1.5T MSK HOSPITAL PROTOCOLS  
(Updated January 6, 2020)  

General Guidelines

- NEVER hesitate to reach out to a radiologist for guidance!
- Use “Weak” FS (Siemens) or “Classic” FS (GE) on all sequences with FS
- Two planes post contrast are always needed on MSK exams
- ALL MSK mass / infection exams should be performed using is T1 & T2 FS all 3 planes with appropriate T1 FS pre & post.
  - Always need
    - Mass / tumor exams - request prior x-ray study for comparison, if applicable.
    - T1 FS pre – prior to contrast injection for direct comparison with post imaging.
    - Generally short axis to the mass is the best option for pre/post imaging.
    - T1 (generally coronal) for ALL bone metastasis, infection or fracture cases.
    - If contrast is contraindicated a T1 FS pre does not need to be performed.

Metal Protocols

- Total joint replacements use T1 & IR series (TSE/FSE sequence types)
- Hardware such as pins, screws, etc. use standard protocols with metal reduction techniques.
  - Metal reduction techniques
    - Bandwidth 400 Hz or more with signal compensation, fast RF mode
    - E-line (3T & Aera) WARP on, VAT 100%

All PEDI MSK arthritis exams should be performed using the standard adult protocols, unless specifically requested for pediatric radiologist to read.

MSK Guidelines, portal page reference.
- T1 & T2 weighted imaging is needed to accurately differentiate mass and infection.
- PD’s are generally useful for tendons, ligaments, & joint spaces.

Pelvis vs Hip

- Hip – evaluation of cartilage & labrum
- Pelvis – evaluation of fractures, soft tissue & cancer
  - AVN, Osteonecrosis or history of “steroid use with hip pain”
  - Cancer (mass, tumor), metastasis, myeloma
  - IV contrast

Long Bones

- Focal symptoms, mass or bone lesion
  - Image area of interest only
  - Do not need to include joint to joint, single joint imaging will suffice to target location of pathology
  - Center axials on area of interest, no need to include joint. DO NOT split pathology in upper / lower axial series
- General pain, myositis, cellulitis or non-focal history
  - Image anatomy as indicated
Inflammatory Arthritis (rheumatoid arthritis, psoriatic arthritis, juvenile rheumatoid arthritis, reactive arthritis, gout, CPPD [calcium pyrophosphate deposition disease], or septic arthritis)

- The entire hand and entire foot must be scanned for arthritis cases without any other indications such as a tear or mass
  - Contrast is needed to differentiate joint fluid from synovitis
- If a hand and wrist exam are ordered with a diagnosis of arthritis without any other indications, the wrist and hand need to be scanned together in the same FOV
ANKLE ACHILLES TENDON
PD Axial (150 FOV, 3.5x1, 36 slices)
T2 FS Axial
T1 Cor (160 FOV, 3.5x1, 32 slices, perpendicular to lateral/medial malleoli)
T2 FS Cor
T1 Sag (160 FOV, 3x1, 21 slices, parallel to lateral/medial malleoli)
STIR Sag
T2 FS Sag (~300 FOV, 3x1, 22 slices, mid-calf through calcaneous, parallel to Achilles tendon)

NOTE: Increase the FOV of the Sag sequences if the Achilles is torn and retracted outside of a 160 FOV.

ANKLE (including plantar fasciitis and posterior tibial tendon pathology)
PD Axial (~140 FOV, 3.5x1, 24 slices)
T2 FS Axial
PD Axial Oblique (~140 FOV, 3.5x1, 32 slices)
T1 Cor (~140 FOV, 3.5x1, 32 slices, perpendicular to lateral/medial malleoli)
T2 FS Cor
IR Sag (~140 FOV, 3x1, 21 slices, parallel to lateral/medial malleoli)
T1 Sag

NOTE: The following arthrogram protocols must include tech notes regarding the patient’s pain post arthrogram “fluoro” procedure.
  • Is the pain the same, improved or worsened since the procedure?

