Musculoskeletal MRI Protocols

**General Marrow - Tumor / Infection**

**Upper extremity**
- Shoulder Routine
- Shoulder Arthrogram
- Should dystocia - brachial plexus
- Shoulder – Dermatomyositis/Myopathies (see Dermatomyositis/myopathy in lower extremity)
- Elbow
- Elbow Arthrogram
- Wrist
- Wrist Arthrogram
- Hand
- Finger
- Thumb

**Lower extremity**
- Pelvis - general
- Pelvis – SI joints
- Dermatomyositis/Myopathies (Pelvis / Thigh / Legs)
- Hip – routine unilateral
- Hip – arthrogram
- SPICA hips
- Athletic pubalgia
- Knee
- Tib/Fib stress
- Ankle
- Foot – Forefoot/midfoot
- Foot – Forefoot
- Foot – entire

**Temporomandibular Joint**
General Tumor/Infection

Choose FOV based on patient size.

*** Place markers above and below site of pain or lump if localizable for both infection/tumor.

SCREENING LOWER EXTREMIT Y OST EOMYELITIS – limping child

Pelvis to ankles - Bilateral Coronal T1 no fs & STIR and axial STIR – then check case if need localized sag stir &/or posts

GENERAL INFECTION / OST EOMYELITIS

Coronal Wide FOV STIR - (if pelvis/hip, femur or leg include contralateral side in wide FOV)

Coronal Wide FOV T1 dixon +/- fat - (if hip, femur or leg include contralateral side in wide FOV)

After these sequences CALL TO LOCALIZE small FOV and if post contrast is needed and in which plane(s)

Axial T2 FS – small FOV

Axial DWIBS – large FOV

Post contrast T1 FS – Axial & Coronal (or Sagittal)

OPTIONAL:

Sag STIR precontrast – small FOV

TUMOR

Coronal Wide FOV STIR - (if hip, femur or leg include contralateral side in wide FOV)

Coronal Wide FOV T1 No fs - (if hip, femur or leg include contralateral side in wide FOV)

After these sequences CALL TO LOCALIZE small FOV and if post contrast is needed and in which plane(s)

Axial T2 FS – small FOV

Axial T1 dixon +/- fat – small FOV

Axial DWIBS – large FOV

Sag STIR – small FOV

Post contrast T1 FS – Axial & Coronal (or Sagittal)

OPTIONAL:

If concern for osteoid osteoma - Post contrast Dynamic T1 cor or sag (which best seen) post contrast with precontrast T1 FS for subtractions followed by standard post T1 FS in other 2 planes.

Lesion size/location or other considerations may override routine slice prescription guidelines.
Arm MUST be at side in neutral position with thumb pointing up to place humerus in anatomical position. From initial offset localizer image rotate 3 plane localizer to create orthogonal views for easier slice Rx. Center the 3 plane localizer on the joint space. Prescribe axial slices from above clavicle to below joint capsule.

Prescribe coronal slices parallel to the supraspinatus tendon. Anterior slice is past coracoid process.

Lesion size/location or other considerations may override routine slice prescription guidelines.
Prescribe sagittal slices perpendicular to coronal slices. Medial most slice to cover coracoid process (should start to see “Y” view)

Choose FOV based on patient size.

SEQUENCES:

Axial PD FS
Axial WATSF
Coronal Oblique T2 FS
Coronal Oblique PD 3D isovoxel
Sagittal Oblique T1
Sagittal Oblique T2 FS

OPTIONAL:

Axial T2 FS BLADE/PROPELLER/MultiVane (motion correction sequence)

Lesion size/location or other considerations may override routine slice prescription guidelines.
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Slice coverage for shoulder arthrograms is usually less than routine shoulders since we evaluating the contrast filled joint capsule looking for tears that allow the contrast to “leak” past normal barriers.

Choose FOV based on patient size.

**SEQUENCES:**

Axial T1 FS

Axial 3D T2 FS (WATSc 3D) isovoxel

Coronal Oblique T1 FS

Coronal Oblique T2 FS

Sagittal Oblique T1

Sagittal Oblique T2 FS

ABER T1 FS

**OPTIONAL:**

Axial T1 FS BLADE/PROPELLER/MultiVane (motion correction sequence)
Shoulder Dystocia / Brachial Plexus

Choose FOV based on patient size.

