MSK MRI PROTOCOLS

USE: " Ctrl f "to search keywords in this powerpoint

TECH TIPS

- For exams that need markers – Mark above and below mass
- Scaphoid fractures of the wrist may require GD, consult Radiologist
- Contrast studies will require subtracted images. Make sure you always have a pre/post Axial T1 FS and subtraction sequence
- If R/O is hamstring tear for Hip or Pelvis, be sure to include insertion at ischial tuberosity and distal enough to seen entire hamstring tear

Contents

Upper Extremity

- Shoulder Routine, Infection, Arthrogram, Saline Only Arthrogram, MARS, Pectoralis Muscle
- MRA Upper Extremity
- Clavicle
- Scapula
- Sternum/SC Joints
- Elbow
- Hand/Finger
- Wrist, Routine, Infection, Arthrogram,
- Thumb

Lower Extremity

- Hip Routine, Infection, Arthrogram,Arthrogram Saline ONLY, MARS, Hamstring(illust.)
- Hip – Athletic Pubalgia
- Bony Pelvis
- Sacrum/SI Joints
- Long Bone/Tib Fib/Femur
- Knee Routine, Arthrogram, MARS
- MRA Lower Extremity
- Ankle Routine, Mass/Infection
- Foot Routine, Mass/Infection
- ***General*** Soft Tissue Mass Protocol

MR SHOULDER INDICATIONS

- **Routine Shoulder**
  - Indications
    - Evaluate Rotator Cuff

- **MR Arthrogram**
  - Indications
    - Labrum Pathology/Tear ; Shoulder Instability

- **Post Gadolinium Shoulder (Indirect MR Arthrogram)**
  - Rarely used
  - Indications
    - Suspect labral pathology/Instability with contraindication for shoulder arthrogram
    - Infection

ROUTINE SHOULDER

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T2 FS	160	3.0/0.3	Keep TE between 40-70	
COR T2 FS	160	3.0/0.3	Keep TE between 40-70	
COR T1	160	3.0/0.3		
SAG T2 FS	160	3.0/0.3	Keep TE between 40-70	
OPTIONAL SAG T1	160	3.0/0.3		
			Adjust FOV according to body habitus.	
				Patient's arm should be in neutral position

MR SHOULDER W/WO GAD - INFECTION

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T1	160	3.0/0.3		
AXIAL T2 FS	160	3.0/0.3		
COR T1	160	3.0/0.3		
COR T2 FS	160	3.0/0.3		
SAG T1	160	3.0/0.3		
SAG T2 FS	160	3.0/0.3		
AXIAL T1 FS PRE **CONTRAST**	160	3.0/0.3		
AXIAL T1 FS POST GD	160	3.0/0.3		
*Post Contrast Subtraction sequence				

SHOULDER ARTHROGRAM

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T1 FS	160	3.0/0.3		
AXIAL T2 FS	160	3.0/0.3		
COR T1 FS	160	3.0/0.3		
CORT2 FS	160	3.0/0.3		
SAG T1	160	3.0/0.3		
SAG T2 FS	160	3.0/0.3		
Reposition Patient **ADD ABER FOR ATHLETES				Arm above head – please see illus.
ABER T1 FS	160	3.0/0.3		

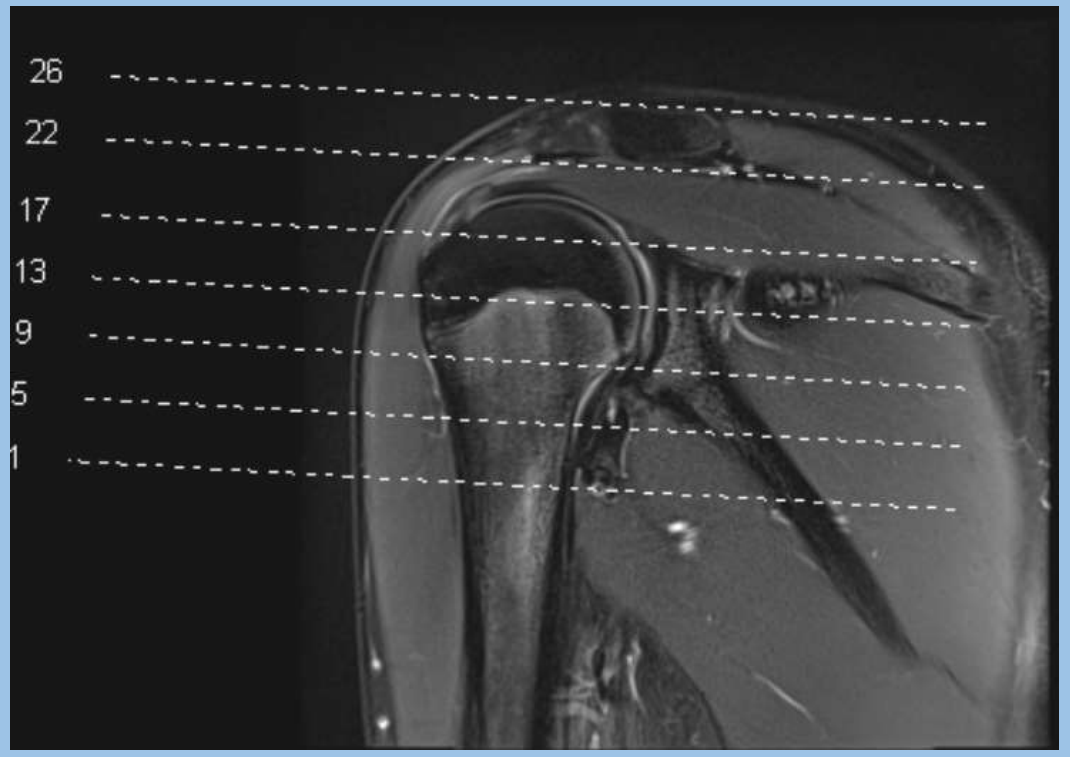
SHOULDER ARTHROGRAM SALINE ONLY

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T2 FS	160	3.0/0.3		
COR T2 FS	160	3.0/0.3		
SAG T2 FS	160	3.0/0.3		
COR T1	160	3.0/0.3		
Reposition Patient **ADD ABER FOR ATHLETES				Arm above head – please see illus.
ABER T2 FS	160	3.0/0.3		

METAL SHOULDER - WARP

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL STIR WARP	160	3.0/0.3		
COR T1 WARP	160	3.0/0.3		
COR T2 STIR WARP	160	3.0/0.3		
SAG T2 STIR WARP	160	3.0/0.3		

AXIAL IMAGING PLANE



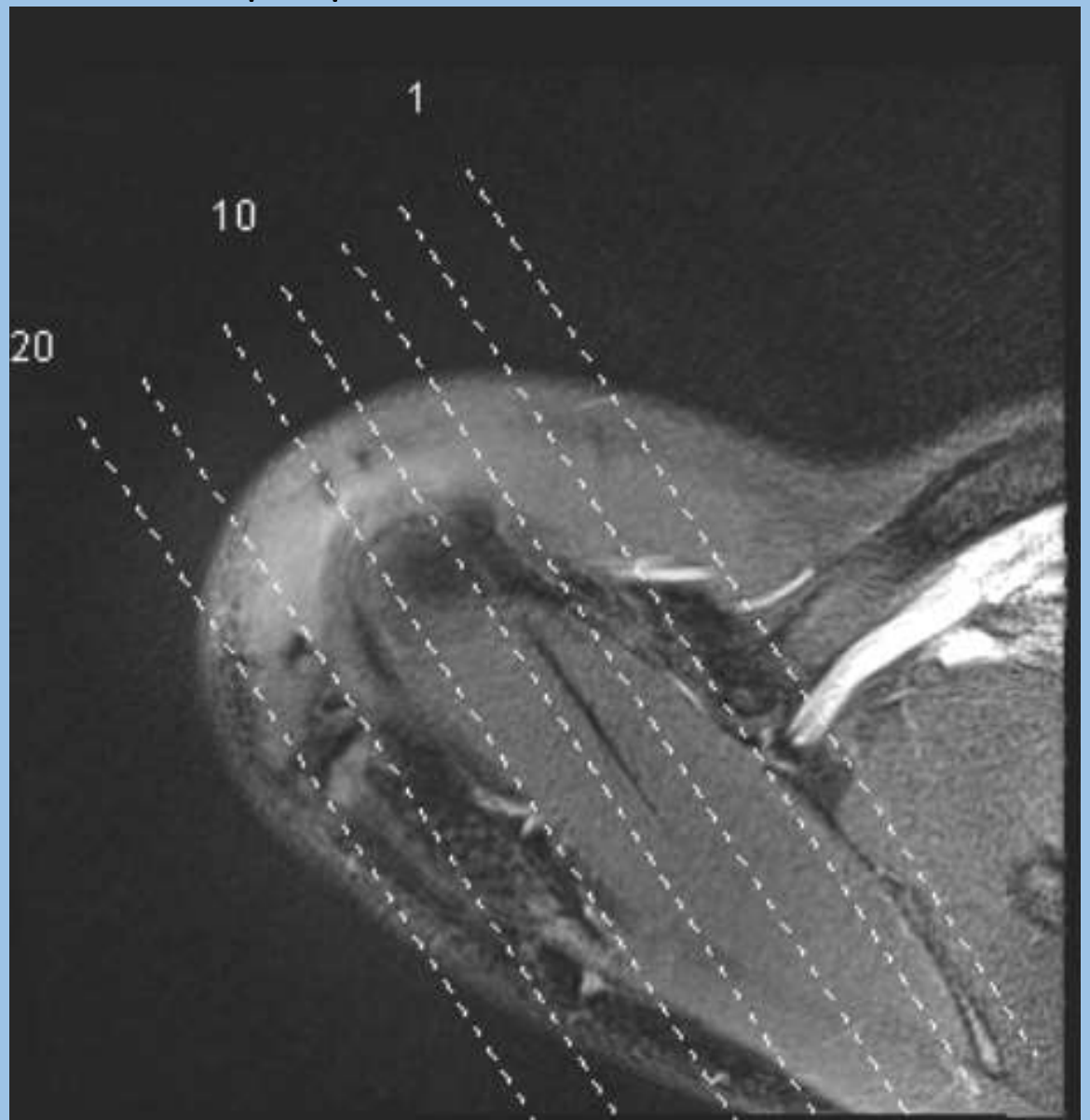
- Imaging plane should be perpendicular to humerus and glenoid fossa
- Be sure to scan thru AC joint and below the glenohumeral ligament