ARTHROGRAM SHOULDER
Position patient with the affected arm at their side with the palm facing upward. Place sandbag on palm if necessary to help the patient maintain this position.
T1 FS Axial
T2 FS Axial
T1 FS Cor
T2 FS Cor
T1 Sag Oblique (~140 FOV, 4x1, approx. 24 slices, must include approx. 6cm of medial anatomy from glenoid fossa)
T2 FS Sag

Cor Localizer (ABER, position the affected arm above the patient’s head with the elbow flexed and the palm of the hand under the patient’s head)
T1 FS ABER View (Slices must be prescribed from a Cor Scout image, parallel to the long axis of the humerus and centered to the joint, see the picture protocol if any questions).

NOTE: Send the Cor Localizer to PACS.

ARTHROGRAM ANKLE
T1 Axial
T1 FS Axial
T2 FS Axial
T1 FS Cor (perpendicular to lateral/medial malleoli)
T1 FS Sag (parallel to lateral/medial malleoli)
T2 FS Sag
ARTHROGRAM ELBOW
T1 FS Axial
T1 FS Cor
T1 FS Sag
T2 FS Cor

NOTE: Add a non FS T1 Cor if for trauma/fracture or if scanning technologist sees a possible fracture.

ARTHROGRAM HIP
T1 Axial
T1 FS Oblique Axial
T2 FS Cor (Full FOV to include both hips this sequence only)
T1 FS Cor
T1 FS Sag

ARTHROGRAM KNEE
T1 FS Axial
T1 FS Sag
PD Sag Non FS
T1 FS Cor
T2 FS Cor

NOTE: Add a non FS T1 Cor if for trauma/fracture or if scanning technologist sees a possible fracture.

ARTHROGRAM WRIST
T2 FS Axial
T1 Cor
T1 FS Cor
T1 FS Sag
T2 FS Cor

NOTE: Add a non FS T1 Cor if for trauma/fracture or if scanning technologist sees a possible fracture.

INDIRECT ARTHROGRAM OF ANY JOINT
- Requires Radiologist consultation and do not perform this exam without getting approval from a MSK radiologist.
- Inject gadolinium contrast intravenously.
- Instruct patient to move the affected joint for 15 minutes (rotation, abduction, and adduction) prior to scanning.
- Follow the applicable routine Arthrogram protocol.
CHEST WALL (Chest Wall Mass)
T1 Axial
T2 FS Axial
T1 Cor
T2 FS Cor
T1 Sag
T2 FS Sag
T1 FS Axial Pre
T1 FS Axial Post

NOTE: Run phase in direction that best minimizes motion artifact.

ELBOW
PD Axial (~120 FOV, 4x1, 24 slices)
T2 FS Axial
PD Cor (~140 FOV, 3x0, 30 slices, parallel to condyles off axial)
T2 FS Cor
T1 Sag (~140 FOV, 3x1, 21 slices, perpendicular to condyles off axial)
IR Sag

EXTREMITY LONG BONE PAIN / MASS  Tailor FOV to Body Part!!
T1 Axial
IR Axial
T1 Cor
IR Cor
T1 Sag
IR Sag

CONTRAST:
- T1 FS Axial Pre, T1 FS Axial Post
- Consult Radiologist for contrast for Mass, Infection or Post-Op Tumor or additional post planes if needed.

NOTE: Hands, Fingers, Feet and Toes: FOV should be tailored to the area of interest when there is a specific indication for such area. Any questions should be addressed to the radiologists. Evening shifts will need to be preemptive. Review the schedule at the start of shift for any possible radiologist questions. Late add on exams should be directed to the radiologists on shift in the evening.