**Sequences:**

Axial WATSf – both shoulders

Axial PD – both shoulders

Coronal PD – both shoulders

Axial WATSf GR – small FOV affected side – (Do not reformat – alignment may be abnormal)

Coronal PD – small FOV affected side

Lesion size/location or other considerations may override routine slice prescription guidelines.
ELBOW

Axial scan runs from distal humeral diaphysis above the epicondyles to below the radial tuberosity (arrow)

Coronal scan plane is oriented along the anterior aspect of the humeral condyles (dashed line).

Sagittal scan plane (dashed line) is oriented perpendicular to the coronal plane.

Lesion size/location or other considerations may override routine slice prescription guidelines.
ELBOW

Choose FOV based on patient size.

ROUTINE ELBOW SEQUENCES

Axial T2 FS
Coronal Oblique T1
Coronal Oblique T2 FS
Sagittal Oblique T2 FS
Sagittal 3D PD no FS isovoxel (reconstruct in axial and coronal)
Sagittal 3D WATSc

OPTIONAL:

T1 FS post contrast – axial, coronal oblique or sagittal oblique

ELBOW ARTHROGRAM SEQUENCES

Axial T2 FS
Axial T1 FS
Coronal Oblique T2 FS
Coronal Oblique T1 FS
Sagittal T2 FS
Sagittal 3D PD no FS isovoxel (reconstruct axial and coronal)

Optional:

Sagittal 3D WATSc

Lesion size/location or other considerations may override routine slice prescription guidelines.
Lesion size/location or other considerations may override routine slice prescription guidelines.
WRIST

Choose FOV based on patient size.

Routine Wrist Sequences:
Axial T2 FS
Coronal T1
Coronal T2 FS
Coronal WATsf 3D isovoxel
Sagittal 3D PD no FS isovoxel (reconstruct coronal and axial)
Sagittal T2 FS

OPTIONAL:
Routine post contrast T1 FS axial, Coronal or sagittal

IF evaluation of Scaphoid avascular necrosis – do Dynamic T1 cor post contrast with precontrast T1 FS for subtractions followed by standard axial and coronal post.

Wrist Arthrogram Sequences:
Axial T1 FS
Axial T2 FS
Coronal T1 FS
Coronal T2 FS
Coronal WATSc 3D isovoxel
Sagittal T2 FS
Sagittal PD 3D no FS isovoxel (reconstruct in axial and coronal planes)

Lesion size/location or other considerations may override routine slice prescription guidelines.
Hand

Choose FOV based on patient size.

SEQUENCES:

Axial T1
Axial T2 FS
Coronal STIR
Coronal T1
Sagittal T1
Sagittal T2 FS

OPTIONAL:

Post contrast T1 FS axial and Coronal or Sagittal
Axial T1 FS precontrast
Sagittal WATSf

Lesion size/location or other considerations may override routine slice prescription guidelines.
Finger

Choose FOV based on patient size.

For individual fingers – include whole metacarpal through distal aspect of finger & include finger on either side for axial, coronal, and sagittal sequences

SEQUENCES:

Axial T1
Axial T2 FS
Coronal STIR
Coronal T1
Sagittal T1
Sagittal T2 FS

OPTIONAL:

Post contrast T1 FS axial and Coronal or Sagittal
Axial T1 FS precontrast

Lesion size/location or other considerations may override routine slice prescription guidelines.
**THUMB** (specifically Gamekeeper’s Thumb/Stener Lesion/Ulnar Collateral Ligament Tear)

Lesion size/location or other considerations may override routine slice prescription guidelines.
Lesion size/location or other considerations may override routine slice prescription guidelines.

THUMB SEQUENCES:

Axial PD

Axial T2 FS

Coronal T1 (scan parallel to the sesmoid bones as seen on the axial view)

Coronal PD FS (scan parallel to the sesmoid bones as seen on the axial view)

Coronal T2 FS (scan parallel to the sesmoid bones as seen on the axial view)

Sagittal T2 FS (Scan perpendicular to the coronal plane)
General Pelvis

Choose FOV based on patient size.

SEQUENCES:

Coronal STIR pelvis
Coronal T1 pelvis
Axial T2 FS pelvis
Axial T1 FS pelvis

OPTIONAL:

Routine Post contrast – Axial T1 FS and Coronal T1 FS
Axial T1 FS of pelvis precontrast

If for Legg-Calve Perthes, Avascular necrosis/osteonecrosis, Osteoid Osteoma, then do Dynamic T1 FS cor post contrast with precontrast T1 FS for subtractions followed by standard axial and coronal post.