Image from www.healthline.com

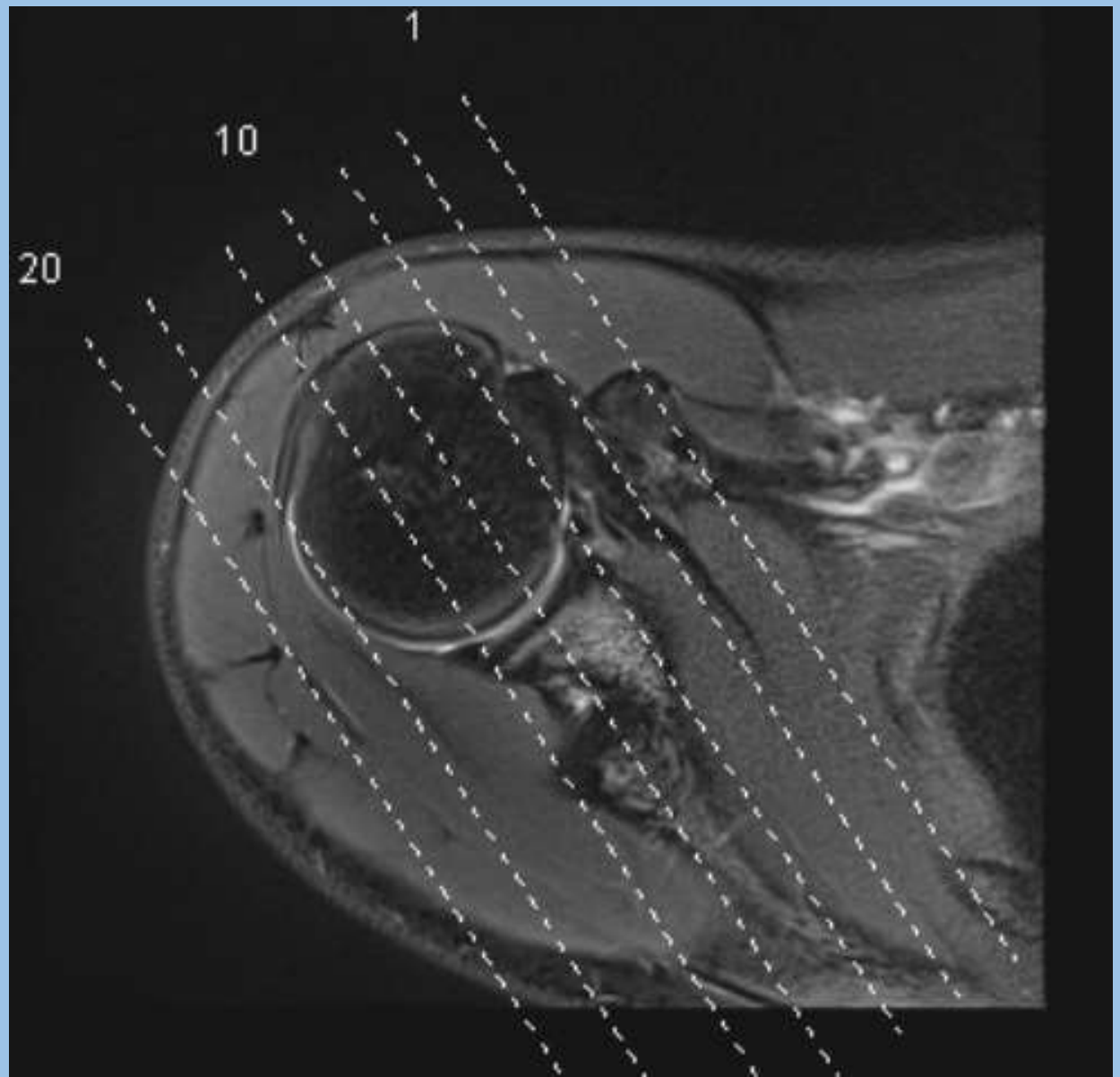
Patient's arm should be in the neutral position

CORONAL IMAGING PLANE

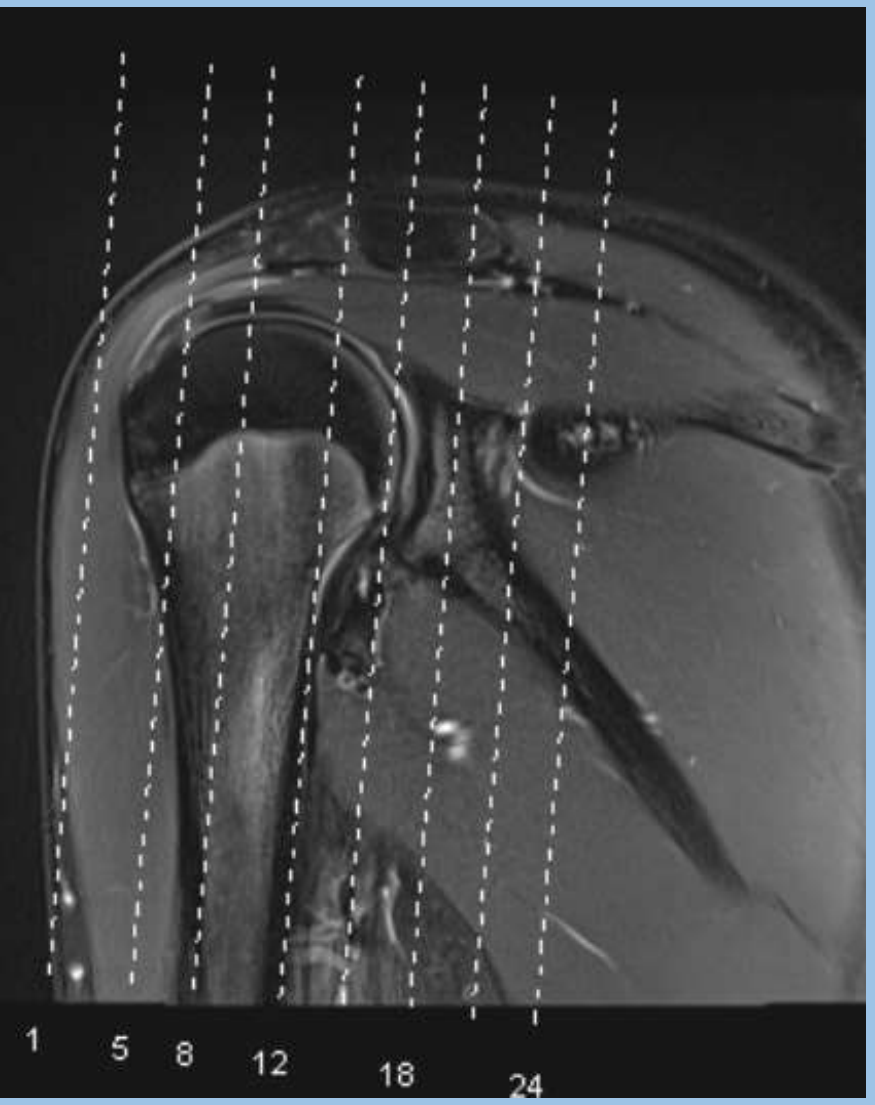
Align slices parallel with supraspinatus tendon/muscle



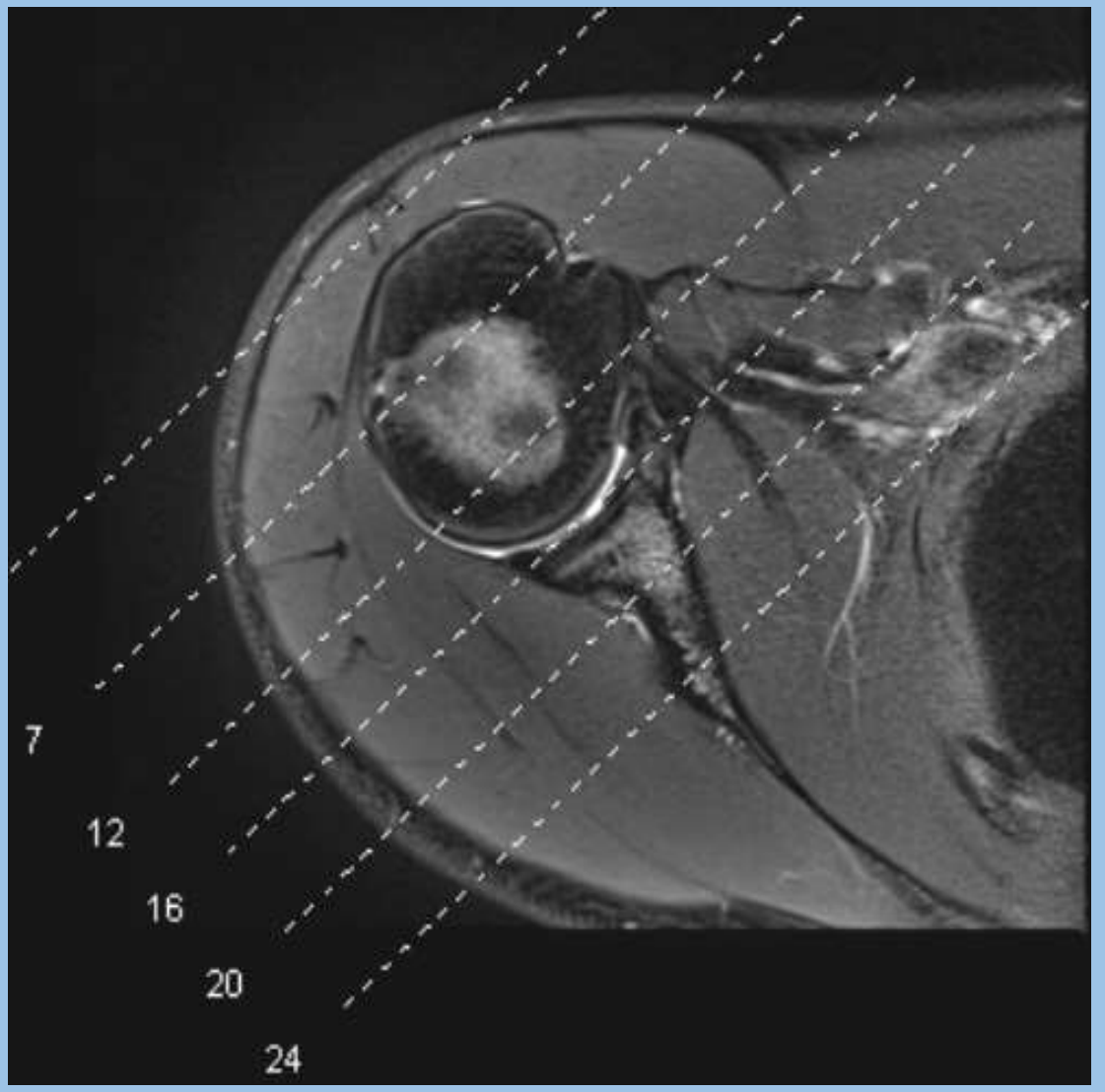
Proper Coverage



SAGITTAL IMAGING PLANE



- Sagittal plane should be parallel to glenohumeral joint
- Cover entire shoulder joint from deltoid muscle to a few slices medial of glenoid fossa



ABER VIEW

- Patient is supine with shoulder abducted and externally rotated above head
- Wrap surface coil around shoulder joint

