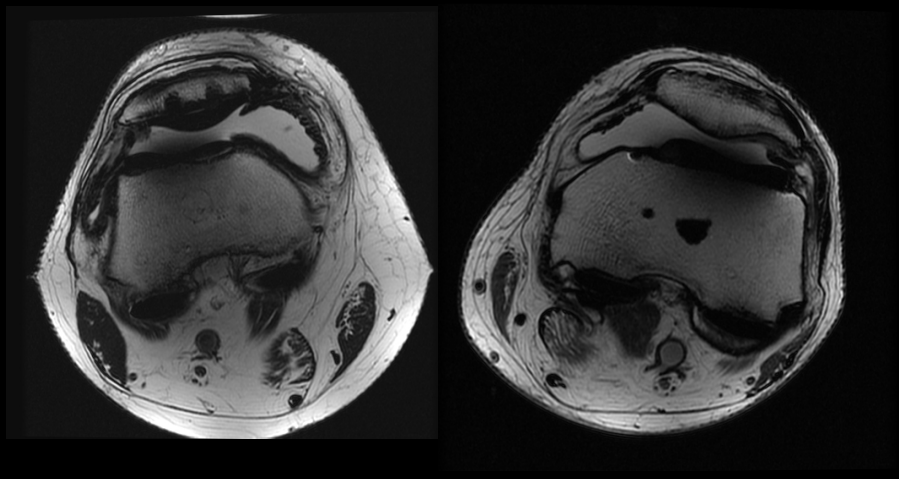


Axial STIR

Sagittal T2

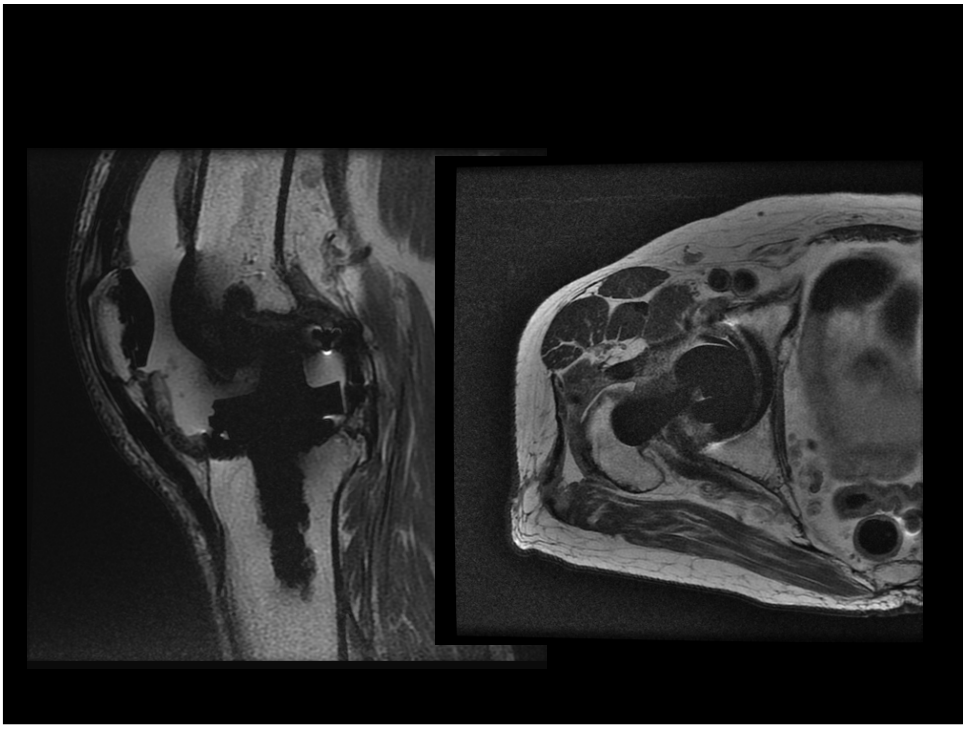
52

MARS prosthesis imaging



Axial T2

53



54

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.