*Please get or let us know where radiologist can review plain films.  
*For Texas Orthopedics and other Docs requesting only MSK section read for their pediatric patient, please follow adult MSK section protocols unless for unusual indication or questions and then contact MSK radiologist to see if they want pediatric radiology input.  
*Central Texas Pediatric Orthopedics has a separate PACS that is accessible to our radiologists. It is not necessary to request x-rays from CTPO for comparison. All that is required of the technologist is to state in their tech notes that the patient has comparison films with CTPO.

**A. GENERAL INSTRUCTIONS FOR ALL MR PROTOCOLS BELOW.**

1) Use No Phase Wrap / Phase Oversampling whenever possible.  
2) T1 is conventional SE T1 unless specifically stated otherwise; T2’s are FSE however.  
3) Frequency direction should be perpendicular to plane of growth plate most of interest – and please switch phase and frequency if vascular artifacts obscure structures of interest.  
4) Most slice thicknesses 3-4 mm with gap of 0, .5, or 1mm unless covering a large area such as axials through pelvis or long bones, then increase slice thickness and gap as needed.  
5) Use a TI of 150 for FSE IR.  
6) For small joint, for high resolution PD, use 3-4 NEX.  
7) Try to keep sequences 7 minutes or less (hopefully less).  
8) Need for extra set for whole bone in pedi is because of skip lesions in tumor and marrow diseases.  
9) Glucagon is needed for Pediatric Enterography studies.  
10) Glucagon is not needed routinely for other Pediatric Abdominal and Pelvic studies but if a Female Pelvis MRI is scheduled on a teenage girl, check with a Radiologist to see if glucagon is needed.

**B. Pediatric Bone** — routine, such as tumor, infection — must include whole lesion extent, including edema — if possible, review with an MSK radiologist to see if IV contrast is needed (some lesions don’t, e.g., osteochondroma) and if is small lesion unlikely to be malignant tumor, may not need large FOV’s.  

1) Coil  
   a) 1st large FOV whole bone – larger or body coil if needed to check for skip lesions in the bone.  
   b) Then place smaller coil to cover area of interest.  
2) Sequences  
   Adult Long Bone Protocol

**C. Pedi non-tumor joint study – knee, shoulder, wrist, elbow in teenager, athlete**  
Adult Protocols

**D. Abbreviated Pediatric specific small joint (e.g., wrist, elbow – include for acute or chronic pain, possible bony bridge of growth plate).**

1) Put joint as close to center of magnet as possible.  
2) Use small surface coil appropriate for size of joint.  
Adult Protocols
E. Pedi Joint for Arthritis, Synovial Derangement Protocol (e.g., Juvenile Chronic (Rheumatoid) Arthritis).
1) Appropriate extremity coil for joint.
2) Base sequences.
   a) T2 FSE Fat Sat Axial
   b) T1 FSE Coronal
   c) T2 FSE Fat Sat Coronal
   d) T2 FSE Fat Sat Sagittal or STIR
3) Add T1 FSE Fat Sat Coronal to Shoulder, Elbow, Wrist, Hand, Hip, Knee, Ankle exams pre contrast.
4) Add T1 FSE Fat Sat Axial to Feet exams pre contrast.
5) Add T1 FSE Fat Sat Axial and T1 FSE Fat Sat Coronal to Shoulder and Hip exams post contrast.
6) Add T1 FSE Fat Sat Sagittal and T1 FSE Fat Sat Coronal to Elbow, Wrist, Hand, Knee, and Ankle exams post contrast.
7) Add T1 FSE Fat Sat Sagittal and T1 FSE Fat Sat Axial to Feet exams post contrast.