Image: //radsource.us

Proper Angle/Coverage for Aber View

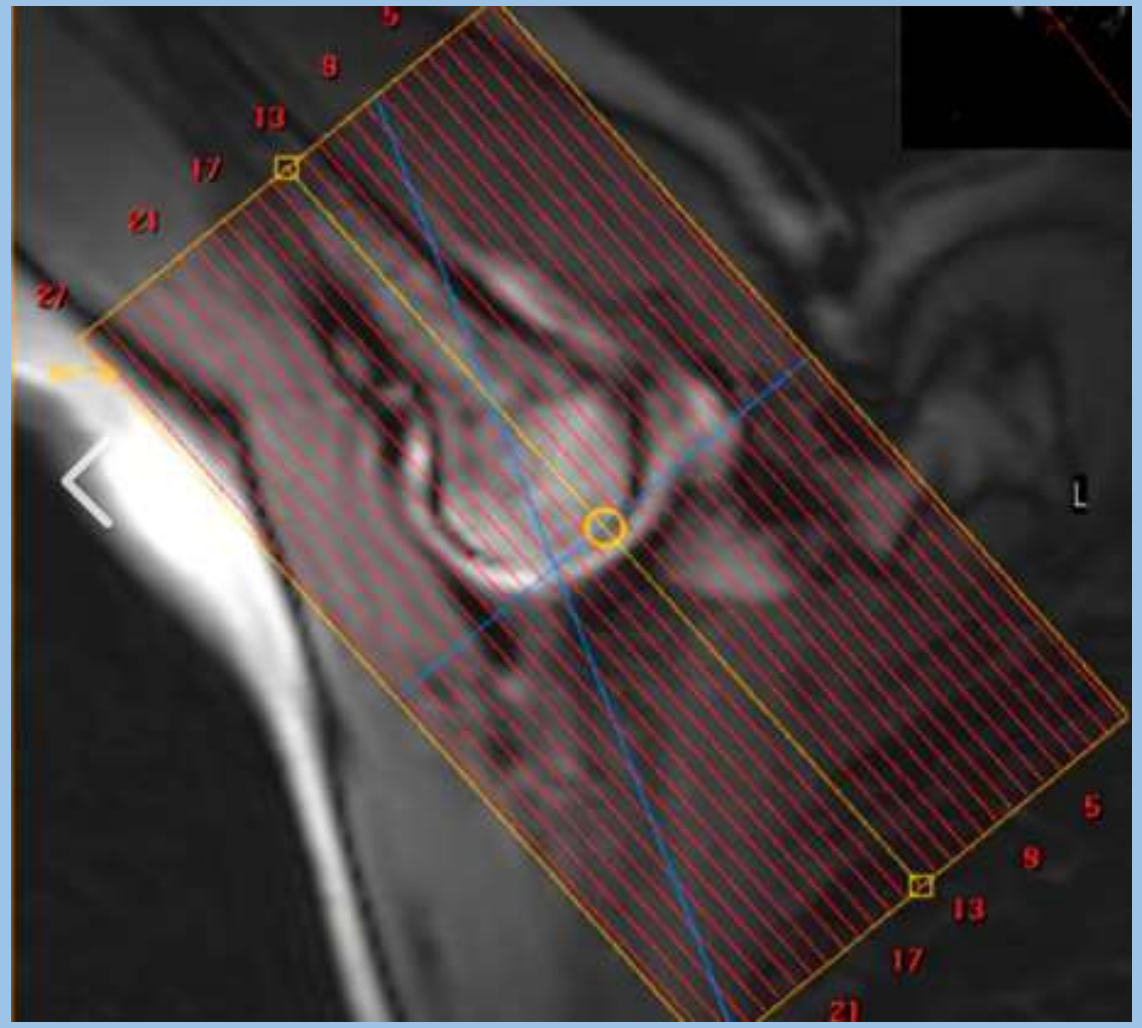


Image source: www.radsource.us

ABER VIEW - Thin solid arrow: Anteroinferior glenoid and labrum. Star: Humeral head. Dotted arrow: Partially imaged supraspinatus.