Lesion size/location or other considerations may override routine slice prescription guidelines.


**SI JOINTS**

Choose FOV based on patient size.

**SEQUENCES:**

Coronal STIR entire pelvis

Coronal T1 entire pelvis

Axial T2 FS entire pelvis

Coronal oblique small FOV T2 FS to SI joints

Coronal oblique small FOV T1 to SIJ

**OPTIONAL:**

Post contrast – Coronal Oblique T1 FS Small FOV of SIJ, Axial and Cor T1 FS of entire pelvis

Lesion size/location or other considerations may override routine slice prescription guidelines.
Lesion size/location or other considerations may override routine slice prescription guidelines.

**Dermatomyositis/Myopathy**

Choose FOV based on patient size.

Typically this is for pelvis and thighs but same sequences can be used on bilateral legs (calves) and neck/shoulders

For neck/shoulders include lower neck muscles and shoulders to just below scapulas.

**SEQUENCES:**

Coronal STIR entire pelvis and thighs (legs) (shoulders)

Coronal T1 entire pelvis and thighs (legs) (shoulders)

Axial T2 FS entire pelvis and thighs (legs) (shoulders)

Axial T1 entire pelvis and thighs (legs) (shoulders)

**OPTIONAL:**

Post contrast – Coronal & Axial T1 FS of entire pelvis

Lesion size/location or other considerations may override routine slice prescription guidelines.
HIP

Rotate legs internally & secure. Larger patients may require anterior coil moved over to better cover the side of interest for unilateral views. Avoid scanning patients with a full bladder whenever possible.

Lesion size/location or other considerations may override routine slice prescription guidelines.
HIP

Choose FOV based on patient size.

SEQUENCES:

Coronal T1 entire pelvis

Coronal STIR entire pelvis

Axial T2 FS entire pelvis

Axial oblique T2 FS - small FOV side of interest

Sagittal 3D PD no FS isovoxel - small FOV side of interest (reconstruct coronal and axial)

Coronal T2 FS small FOV - small FOV side of interest

OPTIONAL:

Routine Post contrast T1 FS axial, coronal or sagittal

If for Legg-Calve Perthes, Avascular necrosis/osteonecrosis, Osteoid Osteoma, then do Dynamic T1 FS cor post contrast with precontrast T1 FS for subtractions followed by standard axial and coronal post.

Lesion size/location or other considerations may override routine slice prescription guidelines.
HIP ARTHROGRAM

Small FOV hip of interest.

SEQUENCES:

Axial T1 FS
Coronal T1 no FS
Coronal T2 FS FS
Axial oblique T1 FS
Axial oblique WATSc
Sagittal 3D PD no FS isovoxel (reconstruct coronal and axial)

Lesion size/location or other considerations may override routine slice prescription guidelines.
SPICA HIPS

Choose FOV based on patient size.

SEQUENCES:

Cornal PD – Bilateral

Axial PD FS – Bilateral

OPTIONAL:

Axial T2 FS – Bilateral

Post contrast Coronal and axial – Bilateral

Lesion size/location or other considerations may override routine slice prescription guidelines.
ATHLETIC PUBALGIA

Coronal STIR/T1 and Axial T2 FS, cover entire pelvis, especially pubic symphysis. FOV to cover boney anatomy.

Sagittal T2 FS, cover through both ischial tuberosities. Axial Oblique parallel to iliopectineal line. Must cover pubis completely.

Lesion size/location or other considerations may override routine slice prescription guidelines.
Choose FOV based on patient size.

**ATHLETIC PUBALGIA SEQUENCES:**

Coronal STIR pelvis

Axial T2 FS Pelvis

Axial T1 Pelvis

Sagittal Oblique small FOV T2 FS

Axial Oblique small FOV T2 FS

Lesion size/location or other considerations may override routine slice prescription guidelines.
Axial: Cover above patella inferiorly to patellar tendon insertion. Use localizers for scan angle & FOV rotation.

Sagittal: Use coronal localizer and axial view for rotation of scan angle. Be sure to cover laterally past head of fibula.

Lesion size/location or other considerations may override routine slice prescription guidelines.
Coronal: Use axial & sagittal views for scan angle. Use coronal localizer for FOV rotation.

