

# TRA-MINW

## **Musculoskeletal MRI Protocols**

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### **\*Note to MR technologists:**

Updates and new protocols are underlined in this document.

Please feel free to contact Dr. Tang if you have any questions. Thank you.

### **General parameters (1.5 T magnets):**

For all T1 sequences, please keep TE below 20 (between 10 and 15 if possible); TR 500-600.

For all T2 FS sequences, use equivalent of FSE/TSE. TE of mid to upper 50's is the most ideal for Siemens, 60-65 for GE, and ~ 60 for Toshiba.

It is important to have TE long enough for T2 weighting but not so long that it is signal starved.

For STIR, TI = ~ 135

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## **Routine Knee**

- ax T2 FS
- sag PD
- sag T2 FS
- cor T1
- cor T2 FS

**Pelvis:** All pelvis cor and ax sequences need to cover from bone to bone to be adequate

### • **Routine Pelvis**

- cor T1
- cor STIR
- ax T1
- ax T2 FS

### • **Sacrum**

- do standard pelvis then add
- small for sacrum and coccyx (FOV = 24 cm)
- sag T1
- sag T2 FS (if FS fails, do STIR)

### • **Sacroiliac Joints**

- cor T1 - whole pelvis
- cor STIR – whole pelvis
- small FOV for sacrum and SI joints (FOV = 22 cm)
- oblique cor T1
- oblique cor T2 FS
- oblique cor T1 FS pre contrast
- oblique cor T1 FS post contrast

### • **Routine Hip**

- cor T1 (whole pelvis)
- cor STIR (whole pelvis)
- ax T2 FS – small FOV, hip of interest only (FOV = 18 to 24 cm)
- cor T2 FS – small FOV, hip of interest only
- sag T1 – small FOV, hip of interest only
- sag T2 FS – small FOV, hip of interest only
- oblique ax T2 FS – small FOV, hip of interest only

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- **Routine Shoulder**

- ax T1
- ax T2 FS
- oblique cor T1
- oblique cor T2 FS
- oblique sag T1
- oblique sag T2 FS

- **Routine Elbow**

- ax T1
- ax T2 FS
- cor T1 (use the interepicondylar line to determine cor plane)
- cor T2 FS
- sag T1
- sag T2 FS

*For distal biceps tendon rupture evaluation, please start the exam as routine elbow, radial tuberosity has to be included in coverage.*

- **Routine Wrist**

- ax T1
- ax T2 FS
- cor T1
- cor T2 FS
- cor 3D gradient echo
- sag T1
- sag T2 FS

- **Routine Hand/Finger (generalized hand/finger pain)**

- ax T1
- ax T2 FS
- cor T1
- cor T2 FS
- sag T1
- sag T2 FS

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- **Trauma Hip**

Reserved for ER/urgent care/prompt care patients to “rule out hip fracture”

*\*\*\*All sequences done for the whole pelvis*

- cor T1 (whole pelvis)
- cor STIR (whole pelvis)
- ax T1 (whole pelvis)
- ax T2 FS (whole pelvis)

- **Routine Ankle/Hindfoot (not for osteomyelitis)**

- ax T1
- ax T2 FS
- cor T1
- cor T2 FS
- sag T1
- sag STIR (TI = 135 for 1.5 T)

- **Routine Forefoot (not for osteomyelitis)**

- short axis T1
- short axis T2 FS
- cor T1 (cor to foot)
- cor T2 FS
- sag T1
- sag STIR

- **Long Bone Pain Protocol (lower extremity)**

- ax T1 – bilateral
- ax T2 FS – bilateral
- cor T1 – bilateral
- cor T2 FS or STIR – bilateral
- sag T2 FS or STIR – unilateral