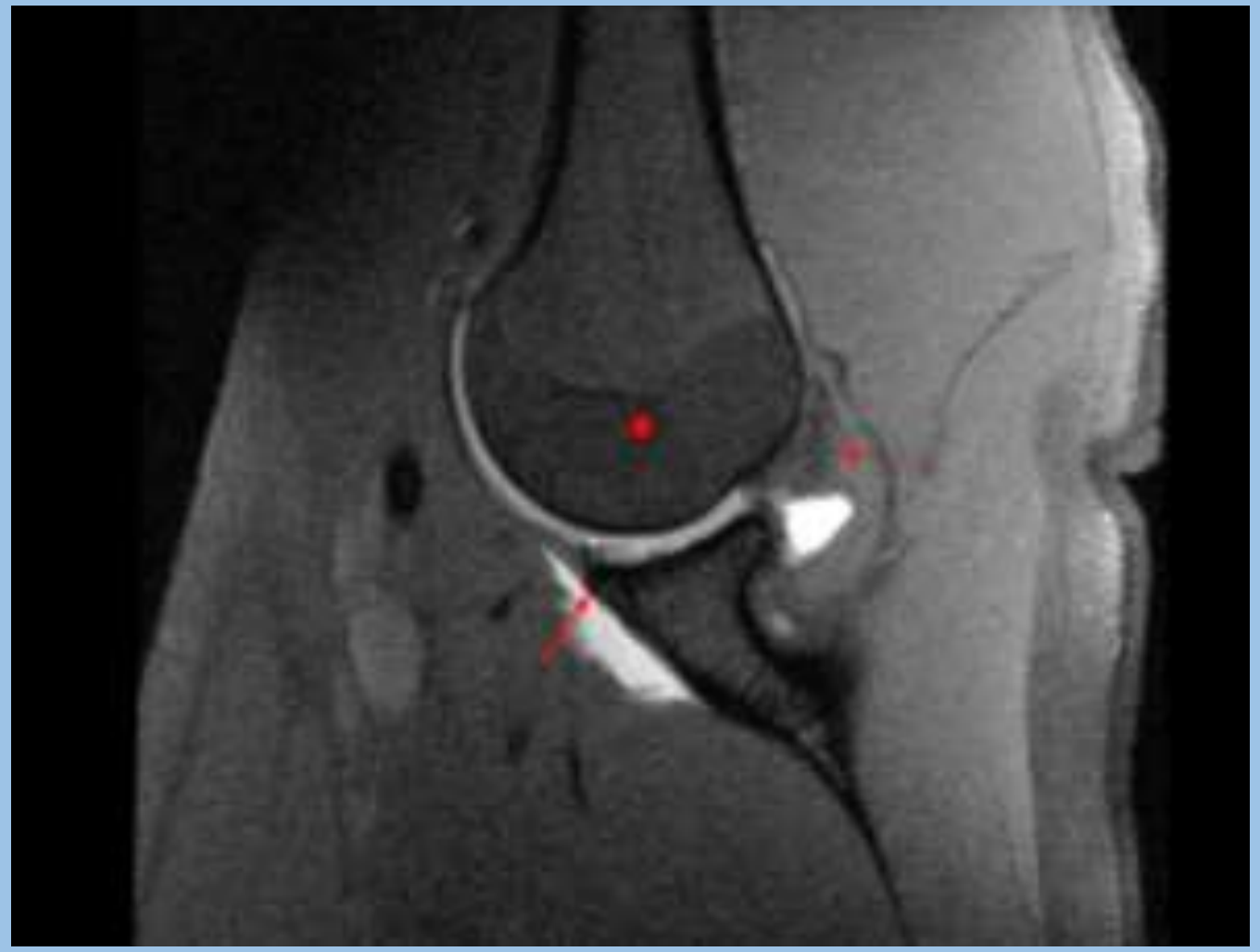


Image source: www.radsource.us

Shoulder Anatomy

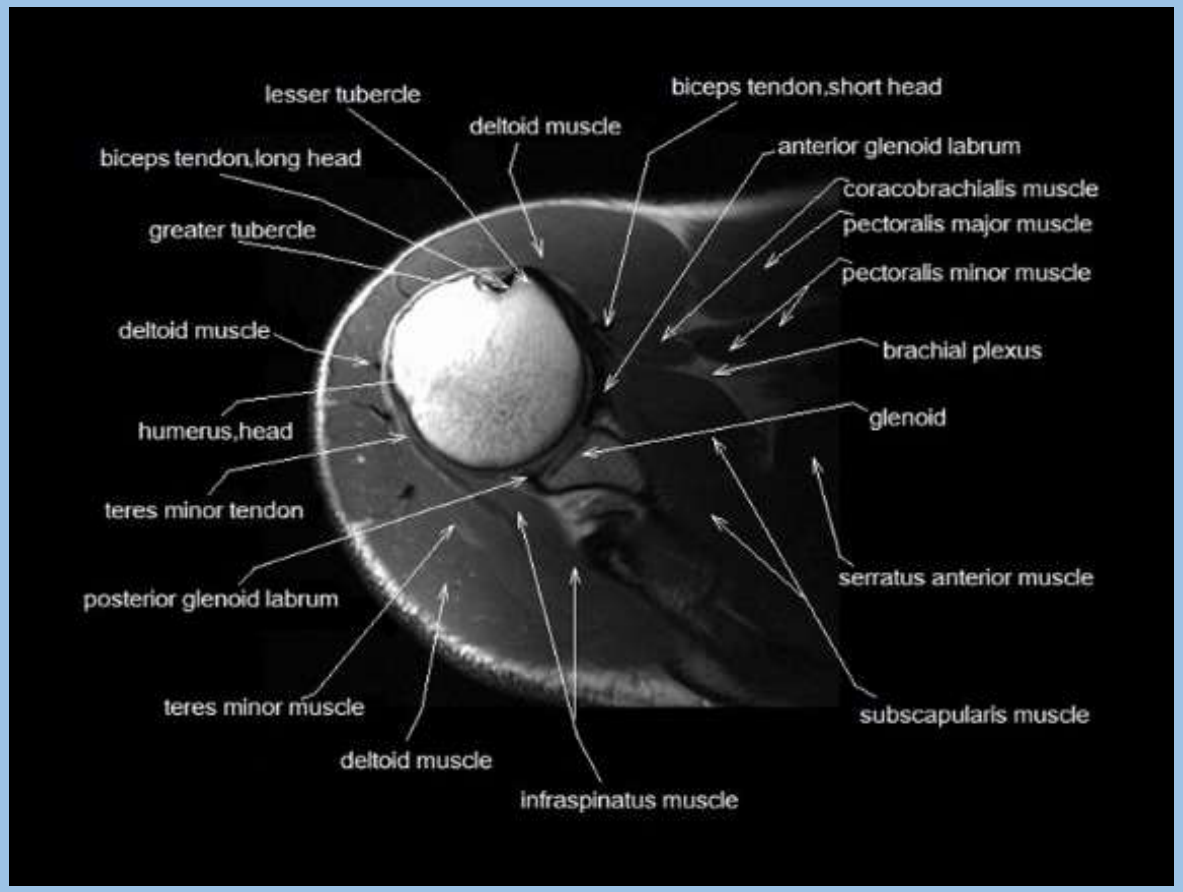


Image from mrimaster.com

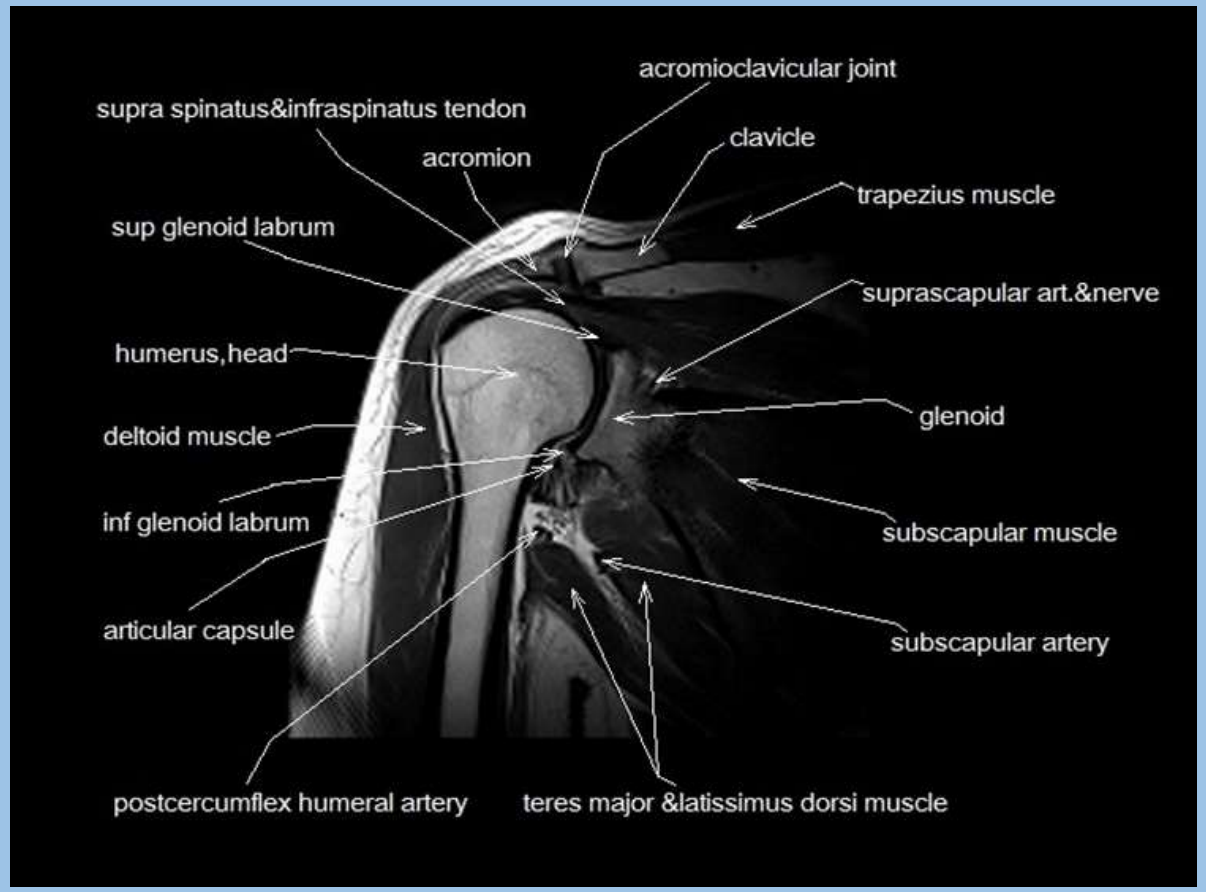
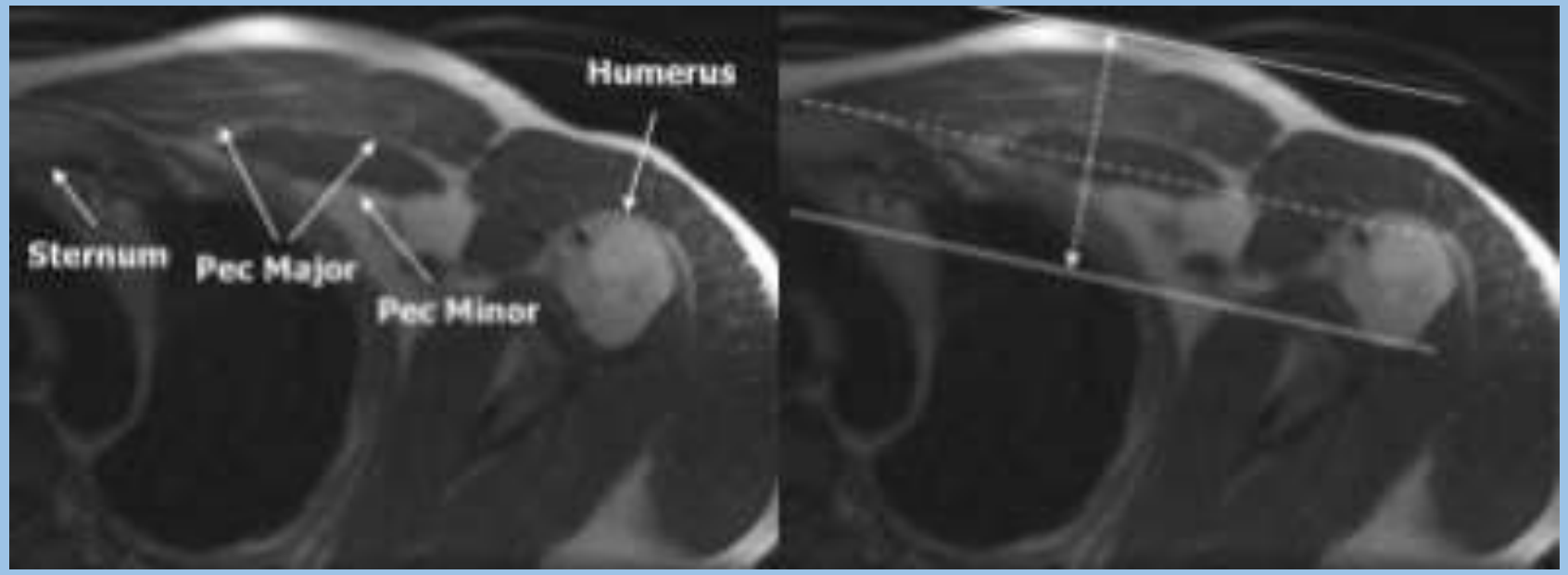


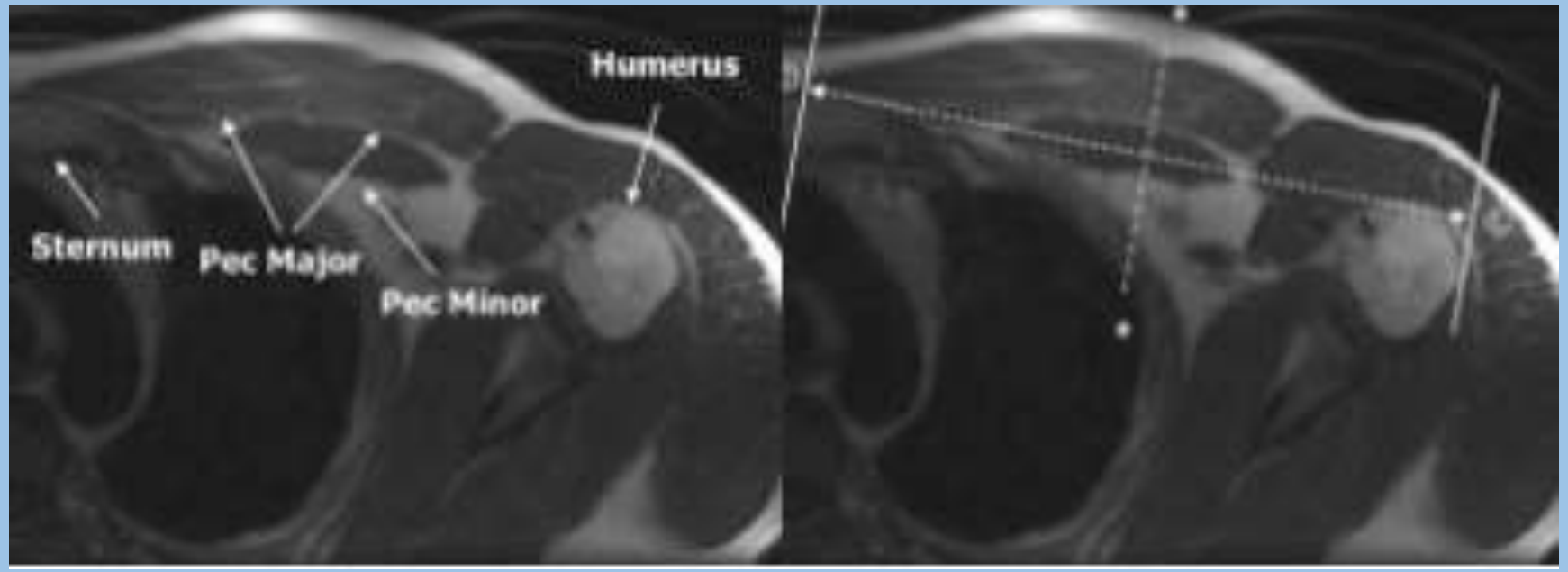
Image from mrimaster.com

PECTORALIS MUSCLE

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T1	200-220	4.5/1.0	*See illustration for coverage	
AXIAL STIR	200-220	4.5/1.0		
AXIAL T2	200-220	4.5/1.0		
COR OBL STIR	200-220	4.5/1.0	*See illustration for angle	
SAG OBL T2 FS	200-220	5.0/1.0	*See illustration for angle	

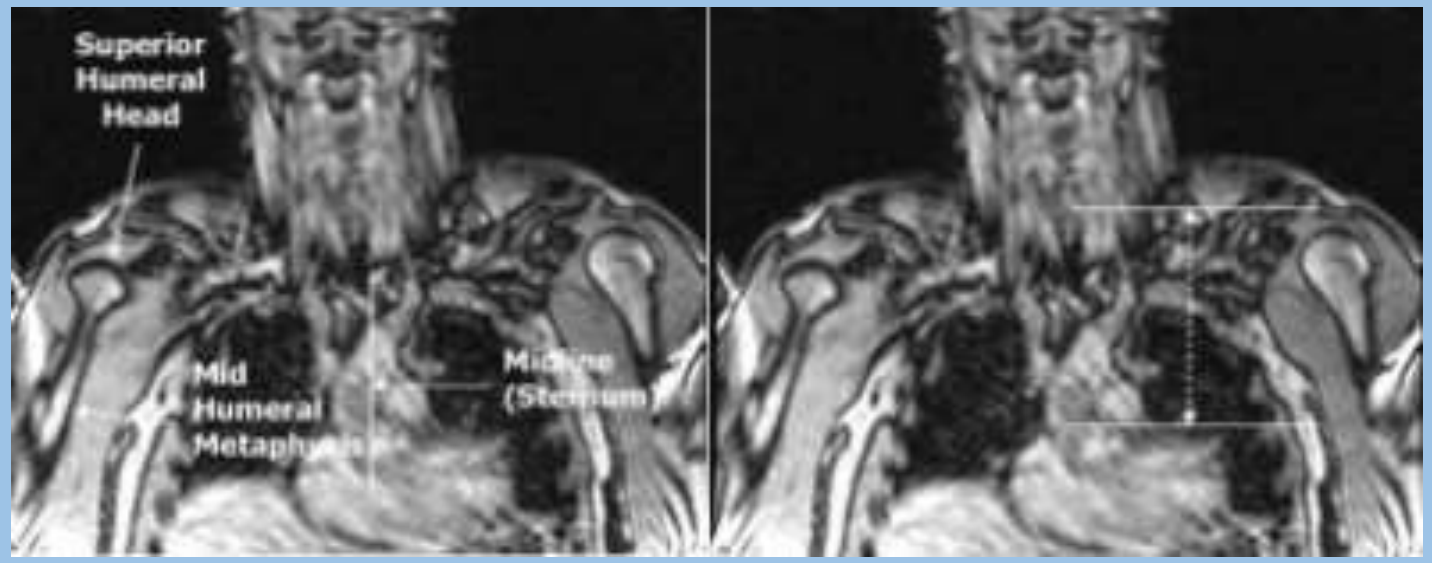


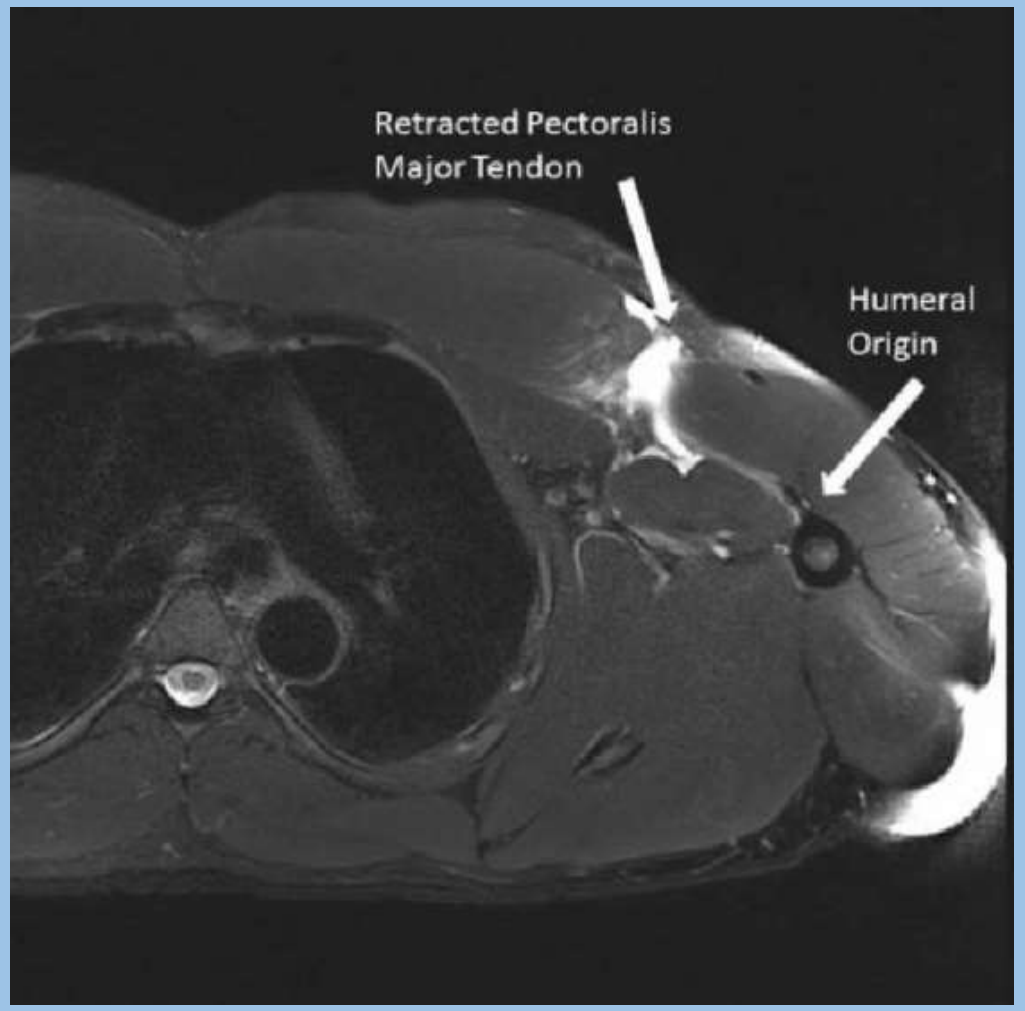
- **Coronal Plane: Prescribe a plane parallel to the line from sternum through anterior humerus. Scan from skin through posterior humeral head. Field of view should include the sternum and humerus.**



