MRI of the Knee

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

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

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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

Normal Anatomy: Medial Collateral Ligament (MCL)

Coronal T1
Coronal T2 Fat Sat

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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

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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

Grade 3 LCL Sprain

Acute Interstitial ACL Tear

ACL Avulsion

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Bucket Handle Medial Meniscus Tear

Flipped Locked Lateral Meniscus Tear

Discoid Lateral Meniscus Tear

Parameniscal Cyst presenting as mass - percutaneous aspiration and rupture

Medial and Lateral Bucket Handle Tears

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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

Transient Patellar Dislocation

Coronal T2 Fat Sat

Jumper’s Knee (Infrapatellar Tendonopathy)

Sagittal PD  Sagittal T2 Fat Sat

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Quadriceps Tendon Rupture

Infrapatellar Tendon Rupture

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

Exostotic Osteochondroma

Fractures

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Fractures

Cartilage Mapping

• T2 mapping

Cartilage Mapping

MARS (metal artifact reduction sequence)

MARS prosthesis imaging

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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.