F. Cartilage Specific Joint Study- (e.g., congenital and developmental malformations, Blount’s disease, post-traumatic or post-infection bony bridges of growth plate).
1) Coil – appropriate for specific joint.
2) Sequences.
   Adult joint specific protocols

G. Pedi Foot Routine (e.g., tumor or infection).
1) Coil – smallest that fits foot.
2) Sequences.
   Adult foot protocol

H. Tarsal Coalition. Place foot in extremity coil, or both feet in head coil.
1) Sequences.
   Ankle Protocol

I. Pedi Shoulder for Dysplasia (e.g., dysplasia due to brachial plexus injury).
1st – Use coil to include both shoulders for 1st sequence, change to surface coil for rest.
1) Sequences.
   Adult Protocol

J. Unilateral Hip (generally over 5 years) – e.g., Legg-Perthes, hip dysplasia – check if radiologist wants bilateral or unilateral hip or intravenous contrast.
1) Coil per patient size.
2) Sequences.
   Adult Protocol

K. Bilateral Hip (generally under 5 years) e.g. AVN, hip dysplasia, SCFE.
   Adult Protocol

L. Pelvic Tumor / Infection / Pain Protocol – include whole pelvis, which will include hips.
1) Appropriate coil for age – e.g., head coil in very young, torso in larger, etc. – center between symphysis and anterior superior iliac spine – if area of interest is buttocks, please scan prone.
2) Sequences.
   a) T1 Coronal.
   b) Fast IR Coronal.
   c) Fast IR Sagittal.
   d) T2 FSE Fat Sat Sagittal.
   e) T1 Fat Sat Coronal and T1 Fat Sat Axial post contrast.
M. Dermatomyositis evaluation – Image bilateral pelvis through thighs.

1) Body coil for larger children, head coil or torso coil for smaller – scan large FOV, are mapping edema, not looking for fine detail. Do not scan these sequences in segments. In order to obtain accurate measurements, the FOV of the Coronal sequences must include the entire area of interest. Do not split the Coronal sequences into an upper and lower section and then combine them. The Axial sequence needs to be scanned in a single sequence also. Depending on the size of the child, they may not be able to have this exam performed on an Espree.

2) Sequences.
   a) T1 Coronal.
   b) Fast IR Coronal.
   c) T2 FSE Fat Sat Axial (Increase slice thickness and spacing as needed).

N. Vascular mass / birthmark

1) Coil depends on extent of lesion.

2) Sequences.
   a) T1 Axial
   b) T1 Coronal (if pathology is medial or lateral)
   c) T1 Sagittal (if pathology is anterior or posterior)
   d) T2 Fat Sat Axial (change to STIR if fat sat is poor)
   e) T2 Fat Sat Coronal (change to STIR if fat sat is poor)
   f) T2 Fat Sat Sagittal (change to STIR if fat sat is poor)
   g) T1 Fat Sat Axial
   h) MR Contrast Angiogram if first study or if AVM (1 arterial and 3 venous phases)
   i) T1 Fat Sat Axial post contrast
   j) T1 Fat Sat Coronal post contrast
   k) T1 Fat Sagittal post contrast

O. MSK Pelvis (Includes for diagnosis of imperforate anus).

1) Head coil for infant, torso coil for older – if for anorectal musculature, delete Fast IR Coronal, center at anorectal area and use 3mm slices with 0mm gap – check with pediatric radiologist.

2) Sequences.
   a) Fast IR Coronal.
   b) T1 Coronal.
   c) T1 Axial.
   d) T2 FSE Fat Sat Axial.
   e) T2 FSE Coronal no fat sat.
   f) T2 FSE Sagittal no fat sat.

O2. Female Pelvis for Primary Amenorrhea & other gynecologic symptoms.

1) Adult Mullerian Duct protocol.

2) With exception of ovarian or pelvic tumor, a female pelvis for gynecologic symptoms are always a mullerian duct protocol.

3) For case by case clarification contact appropriate pediatric radiologist.

P. Pediatric Body Tumor.

1) Coil per patient size – infant head or extremity, child torso coil.