- **Sagittal Plane: Prescribe plane perpendicular to coronal plane. Scan From sternum through lateral aspect of humerus**

- **Axial Plane: Scan from superior humeral head through the xyphoid process. The field of view should include the sternum medially, and the humeral shaft laterally.**





EXAMPLE PECTORALIS TEAR

MRA UPPER EXTREMITY (Shoulder to Elbow)

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
3 – PLANE LOCALIZER True FISP		5-8 slices per plane	True FISP localizer under 25 sec. Best to visualize vessels	See illustration next page
AXIAL T1 True FISP, TRUFI or FIESTA		4mm	Cover affected shoulder to elbow. Phase direction A-P to avoid wrap from abdomen	Add Sat Band over chest to reduce breathing motion
CORONAL True FISP, TRUFI or FIESTA		4mm	Cover affected shoulder to elbow	
CORONAL T1 FLASH DYNAMIC 3D		4mm	Cover affected shoulder to elbow	
CARE BOLUS CONTRAST		Use a Coronal Plane; angle parallel to ascending aorta	See comments for timing on next page	See illustration next page
CORONAL T1 FLASH DYNAMIC 3D		4mm	Include Rotating 3-D max-intensity projection reformats (MIPS)	2 Measurements less than 20 sec. each

NOTE: TRICKS OR TWIST can be used instead of CARE BOLUS if scanner has capability.

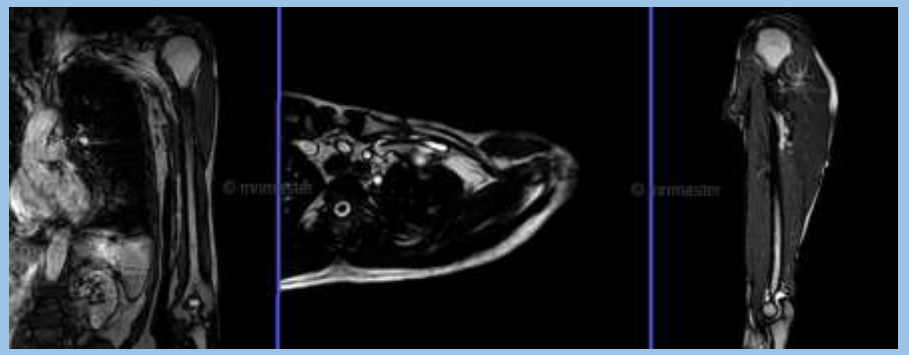
POSITIONING

Images from mrimaster.com

CARE BOLUS

Images from mrimaster.com

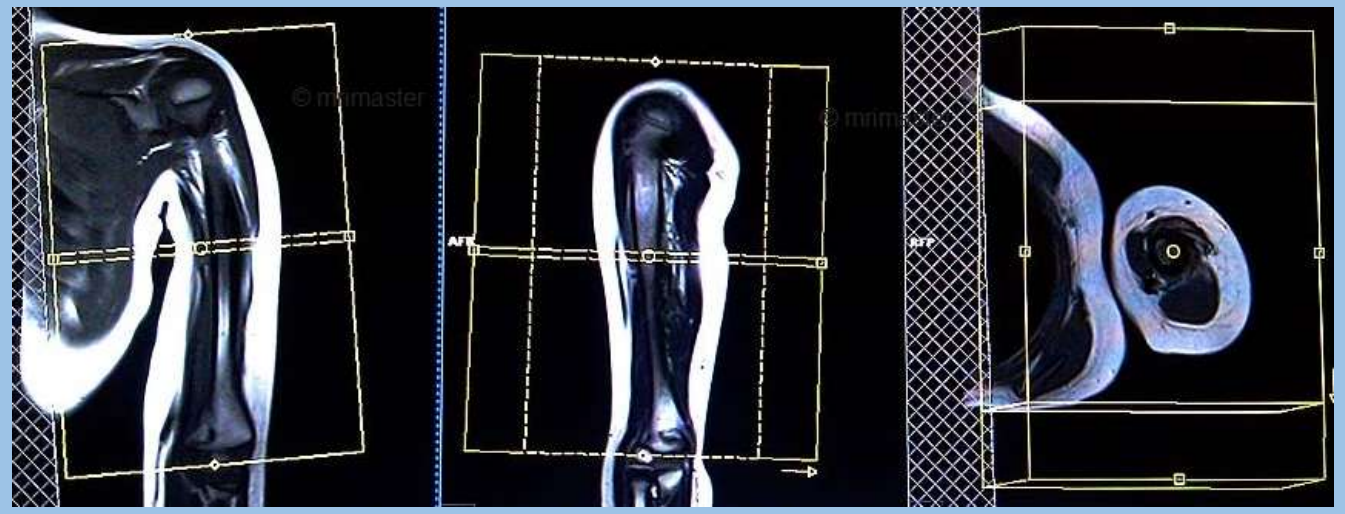
LOCALIZER



Images from mrimaster.com

- PLAN THE CORONAL CARE BOLUS ON A SAGITTAL IMAGE
- ANGLE PARALLEL TO ASCENDING AORTA
- WATCH CONTRAST FILL THE HEART
- START SCAN WITH A 2 – 3 SECOND DELAY AFTER CONTRAST ENTERS HEART. THIS ALLOWS TIME FOR THE CONTRAST TO REACH THE ARM
- BE SURE POST CONTRAST SCAN IS 2 MEASURMENTS TO IMAGE BOTH ARTERIAL AND VENOUS PHASES

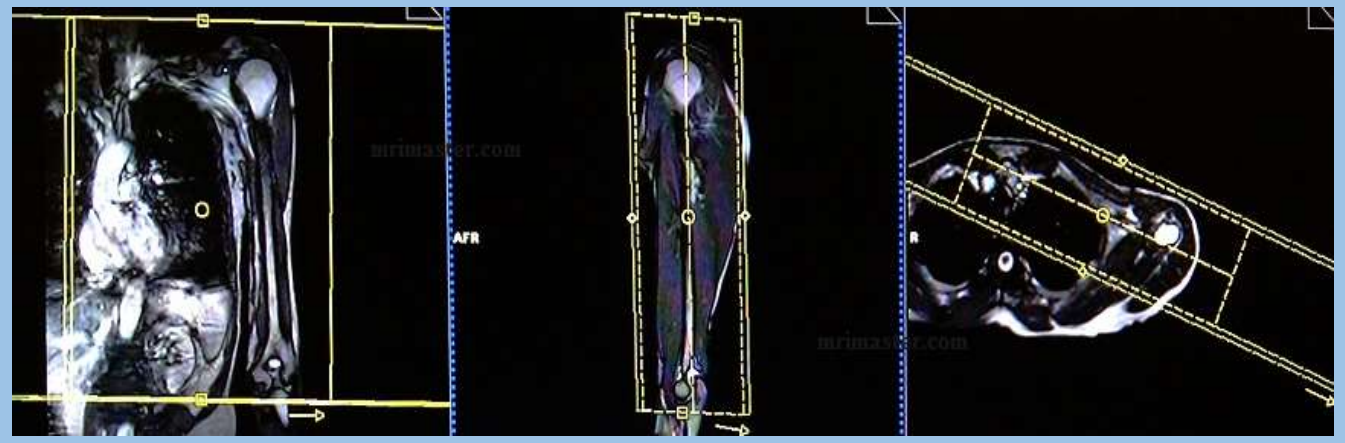
AXIAL COVERAGE



Images from mrimaster.com

- BE SURE TO ADD SAT BAND OVER CHEST TO REDUCE BREATHING MOTION
- PHASE DIRECTION SHOULD BE A-P

CORONAL ANGLE/COVERAGE



Images from mrimaster.com

- BE SURE TO COVER SHOULDER TO ELBOW
- PHASE OVERSAMPLING MUST BE 100% TO AVOID WRAP
- DYNAMIC POST CONTRAST COR SCAN MUST BE 2 MEASUREMENTS, LESS THAT 20 SECONDS EACH

MR CLAVICLE INDICATIONS

- **Routine Clavicle**
  - Indications
    - Metastatic disease
    - Multiple myeloma
    - Tumors or tumorous lesions of the clavicle

CLAVICLE

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T1	200-230	3.0/0.3	Use flex surface coil	
AXIAL T2 STIR	200-230	3.0/0.3		
COR T1	200-230	3.0/0.3		
COR T2 STIR	200-230	3.0/0.3		
SAG T2 STIR	170-200	3.0/0.3		
			*Blade sequences and sat bands can help reduce motion artifact	