- **Long Bone Pain Protocol (upper extremity)**

- All unilateral sequences
- ax T1
- ax T2 FS
- cor T1

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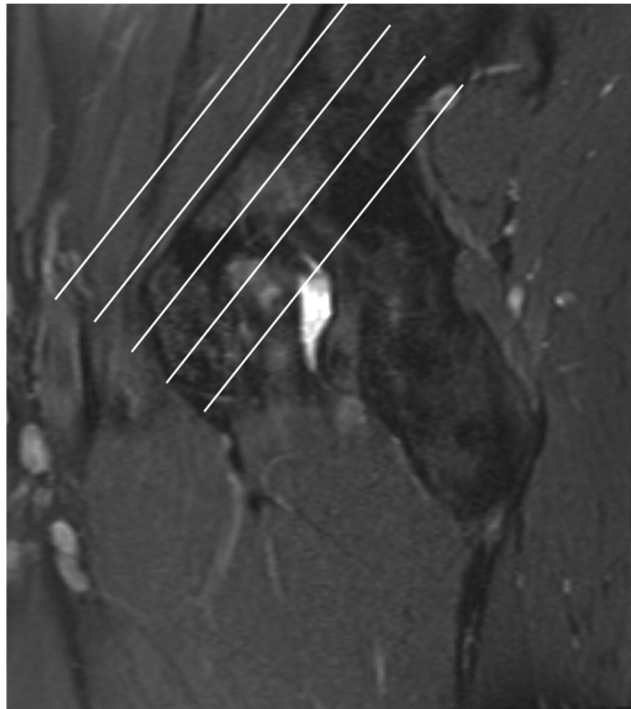
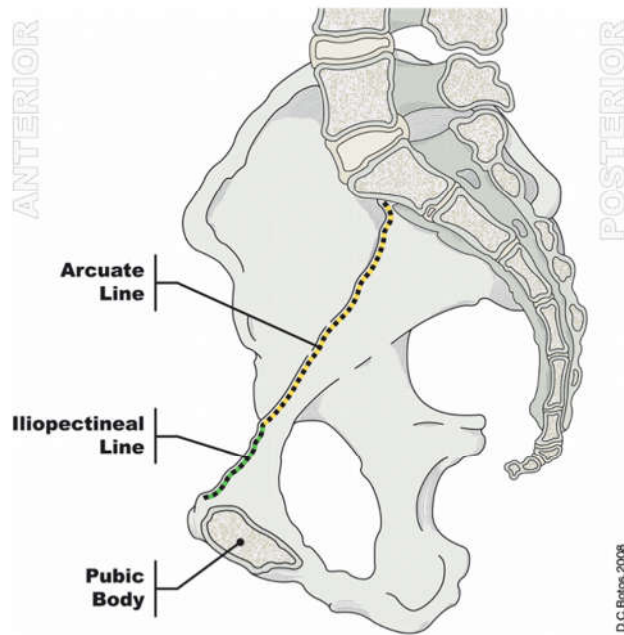
- cor T2 FS or STIR
- sag T2 FS or STIR

## **MR Chest Pectoralis Protocol**

- Unilateral
  - Coverage: proximal half of humerus, medial half of clavicle (including clavicular head) and unilateral half of the sternum
  
  - ax T1
  - ax T2 FS
  - oblique cor T1 (align with pectoralis major muscle)
  - oblique cor T2 FS
  - sag T2 FS
- **Routine Thumb: MCP Joint Collateral Ligaments or Thumb Pain**
    - ax T1
    - ax T2 FS
    - oblique cor T1 (cor to the MCP joint)
    - oblique cor T2 FS (cor to the MCP joint)
    - sag T1
    - sag T2 FS
  
  - **Sports Hernia/Athletic Pubalgia**
    - cor T1 – whole pelvis
    - cor STIR – whole pelvis
  
    - Small FOV to center at symphysis pubis
    - cor T1 FOV 28 – 32 cm
    - cor STIR FOV 28 – 32 cm
    - ax T2 FS FOV 28 cm
    - sag T2 FS FOV 20 cm
    - oblique ax T1 FOV 20 cm
    - oblique ax T2 FS FOV 20 cm

**Note:** oblique axial plane set up after sagittal sequence – plane approximately parallel to the arcuate line and iliopectineal line (see illustration on the next page). Do not hesitate to call MSK radiologist to check the sequences.