2) Sequences.
   a) Fast IR Coronal.
   b) Fast IR Sagittal.
   c) T1 Coronal.
   d) T2 FSE Fat Sat Axial.
   e) T1 GRE Axial (out of phase).
   f) T1 Fat Sat Coronal Post Contrast.
   g) T1 Fat Sat Axial Post Contrast.
Q. Pediatric Renal Study.
1) Torso coil if small infant, can use head coil.
2) Sequences.
   a) T1 Axial no fat sat.
   b) T2 FSE Fat Sat Axial.
   c) Fast IR Coronal.
   d) Post Contrast.
      i) If for pyelo:
         (1) Coronal post contrast FSE T2 Fat Sat.
         (2) Coronal Fast IR (TE 20).
         (3) Axial T1 Fat Sat.
      ii) If for tumor, nephroblastomatosis:
         (1) T1 Fat Sat Axial.
         (2) T1 Fat Sat Coronal.
   e) MR Urogram post contrast.
      i) 3D T1 weighted SPGR (70 degree flip angle, 2 - 2.5mm thick, overlap 1mm, in coronal plane, with fat sat, kidneys to bladder, with large FOV).
      ii) Recon as MIP parallel to long axis of body and display in 15 degree increments sent to PACS.

R. Pediatric Liver
1) Perform exam with patient holding their breath if possible. If not, use free breathing sequences.
   a) T1 Coronal.
   b) T2 Fat Sat Coronal.
   c) T1 Axial (In and Out of Phase).
   d) T2 Fat Sat Axial.
   e) Heavy T2 Axial.
   f) T1 Fat Sat 3D Axial (vibe or lava) Pre Contrast.
   g) T1 Fat Sat 3D Axial (vibe or lava) Post Contrast.
      i) Immediate post contrast.
      ii) 2 minute delay post contrast.
      iii) 5 minute delay post contrast.
      iv) 10 minute delay post contrast.

S. Routine Abdomen
1) T1 Coronal.
2) T2 Fat Sat Coronal (HASTE / SSFSE if needed).
3) T1 Axial.
4) T2 Fat Sat Axial (HASTE / SSFSE if needed).
5) T1 Fat Sat Axial post contrast.
6) T1 Fat Sat Coronal post contrast.
S2. ABDOMEN HEMACHROMATOSIS WITHOUT CONTRAST
1) T2 TRUFI Cor (8x2.5, 360mm)
2) T2 fl2d In/Out Phase Cor (120 TR, TE 2 / TE 4, 20 flip angle)
3) T1 fl2d Axial (10x0, 350mm) 5 series at following parameters
   - 120 TR, 2 TE, 20 flip angle
   - 120 TR, 4 TE, 20 flip angle
   - 120 TR, 9 TE, 20 flip angle
   - 120 TR, 14 TE, 20 flip angle
   - 120 TR, 19 TE, 20 flip angle
   - 120 TR, 21 TE, 20 flip angle

NOTE: Example ACC 27084698

S3. UROGRAM
1) Pre Scan
   a) Patient arrives 1 hour prior to table time. IV and catheter placed.
   b) Ringer Lactate IV, total dose 10ml/Kg at approximately 1 liter/hour rate, 30-40 minutes prior to imaging.
   c) PT positioned on table, immediately inject Lasix 1mg/Kg, max dose 20mg over 2 minutes, approximately 15 minutes before contrast injection.

Include upper pole of kidneys to the perineum.
2) Localizer & Free breathing localizer
3) T2 Trufi Axial
4) T2 FS Trufi Axial
5) T2 Haste Axial
6) T2 Trufi Coronal (5x1.5mm, angle along aorta/ureters for true coronal)
7) T2 Haste Coronal
8) T1 Vibe Cor (2.5mm)
9) T2 Space Coronal trigger
10) T1 FS Vibe Coronal (dynamic, 25 measurements, inject contrast after 1st measurement at .5ml/sec)
11) T1 FS Vibe Axial Post
12) T1 FS Vibe Coronal Post (dynamic, 6 measurements, free breathing)
13) T1 FS Vibe Axial Post Delay
14) T1 FS Vibe Coronal Post Delay
15) T1 FS Vibe Axial Post Delay
16) T1 FS Vibe Sagittal Post Delay

NOTE:
  - Example ACC 22702387
  - Create RT Lateral, LT Lateral MPRs & Bilateral Lateral MIP from T2 Space Coronal.