SCOUT IMAGING

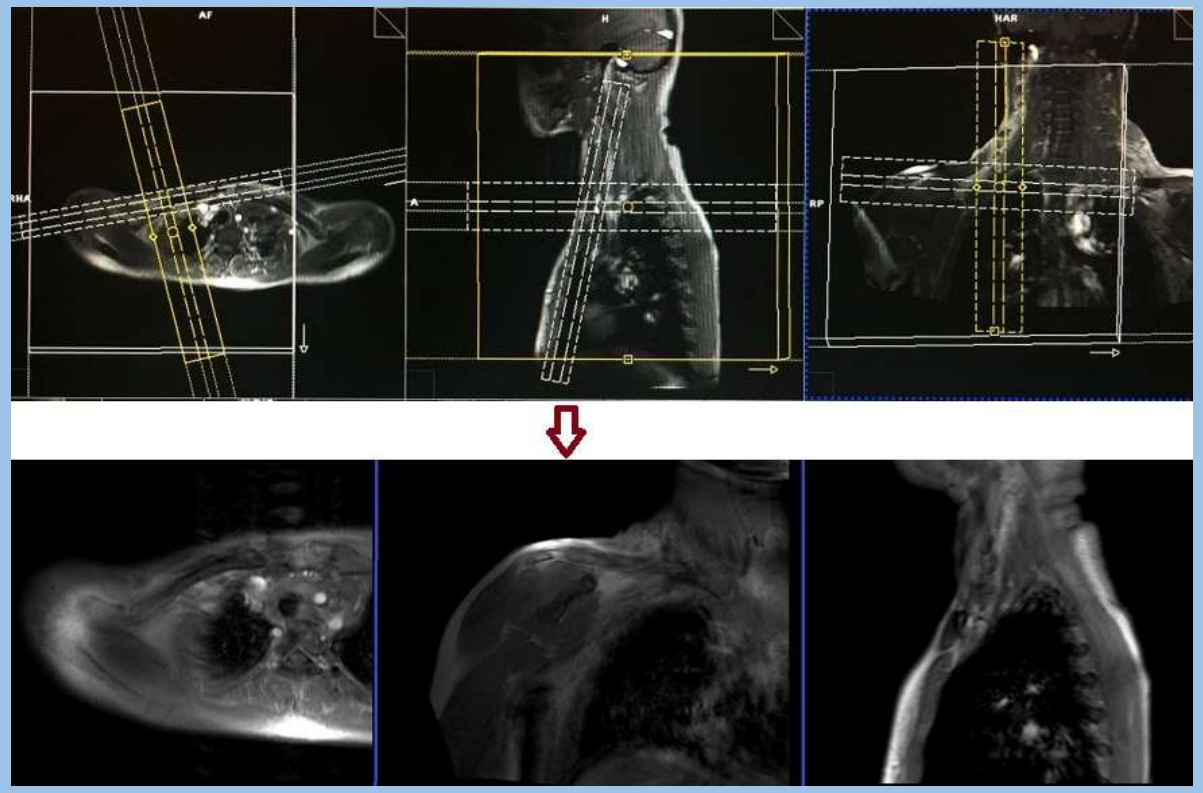
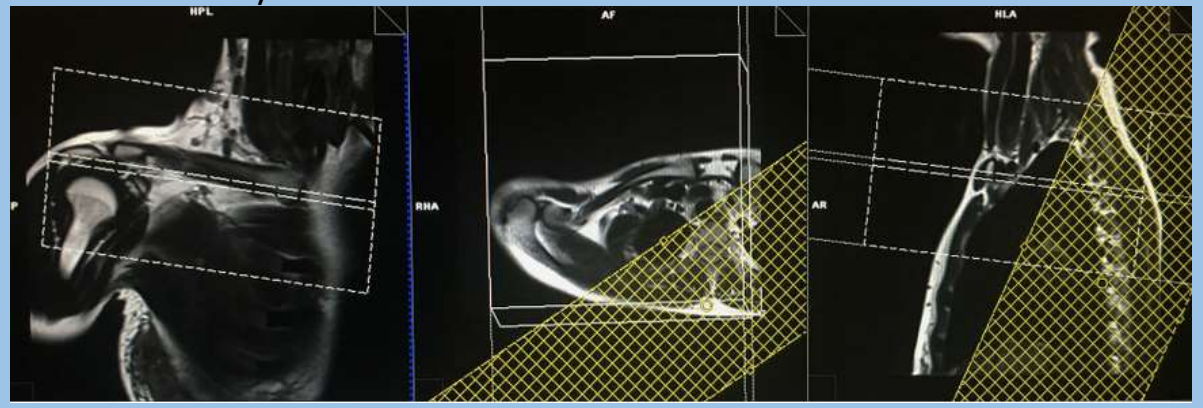
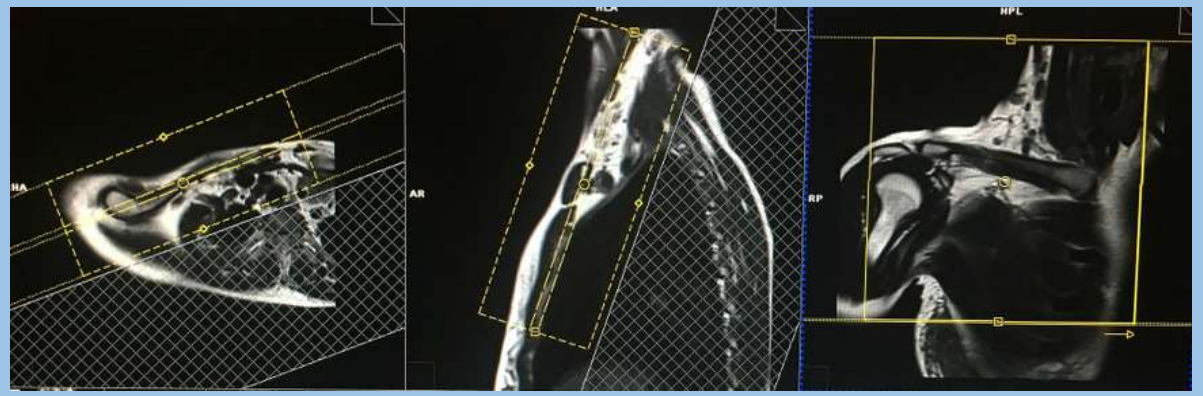


IMAGE SOURCE: WWW.MRIMASTER.COM

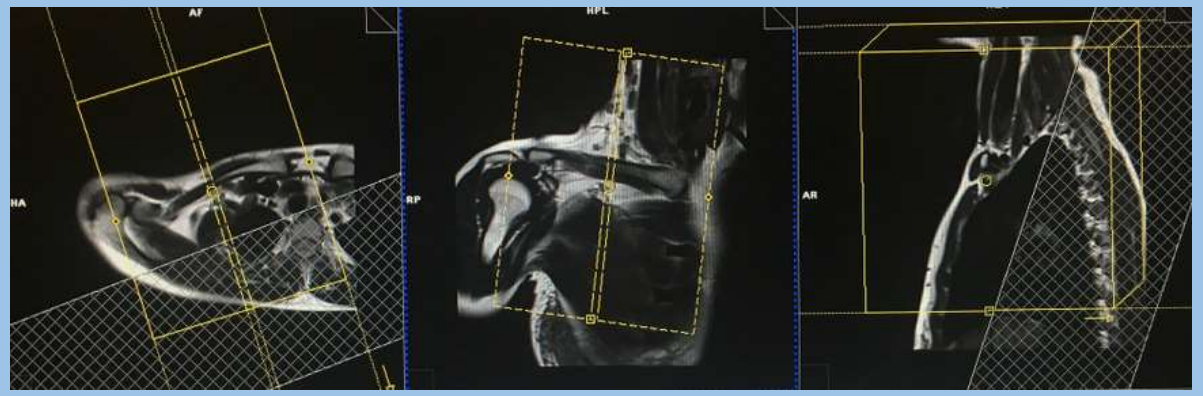
AXIAL ANGLE/COVERAGE



COR ANGLE/COVERAGE



SAG ANGLE/COVERAGE



MR SCAPULA INDICATIONS

- **Routine Scapula-Typically performed w/contrast in the setting of infection or tumor**
  - Example Indications
    - Osteochondroma
    - Osteosarcoma
    - Fibromas in the scapular region
    - Ewing's sarcoma
    - Gorham's disease of scapula
    - Paget disease
    - Infection of bone, joint or soft tissue

SCAPULA

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T1	280	4.0/0.4	Use flex surface coil	
AXIAL T2 STIR	280	4.0/0.4	*Blade sequences and sat bands can help reduce motion artifact	
SAG T1	280	4.0/0.4		
SAG T2	280	4.0/0.4		
COR STIR	280	4.0/0.4		
IF ORDERED WITH **CONTRAST**			*Be sure to include inferior, medial margin See illustration	
AX T1 FS PRE	280	4.0/0.4	**Include subtraction images (pre & post axial T1 FS) for tumor protocol	
AX T1 FS POST	280	4.0/0.4		
COR T1 FS POST	280	4.0/0.4		
SAG T1 FS POST	280	4.0/0.4		

Scapula Scout/localizer

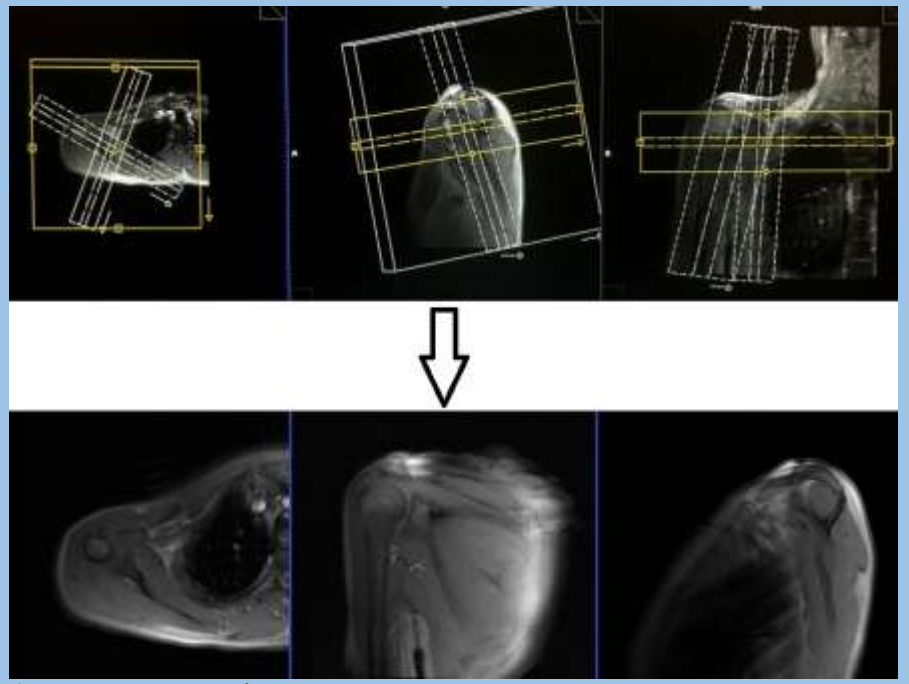
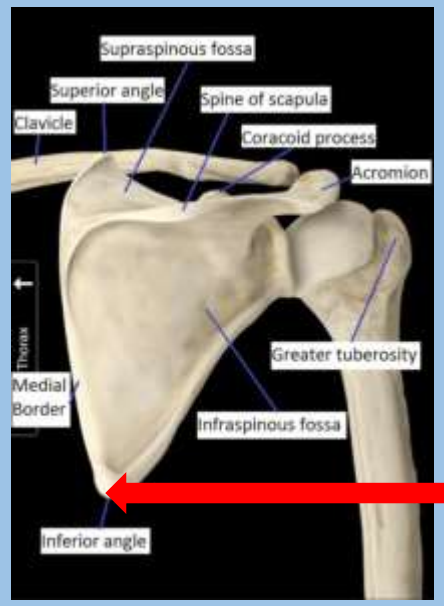
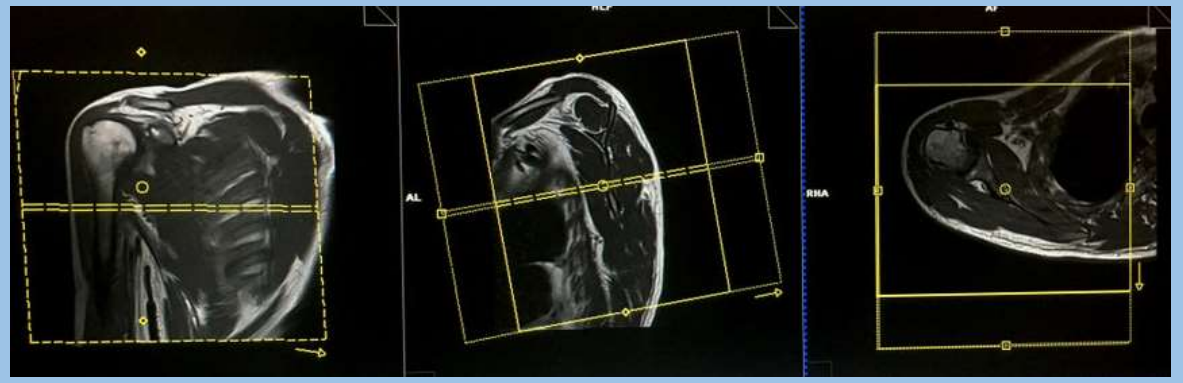