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- **Hands/Wrists for Arthritis/Inflammatory Arthropathy (e.g. rheumatoid arthritis, psoriatic arthritis)**

Extremity coil

FOV: cor 16-17 cm; ax 15 cm

Coverage: the entire wrist(s), MCP joints, to PIP joints. DIP can be excluded from the FOV to ensure optimal coverage of the wrist(s) and MCPs.

Key joints: wrist(s) and MCP joints; must have good signals on scouts from distal radius to PIPs.

- **Unilateral**

- cor T1
- cor T2 FS
- ax T1
- ax T2 FS
- ax T1 FS pre contrast
- ax T1 FS post contrast
- cor T1 FS post contrast

- **Bilateral**

Image both sides together: line up palms and fingers, skin-to-skin leaving no space in between, tape together;

Mark the dorsum of the right hand with an MR compatible marker; Preacher position.

- cor T1
- cor T2 FS
- ax T1
- ax T2 FS
- ax T1 FS pre contrast
- ax T1 FS post contrast
- cor T1 FS post contrast

- **Hand/Finger Infection.**

- If w/o contrast only
  - ax T1
  - ax T2 FS
  - cor T1
  - cor T2 FS
  - sag STIR
- add the following if w/o and w/ contrast
  - ax T1 FS pre contrast

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- ax T1 FS post contrast
- cor T1 FS post contrast
- sag T1 FS post contrast

## **MSK MR Mass vs. Cyst Protocols**

- **Long bone soft tissue mass vs. cyst protocol (lower extremity)**

- ax T1 – bilateral
- ax T2 FS – bilateral
  
- if lesion anterior or posterior                      if lesion medial or lateral
- sag T1 – unilateral                                              cor T1 – bilateral
- sag T2 FS or STIR – unilateral                              cor T2 FS or STIR – bilateral
- ax T1 FS pre contrast                                              ax T1 FS pre contrast
- ax T1 FS post contrast                                              ax T1 FS post contrast
- sag T1 FS post contrast                                              cor T1 FS post

- **Long bone soft tissue mass vs. cyst protocol (upper extremity)**

- ax T1
- ax T2 FS
  
- if lesion anterior or posterior                                      if lesion medial or lateral
- sag T1                                                                      cor T1
- sag T2 FS or STIR                                                      cor T2 FS or STIR
- ax T1 FS pre contrast                                                      ax T1 FS pre contrast
- ax T1 FS post contrast                                                      ax T1 FS post contrast
- sag T1 FS post contrast                                                      cor T1 FS post contrast

If the mass is thought to be a lipoma, no intravenous contrast is needed. Single plane T1 FS sequence should do – may need radiologist to check.



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## **MSK MR Osteomyelitis Protocols**

The purpose of this seemingly complicated approach to osteomyelitis is to streamline the protocol so we can perform the exams on a consistent basis to obtain adequate diagnostic information with a reasonable amount of scanning time.

For all osteomyelitis cases, post-contrast sequences are needed for evaluation of bone viability.

***If intravenous contrast cannot be administered due to severe renal insufficiency or allergy, please refer to routine protocol to scan the patient.***

***Ulcers should be marked before scanning is initiated.***

***Please acquire sequences in the order listed in the protocol.***

If there is difficulty completing the last post-contrast sequence (e.g. pt. motion, pt. pain, scanner shut down etc.), there is no need to repeat the specific sequence.

- **Foot osteomyelitis**
  - short axis – cross section of the metatarsals
  - cor – cor to the foot
  - sag – sag to the foot
  
- **Osteomyelitis forefoot or mid-foot (ulcer at tip of foot – distal ulcer)**
  - short axis T1
  - short axis T2 FS
  - sag T1
  - sag STIR
  - sag pre contrast T1 FS
  - sag post contrast T1 FS
  - short axis post contrast T1 FS
  - \*\*\*cor (to foot) T1 post contrast, no FS – for anatomic correlation

If ulcer at medial or lateral foot, choose short axis plane for pre and post contrast T1 FS.  
Optional post contrast sequence: cor post contrast T1 FS

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- **Osteomyelitis forefoot or mid-foot (ulcer at dorsal or plantar foot)**
  - short axis T1
  - short axis T2 FS
  - sag T1
  - sag STIR
  - short axis pre contrast T1 FS
  