T. TMJ for Juvenile Rheumatoid Arthritis
1) Do Routine adult protocol.
2) Add Bilateral T1 Fat Sat Sagittal post contrast (closed mouth).
3) Add Bilateral T1 Fat Sat Coronal post contrast (closed mouth).
4) Add Bilateral “Straight On” T1 Fat Sat Coronal post contrast (closed mouth).
U. Entire Spine done in 2 sections.
1) Maximum FOV Sagittal localizer with sufficient signal and resolution for counting the Cervical, Thoracic, and Lumbar spine. If the child is too large to obtain a Sagittal localizer that includes the Cervical, Thoracic, and Lumbar spine in full, the “Entire Spine” study must be done in 3 sections, not 2.

2) Upper half of spine as follows:
   a) T1 Sagittal 250mm FOV.
   b) T2 Fat Sat Sagittal 250mm FOV.
   c) T1 Coronal.
   d) T1 Axial.
   e) T2 Axial.
   f) If giving patient contrast.
      i) T1 Axial post contrast.
      ii) T1 Fat Sat Sagittal 250mm FOV post contrast.

3) Lower half of spine as follows:
   a) T1 Sagittal 250mm FOV.
   b) T2 Fat Sat Sagittal 250mm FOV.
   c) T1 Coronal.
   d) T1 Axial.
   e) T2 Axial.
   f) If giving patient contrast.
      i) T1 Axial post contrast.
      ii) T1 Fat Sat Sagittal 250mm FOV post contrast.

V. SI Joints for Rheumatoid Arthritis for Dr. Carrasco.
1) These studies should be scanned as an MSK Pelvis. Do not oblique the Coronal and Axial sequences.
2) T1 Axial.
3) T2 Fat Sat Axial.
4) T1 Coronal.
5) IR Coronal.
6) T1 Sagittal.
7) T1 Fat Sat Axial Pre Contrast.
8) T1 Fat Sat Axial Post Contrast.
9) T1 Fat Sat Coronal Post Contrast

X. Orthopedic cases for Dr. Yandow.
1) Dr. Yandow will provide notes detailing how she wants each patient to be scanned. Her notes will request that the patient be scanned with specific parameters including but not limited to: FOV, sequence weighting, scan plane, slice thickness, slice spacing, and matrix. Consult with the Pedi Radiologist on each of these cases in order to determine how to integrate Dr. Yandow’s order with our standard protocols. Scan Dr. Yandow’s notes into synapse so that the radiologist will have access to them when reading the case. If Dr. Yandow orders a bilateral study (femur, tib-fib, etc.) and the Coronal sequences include both sides, be sure to send the Coronal sequences to both folders in Synapse.
Y. **Brain Routine** Run the Adult Protocol that applies to the patient’s diagnosis.
1) Add T1 Axial Pre Contrast (if child is 9 or below or has pathology)
2) Replace T1 Sag with T1 SPGR / MPRAGE Sagittal (for DX of developmental delay)
   a) Reformat into Axial and Coronal planes.

Y2. **Brain Non Contrast**
1) T1 3D Sagittal (reformat into Axial and Coronal planes with 3mm slices)
2) Diffusion Axial
3) FLAIR Axial
4) T2 Fat Sat Axial
5) T2 Fat Sat Coronal
6) GRE Coronal

Y3. **Brain Other** Run the Adult Protocol that applies to the patient’s diagnosis.

Z. **LUMBAR SPINE for Sacral Dimple**
1) T1 Sagittal
2) T2 Fat Sat Sagittal
3) T1 Coronal
4) T1 Axial
5) T2 Axial
6) T1 Axial Post Contrast
7) T1 Fat Sat Sagittal Post Contrast

Place one marker at the site of the dimple and another marker at the Superior Gluteal Fold. Scan through both markers on all sequences.

*It is very important to state in your tech notes which marker is located at the site of the dimple.*

AA. **LUMBAR SPINE**
1) T1 Sagittal
2) T2 Sagittal
3) STIR Sagittal
4) T1 Axial
5) T2 Axial

AB. **SPINE for Scoliosis or Vertebral Anomalies**
1) Routine Cervical, Thoracic, or Lumbar Protocol
2) T2 Coronal