Image source: www.mrimaster.com

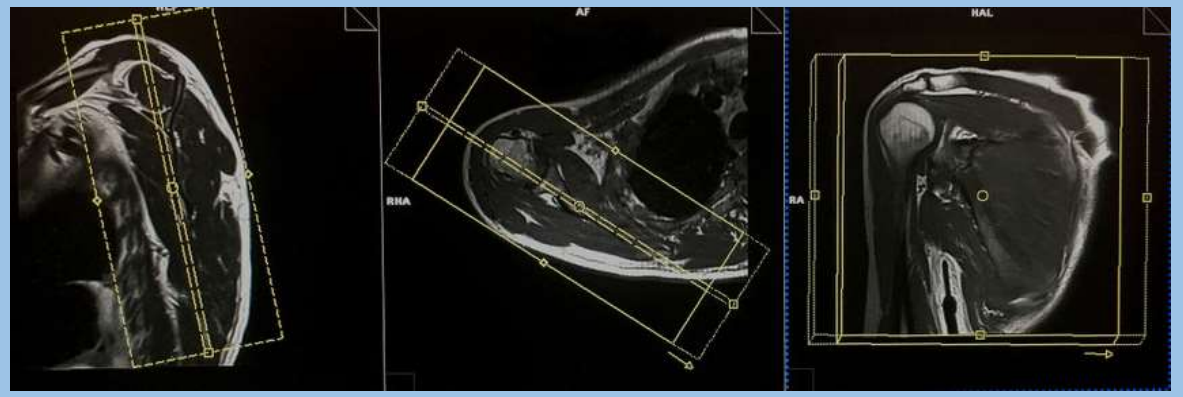


***BE SURE TO INCLUDE INFERIOR MEDIAL MARGIN IN FOV**

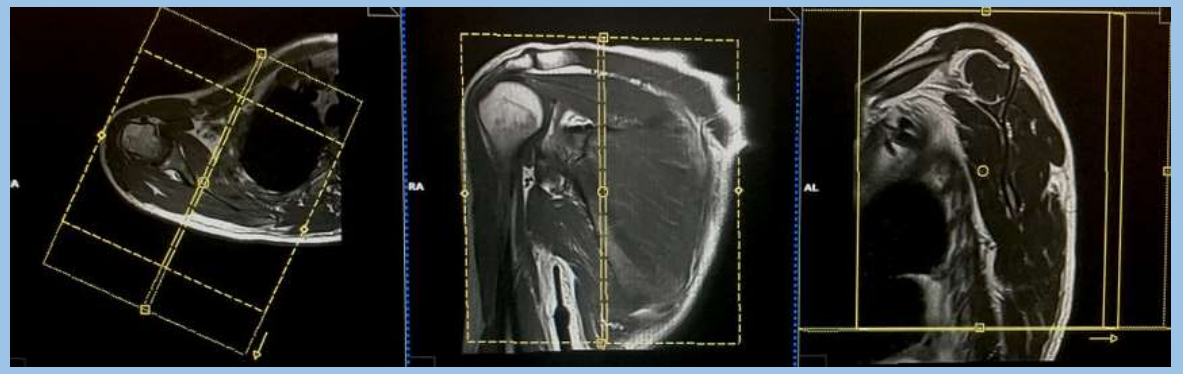
AXIAL ANGLE/COVERAGE



COR ANGLE/COVERAGE



SAGITTAL ANGLE/COVERAGE



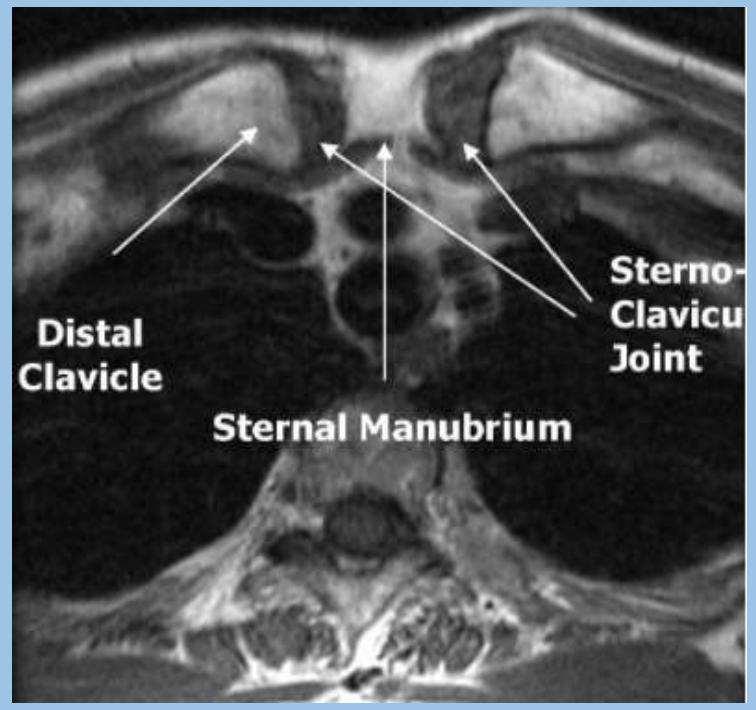
MR STERNUM/SC JOINTS INDICATIONS

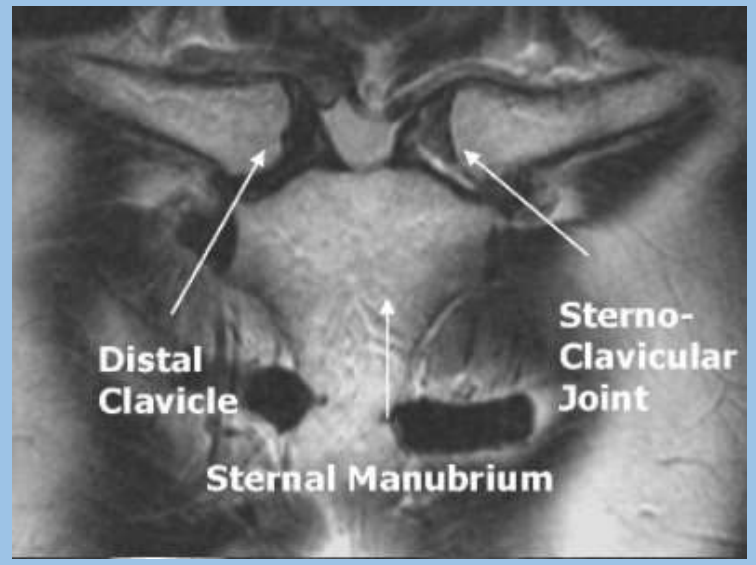
- **Routine SC Joints**
  - Indications
    - Trauma- non-contrast
    - Arthritis – may include contrast
    - Tumor – with contrast
    - Infection – with contrast

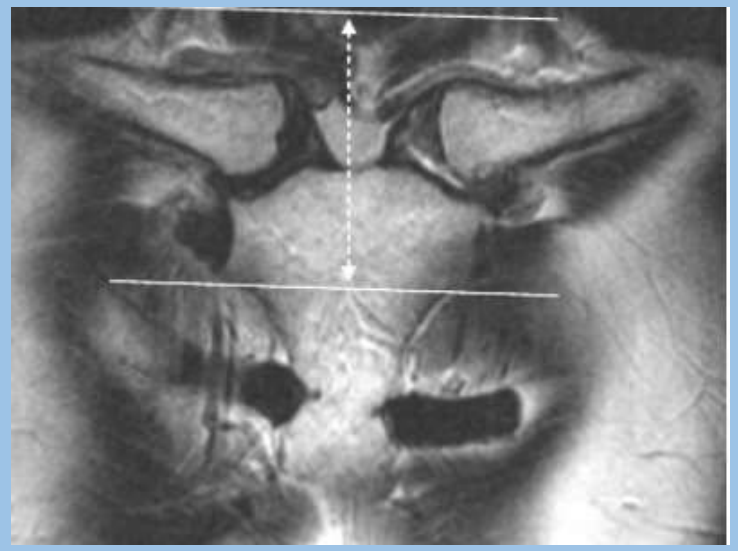
STERNO-CLAVICULAR JOINTS

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T2 FS	200-230	3.0/0.3	**Be sure to include both SC joints	
SAG T1	200-230	4.0/1.0		
SAG T2 FS	200-230	4.0/1.0		
COR T1	200-230	3.0/0.3		
COR STIR	200-230	3.0/0.3		
COR T2 FS	200-230	3.0/0.3	*TIP- Less motion if patient can be positioned prone- use spine coil	Patient can also be scanned supine, use anterior neck coil, spine coil and body matrix
			**PROTOCOL SIMILAR TO STERNUM BUT WITH SMALLER FOV	Utilizing Blade helps reduce motion from heart/lungs

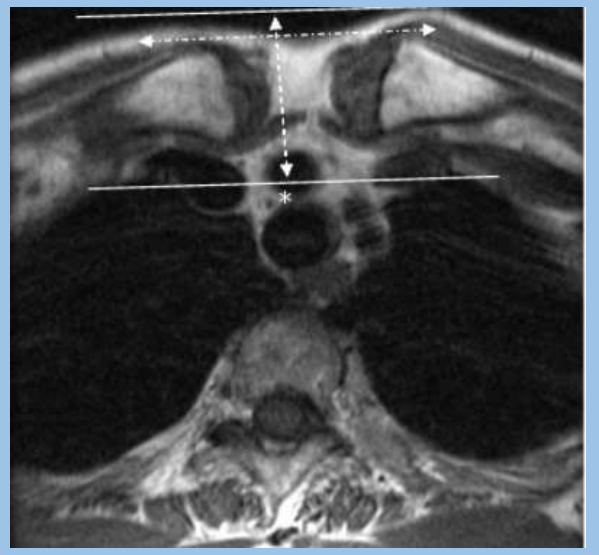
RELEVENT ANATOMY



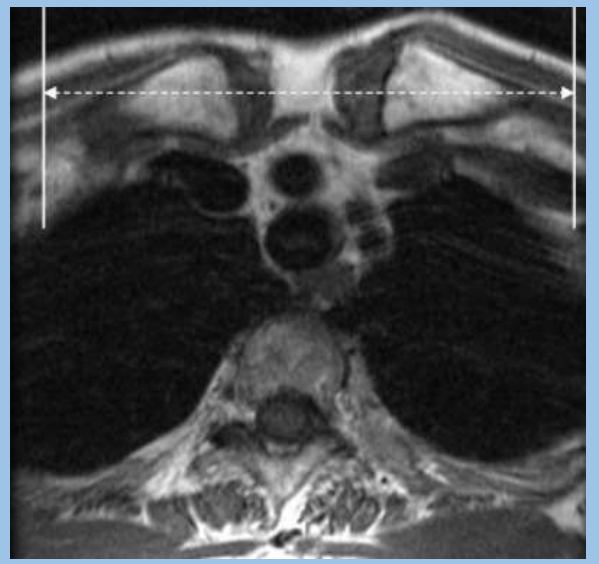




AXIAL COVERAGE



CORONAL COVERAGE

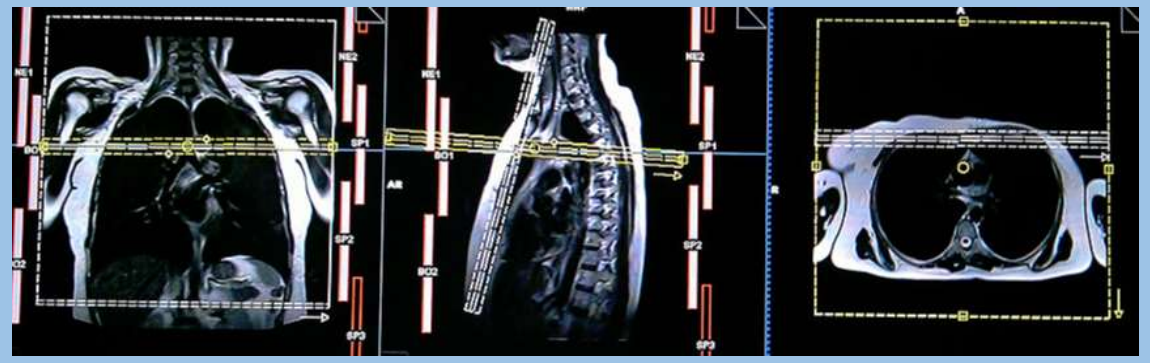


SAGITTAL COVERAGE

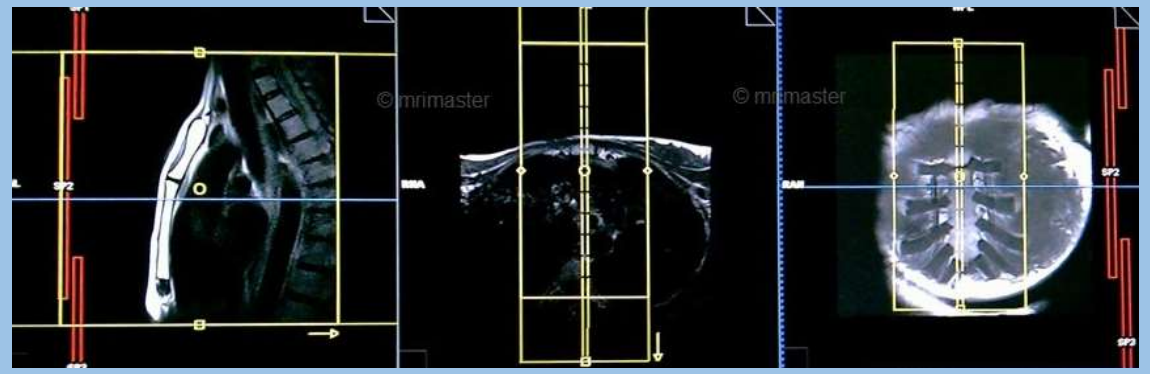
STERNUM

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T2 FS	200-240	3.0/0.3		
SAG T1	200-300	4.0/1.0		
SAG T2 FS	200-300	4.0/1.0		
COR T1	200-280	3.0/0.3		
COR STIR	200-280	3.0/0.3		
COR T2 FS	200-280	3.0/0.3		
			*Adjust FOV according to body habitus	