FOOT METATARSAL PAIN / SWELLING / MASS
T1 Axial
IR Axial
T1 Cor
IR Cor
T1 Sag
IR Sag
FOOT MORTON’S NEUROMA OR CONTRAST EXAMS
Small FOV, from Mid-Foot through End of Toes for Morton’s Neuroma exams, consult with Radiologist regarding FOV and anatomical coverage needed for Non-Morton’s Neuroma exams
T1 Axial
IR Axial
T1 Cor
IR Cor
T1 Sag
IR Sag
T1 FS Cor Pre
T1 FS Cor Post
T1 FS Axial Post

GREAT TOE / 1ST MTP JOINT / TURF TOE INJURY
PD Axial
PD FS Axial (TE 30-45)
PD Cor
IR Cor
PD Sag
T2 FS Sag

NOTE: FOV of 12cm (range 10-14 cm), 3mm slice thickness, and extremity coil.

NOTE: For the following Finger & Hand protocols.
- Always Place Marker to Indicate Area of Concern!!
- If scanning an entire hand, you must include the distal radius/ulna through the fingertips on all sequences.
- Appropriate FOV for Limited Region of Interest!!
- For Hands, Fingers, Feet and Toes: FOV should be tailored to the area of interest when there is specific indication for such area. Any questions should be addressed to the radiologists. Evening shifts will need to be preemptive. Review the schedule at the start of shift for any possible radiologist questions. Late add on exams should be directed to the radiologists on shift in the evening.

FINGERS (not for thumb) – 3T Preferred
PD Axial
STIR Axial
T1 Cor
T2 FS Cor
PD Sag (affected & adjacent 2nd – 5th digit for comparison)
T2 FS Sag

HAND Always place marker to indicate area of concern, must include distal ulnar/radius through finger tips.
T1 Axial (120 FOV, 4x1, 40 slices)
T2 FS Axial
T1 Cor (220 FOV, 2.5x0, 21 slices)
T2 FS Cor
PD Sag (220 FOV, 4x1, 24 slices, affected & adjacent finger for comparison)
T2 FS Sag
HAND & FINGERS MASS / INFECTION (not for thumb) Always place marker to indicate area of concern, must include distal ulnar/radius through finger tips.
T1 Axial
T2 FS Axial
T1 Cor
T2 FS Cor
T1 Sag (affected & adjacent finger for comparison)
T2 FS Sag
T1 FS Cor pre
T1 FS Cor post

HIP – ER LIMITED (Fracture)
T1 Cor (whole pelvis)
IR Cor (whole pelvis)

HIPS BILATERAL AVN
IR Cor (~360 FOV, 4x0, 28 slices)
T1 Cor
T1 Axial No FS (~360 FOV, 5x1, TE 40-45, Above Sacrum through Ischium!)
T2 FS Axial
T1 Sag Left Hip (~220 FOV, 4x1, 22 slices)
T1 Sag Right Hip

HIPS BILATERAL
IR Cor (Bilateral Hips) (Send to both folders in Synapse)
T1 Cor
T1 Axial No FS (Bilateral Hips, Above Sacrum through Ischium) (Send to both folders in Synapse)
T2 FS Axial
LEFT HIP PD FS Axial (TE 40-45, Unilateral) (Above acetabulum through Ischium)
LEFT HIP PD FS Cor (TE 40-45, Unilateral)
LEFT HIP PD FS Sag (TE 40-45, Unilateral)
RIGHT HIP PD FS Axial (TE 40-45, Unilateral) (Above acetabulum through Ischium)
RIGHT HIP PD FS Cor (TE 40-45, Unilateral)
RIGHT HIP PD FS Sag (TE 40-45, Unilateral)