  - short axis post contrast T1 FS
  - sag post contrast T1 FS
  - \*\*\*cor (to foot) T1 post contrast, no FS – for anatomic correlation
- **Osteomyelitis forefoot or mid-foot (ulcer at medial or lateral foot)**
  - short axis T1
  - short axis T2 FS
  - cor T1
  - cor T2 FS (if FS fails, cor STIR)
  - short axis pre contrast T1 FS
  - short axis post contrast T1 FS
  - cor post contrast T1 FS

## **Ankle/hindfoot osteomyelitis**

- Setup as ankle MR
- ax – axial to tibia/fibula
- cor – coronal distal tibial sigmoid notch
- sag – perpendicular to coronal plane
  
- **Osteomyelitis hindfoot or ankle (ulcer at posterior hindfoot/ankle)**
  - ax T1
  - ax T2 FS
  - sag T1
  - sag STIR
  - sag pre contrast T1 FS
  - sag post contrast T1 FS
  - ax post contrast T1 FS
- **Osteomyelitis hindfoot or ankle (ulcer at dorsal or plantar hindfoot)**
  - cor T1
  - cor T2 FS
  - sag T1
  - sag STIR
  - sag pre contrast T1 FS
  - sag post contrast T1 FS
  - cor post contrast T1 FS

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- **Osteomyelitis hindfoot or ankle (ulcer at medial or lateral hindfoot/ankle)**

- ax T1
- ax T2 FS
- cor T1
- cor T2 FS (if FS fails, STIR)
- cor pre contrast T1 FS
- cor post contrast T1 FS
- ax post contrast T1 FS

- **Osteomyelitis bilateral foot**

- When doing MR of both feet for osteomyelitis in one setting, please mark the dorsum of the RIGHT foot with two MR compatible markers.
- Image one foot at a time.

## **Osteomyelitis post-surgical stump (below the knee or above the knee amputation)**

- ax T1
- ax STIR
- cor T1
- cor STIR
- cor T1 FS pre contrast
- cor T1 FS post contrast
- ax T1 FS post contrast
- sag T1 FS post contrast

- **Other long bone osteomyelitis**

- Please refer to ankle osteomyelitis for plane selection of pre and post contrast sequences.\

- **Osteomyelitis pelvis (sacrum and coccyx)**

- whole pelvis
- ax T1
- ax STIR
- cor T1
- sag T1 (sacrum and coccyx)
- sag STIR (sacrum and coccyx)
- sag T1 FS pre contrast (sacrum and coccyx)
- sag T1 FS post contrast (sacrum and coccyx)
- ax T1 FS post contrast (whole pelvis)

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- **Osteomyelitis pelvis (other than sacrum and coccyx)**
  - whole pelvis
    - ax T1
    - ax STIR
    - cor T1
    - cor STIR
    - ax T1 FS pre contrast
    - ax T1 FS post contrast
    - sag T1 FS post contrast (whole pelvis)

## MSK MR Arthrogram Protocols

- **Shoulder Arthrogram**
  - Add ABER T1 (no FS) if the patient is 40 y.o. or younger
    - ax T1
    - ax T2 FS
    - oblique cor T1 FS
    - oblique cor T2 FS
    - oblique sag T1
    - oblique sag T2 FS
    - *Is the patient 40 y.o. or younger? (ABER T1 no FS)*
- **Wrist Arthrogram**
  - ax T1
  - ax T2 FS
  - cor T1 FS
  - cor T2 FS
  - cor 3D gradient echo
  - sag T1
- **Elbow Arthrogram**
  - ax T1
  - ax T2 FS
  - cor T1 FS (use the interepicondylar line to determine cor plane)
  - cor T2 FS
  - sag T2 FS
- **Hip Arthrogram**
  - cor T1 – whole pelvis
  - cor T2 FS – whole pelvis

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- small FOV – hip of interest
- ax T1
- ax T2 FS
- cor T2 FS
- oblique ax T1 (NO FS)
- sag T1 FS
- sag T2 FS

- **Knee Arthrogram**

- ax T2 FS
- sag PD
- sag T2 FS
- sag T1 FS
- cor T1
- cor T2 FS