Choose FOV based on patient size.

**KNEE SEQUENCES:**

Axial T2 FS

Sagittal 3D PD no FS isovoxel (reformat coronal & axial)

Sagittal T2 FS

Sagittal WATSf

Coronal T1

Coronal T2 FS

**OPTIONAL:**

Post contrast T1 FS Axial, Cor or Sag

Lesion size/location or other considerations may override routine slice prescription guidelines.
Tib/Fib – Stress Fx

*** place markers above and below the area of pain

SEQUENCES:

Coronal STIR bilateral

Coronal T1 bilateral

(call to localize after coronals)

Axial T2 FS

Axial T1

OPTIONAL:

Sagittal T2 FS – small FOV at area of interest

Sagittal T1 – small FOV at area of interest

If concern for Osteoid Osteoma - then do Dynamic T1 cor post contrast with precontrast T1 FS for subtractions followed by standard axial and coronal post.
ANKLE

Position the ankle in FULL dorsiflexion (note when not possible). Elevate or retract opposite foot/ankle with receive only coils to avoid aliasing. Tailor shim box to encompass as much tissue as possible to optimize fat sat.

Axial slice Rx. for routine ankle.

Axial slice Rx. for Achilles tendon.

Slice Rx. for Sagittal plane. Sagittal FOV is larger than routine when evaluating the Achilles tendon.

Slice Rx. for Coronal plane from axial and coronal perspectives.

*Lesion size/location or other considerations may override routine slice prescription guidelines.*
ANKLE – PLANTAR FLEXION

Reposition, then rescan axial pd no fs

Foot in plantar flexion (Toe pointed)  Sandbag to keep in position

Lesion size/location or other considerations may override routine slice prescription guidelines.
Choose FOV based on patient size.

*** Place markers anterior and posterior to site of pain

ANKLE STANDARD SEQUENCES:

Axial T2 FS
Axial PD
Sagittal 3D PD no FS isovoxel
Sagittal T2 FS
Sagittal 3D WATSf
Coronal T2 FS
Coronal T1 no FS

OPTIONAL:

Axial PD no FS plantar flexion (see instructions above) **** Should be done on all USTA patients and patient’s with concern for tendon pathology

T1 FS post contrast – axial, coronal or sagittal
Lesion size/location or other considerations may override routine slice prescription guidelines.

FOREFOOT / MIDFOOT

Elevate/retract opposite side with receive only coils to avoid aliasing. Tailor shim box to include as much tissue as possible to optimize fat sat.

FOOTPRINT (long axis) STIR

FOOTPRINT (long axis) T1

AXIAL (short axis) T2 FS

AXIAL (short axis) T1

SAGITTAL T2 FS

SAGITTAL T1

OPTIONAL:

SAGITTAL 3D WATSc

Post contrast T1 FS – short axis and coronal or sagittal

Lesion size/location or other considerations may override routine slice prescription guidelines.
FOREFOOT

Elevate or retract opposite foot with receive only coils to avoid aliasing. Tailor shim box to encompass as much tissue as possible to optimize fat sat.

Lesion size/location or other considerations may override routine slice prescription guidelines.
Choose FOV based on patient size.

**FOREFOOT SEQUENCES:**

- Coronal (Long axis) STIR
- Coronal (Long axis) T1
- Axial (short axis) T2 FS
- Axial (short axis) T1
- Sagittal T2 FS
- Sagittal T1

**OPTIONAL:**

- Sagittal 3D WATSf
- Post contrast T1 FS – short axis and coronal or sagittal

Lesion size/location or other considerations may override routine slice prescription guidelines.
Lesion size/location or other considerations may override routine slice prescription guidelines.

Elevate or retract opposite foot/ankle with receive only coils to avoid aliasing unless stated otherwise by scanner protocol.

Tailor shim box to encompass as much tissue as possible to optimize fat sat.
Choose FOV based on patient size.

**ENTIRE FOOT SEQUENCES:**

Footprint (long axis) STIR

Footprint (long axis) T1

Axial (short axis) T2 FS

Axial (short axis) T1

Sagittal T2 FS

Sagittal T1

**OPTIONAL:**

Sagittal 3D WATSf

Post contrast T1 FS – short axis and coronal or sagittal

*Lesion size/location or other considerations may override routine slice prescription guidelines.*
Lesion size/location or other considerations may override routine slice prescription guidelines.