HIPS BILATERAL WITH CONTRAST
IR Cor Bilateral (Send to both Synapse folders)
T1 Cor Bilateral
T1 Axial Bilateral (Above Sacrum through ischium, send to both Synapse folders)
T2 FS Axial Bilateral
LEFT HIP PD FS Axial (TE 40-45, above acetabulum through ischium)
LEFT HIP PD FS Cor (TE 40-45)
LEFT HIP PD FS Sag (TE 40-45)
RIGHT HIP PD FS Axial (TE 40-45, above acetabulum through ischium)
RIGHT HIP PD FS Cor (TE 40-45)
RIGHT HIP PD FS Sag (TE 40-45)
T1 FS Cor Pre (Whole pelvis, send to both Synapse folders)
T1 FS Cor Post
T1 FS Axial Post (Whole pelvis, send to both Synapse folders)
HIP UNILATERAL
IR Cor Bilateral (~360 FOV, 4x0, 28 slices)
T1 Cor Bilateral
T1 Axial Bilateral (~360 FOV, 5x1, TE 12-20, above sacrum through ischium)
T2 FS Axial Bilateral
PD FS Axial (~200 FOV, 4x1, 24 slices, TE 40-45, above acetabulum through ischium)
PD FS Cor (~200 FOV, 4x1, 24 slices, TE 40-45)
PD FS Sag (~200 FOV, 4x1, 24 slices, TE 40-45)

HIP UNILATERAL WITH CONTRAST
STIR Cor Bilateral (~360 FOV, 4x0, 28 slices)
T1 Cor Bilateral
T1 Axial Bilateral (~360 FOV, 5x1, TE 12-20, above Sacrum through ischium)
T2 FS Axial
PD FS Axial (~200 FOV, 4x1, 24 slices, TE 40-45, above acetabulum through ischium)
PD FS Cor (~200 FOV, 4x1, 24 slices, TE 40-45)
PD FS Sag (~200 FOV, 4x1, 24 slices, TE 40-45)
T1 FS Cor Pre (Whole pelvis, send to both Synapse folders)
T1 FS Cor Post (Whole pelvis, send to both Synapse folders)

HIP DEPUY HIP PROSTHESIS RECALL *Perform on partial and total hip replacements
T1 FSE Axial (include entire bony pelvis 6x1)
IR FSE Axial
T1 FSE Cor (include entire bony pelvis 5x1)
IR FSE Cor
T1 FSE Sag (include entire bony pelvis 6x1)

NOTE: Use Fast Spin Echo sequences and a high bandwidth in order to reduce the artifact from the hip prosthesis.
Siemens – up to 400 hz/pixel, GE – up to 64khz.

JOINT CONTRAST (synovitis, rheumatoid arthritis, inflammatory arthritis, or inflammatory arthropathy)
Hand: Include the distal radius/ulna through the fingertips on all sequences.
Hip: Follow unilateral hip with contrast protocol.

All joints in addition to routine protocol (except for feet, ankles, and hips)
T1 FS Cor Pre
T1 FS Cor Post

Foot in addition to outline protocol
T1 FS Axial Pre
T1 FS Axial Post
T1 FS Sag Post

Ankle in addition to routine protocol
T1 FS Axial Pre
T1 FS Axial Post
T1 FS Sag Post
KNEE
PD FS Axial (~140 FOV, 4x1, 24 slices, TE 40-45)
PD FS Sag (~140 FOV, 3x1, 24 slices, TE 40-45)
PD Sag ( TE 15-20, as close to 15 as possible)
T2 FS Cor (~140 FOV, 3x1, 24 slices)
PD Cor (TE 15-20, as close to 15 as possible)

NOTE:
- Add T1 Cor
  o Bright bone marrow on T2 for possible fracture / trauma / soft tissue pathology (mass)
  o History of PVNS (pigmented villonodular synovitis)

PECTORAL MUSCLE/TENDON TEAR
PD Axial
STIR Axial
T1 Cor
T2 FS Cor
T1 Sag
T2 FS Sag
STIR Axial (Bilateral)

NOTE:
- Affected side only. Scan patient prone and orient phase direction in the direction that minimizes motion artifacts. See the picture protocol for detailed instructions.
- Must include pectoralis attachment on humeral shaft.

PELVIS MSK
T1 Axial (include entire bony pelvis 6x1)
T2 FS Axial
T1 Cor (include entire bony pelvis 5x1)
IR Cor
T2 FS Sag (include entire bony pelvis 6x1)
T1 Sag (through sacrum only, add for fracture of sacrum or coccyx)

NOTE: If the diagnosis or patient history (particularly when the patient is under the age of 60) indicates possible hip pathology such as labral tear, cartilage abnormality, etc., consult with an MSK Radiologist to see if a Hip protocol should be used instead.

PELVIS MSK SPORTS HERNIA OR ATHLETIC PUBALGIA
T1 Axial (include entire bony pelvis 6x1)
T2 FS Axial
T1 Cor (include entire bony pelvis 5x1)
IR Cor
T1 Sag (include entire bony pelvis 6x1)
T2 FS Sag centered to pubic symphysis (240 FOV, 4x0, 30 slices)

SCAPULA
T1 Cor (240 FOV, 4x1mm, 20 slices, oblique to obtain true cor)
T2 FS Cor
T1 Axial (220 FOV, 6x1mm, 24 slices, oblique to obtain true axials)
STIR Axial
T1 Sag (240 FOV, 6x1mm, 24 slices, oblique to obtain true sagittal)
T2 FS Sag
SHOULDER
PD FS Axial (TE 40-45) (~150 FOV, 3x1, 22 slices)
T2 FS Axial
PD Cor Obl (~140 FOV, 3x1, 18 slices)
T2 FS Cor Obl
T1 Sag Obl (~140 FOV, 4x1, 24 slices, must include approx. 6cm of medial anatomy from glenoid fossa)
T2 FS Sag Obl (~140 FOV, 3x1, 24 slices)

NOTE: Position patient with the affected arm at their side with the palm facing upward. Place sandbag on palm if necessary to help the patient maintain this position.

SI JOINTS
T1 Axial (perpendicular to Sacrum)
T2 FS Axial
T2 FS Axial (Non Oblique, large FOV whole pelvis)
T1 Cor (parallel to Sacrum)
IR Cor
T1 FS Cor Pre (parallel to Sacrum)
T1 FS Cor Post

NOTE:
- Send scout images to Synapse.
- If not contrasting, do not perform T1 FS Cor Pre

STERNUM  Patient Prone whenever possible
T1 Axial
T2 FS Axial
T1 Cor
T2 FS Cor
T1 Sag
T2 FS Sag

STERNOCLAVICULAR JOINTS
T1 Axial
T2 FS Axial
T1 Cor
T2 FS Cor
T1 Sag
T2 FS Sag

NOTE: Scan patient prone and orient phase direction in direction that minimizes motion artifacts.

THUMB
PD Axial
T2 FS Axial
IR Axial
PD Cor
T2 FS Cor
PD Sag
T2 FS Sag
TOE
T1 Axial
IR Axial
T1 Sag (Through affected toe and an adjacent toe for comparison)
IR Sag
T1 Cor
IR Cor

TOE MASS WITH CONTRAST (not Morton’s Neuroma or Osteomyelitis)
T1 Axial
IR Axial
T1 Sag (Through affected toe and an adjacent toe for comparison)
IR Sag
T1 Cor
IR Cor
T1 FS Cor Pre
T1 FS Cor Post
T1 FS Sag Post

NOTE: Perform forefoot protocol with diagnosis of osteomyelitis, ulcer or infection.

WRIST
PD Axial (100 FOV, 3x0, 24 slices)
PD FS Axial (100 FOV, 3x0, 24 slices, TE 40-45)
T2 FS Cor (100 FOV, 3x0, 21 slices)
PD Cor
T2 3D Cor (120 FOV, 1.5x0, 36 slices)
T1 Cor (only if history of trauma/fracture or possible fracture)
STIR Sag (100 FOV, 3x0, 24 slices)

Contrast, if needed:
- Pain: T1 FS Cor pre / post with additional T1 FS Axial post
- Mass: Perform T1 & T2 FS protocol with T1 FS Axial pre & post, with additional plane which best demonstrates mass.
- Follow JOINT CONTRAST protocol for other inflammatory/arthritic/etc. diagnosis