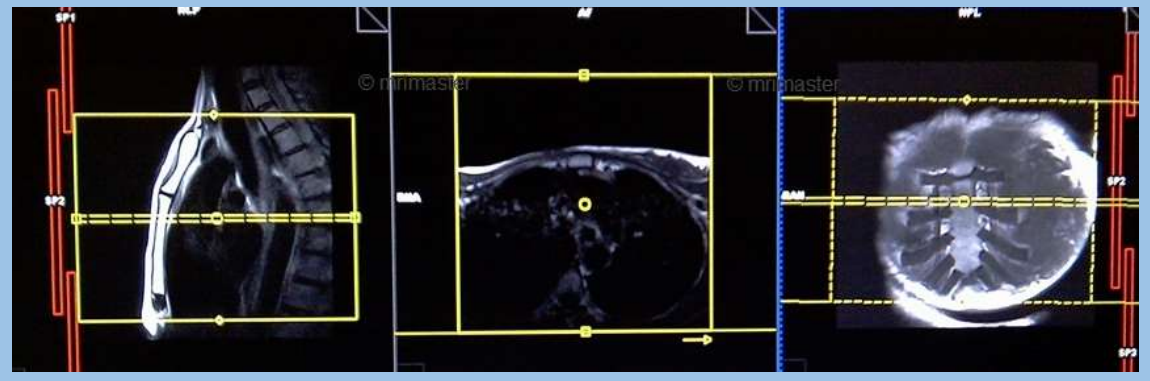
SCOUT/LOCALIZER



SAGITTAL COVERAGE



AXIAL COVERAGE



COR/OBL ANGLE - COVERAGE

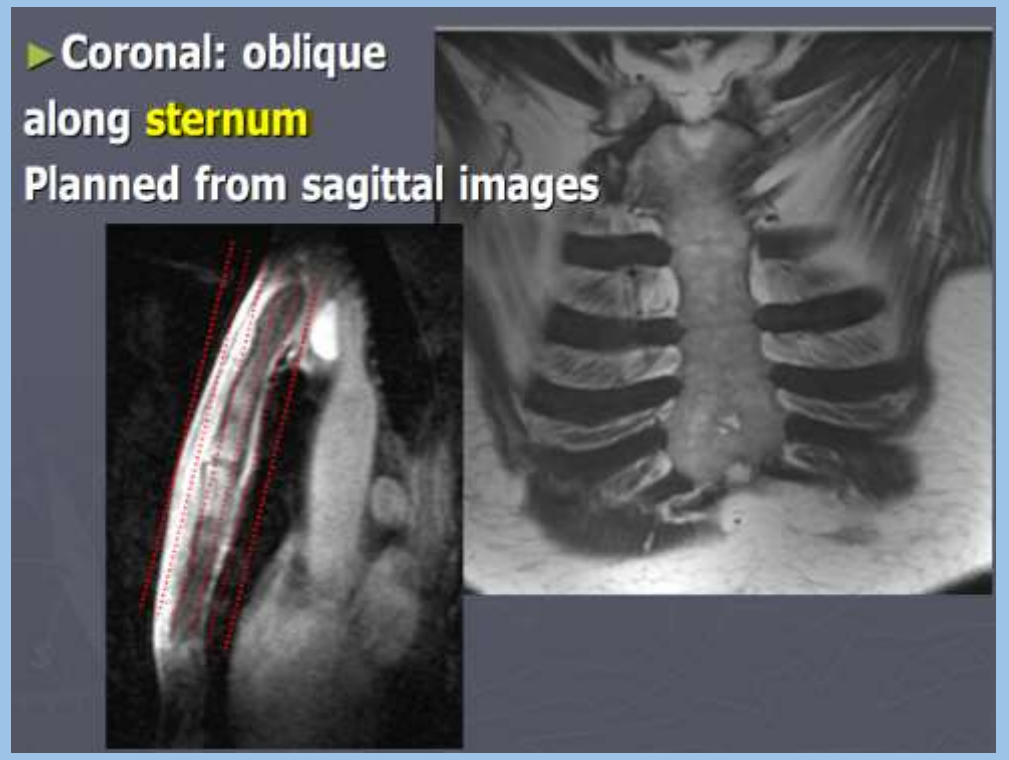


Image Source: www.jefferson.edu

MR ELBOW INDICATIONS

- **Routine Elbow**
  - Indications
    - Biceps/Triceps tear
    - Medial/Lateral collateral ligament tear
- **MR Arthrogram**
  - Indications
    - Medial/Lateral Collateral ligament evaluation
    - Osteochondral defect (OCD)
    - Intra articular body evaluation
- **Post Gadolinium (Indirect MR Arthrogram)**
  - Rarely used
  - Indications
    - Suspect IA body
    - Infection

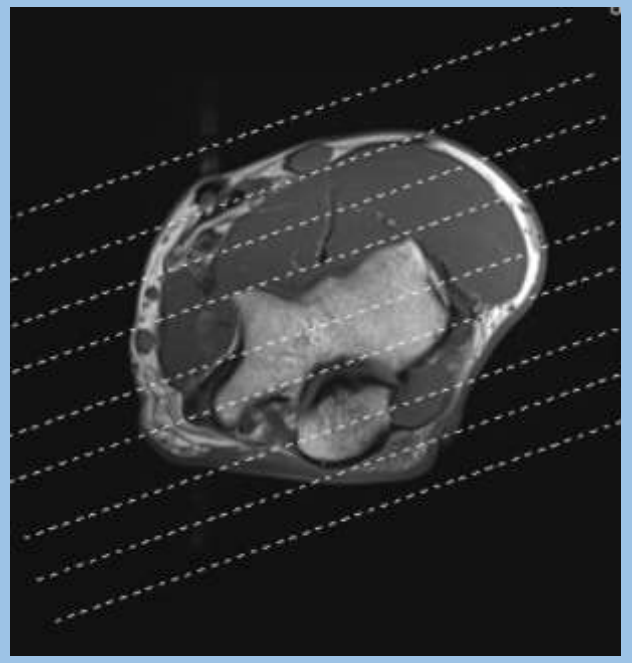
ELBOW ROUTINE

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T2 FS	140	3.0/0.3		Patients can be positioned prone or supine
AXIAL T1	140	3.0/0.3		**Try and get elbow as close to isocenter as possible for best fat saturation
COR T2 FS	160	3.0/0.3		
COR T1	160	3.0/0.3		
COR PD	160	3.0/0.3		
SAG T2 FS	160	3.0/0.3		
FABS VIEW T2 FS	160	3.0/0.3	For Bicep tendon pathology.	Patient is prone for this sequence. See positioning illustration.

ELBOW ARTHROGRAM

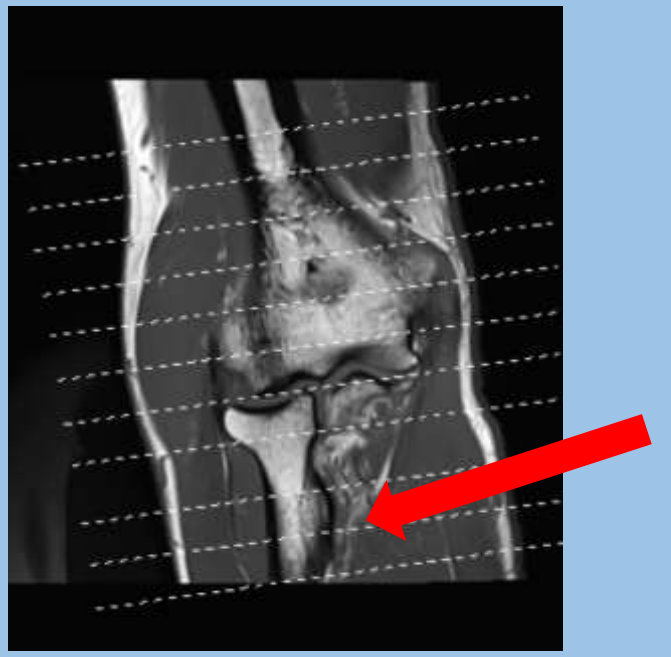
Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T2 FS GD	140	3.0/0.3		
AXIAL T1 FS GD	140	3.0/0.3		
COR T2 FS GD	160	3.0/0.3		
COR T1 FS GD	160	3.0/0.3		
SAG T1 FS GD	160	3.0/0.3		
SAG T2 FS GD	160	3.0/0.3		

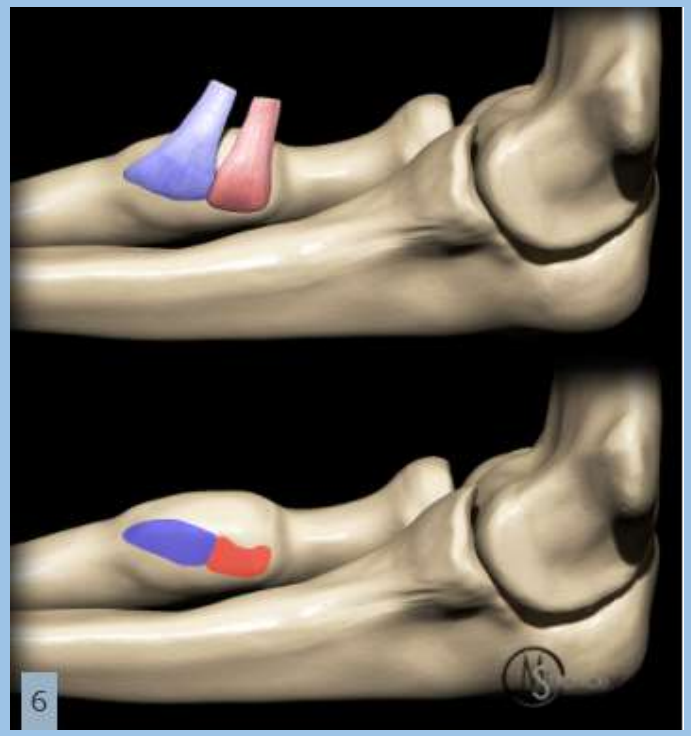
CORONAL ANGLE/COVERAGE



- **PROPER AXIAL COVERAGE – BE SURE TO SCAN THRU BICEP TENDON INSERTION**
- Angle parallel to medial and lateral humeral epicondyles for **Coronal** plane
- **Sagittal plane** is perpendicular to coronal plane- Scan through entire elbow

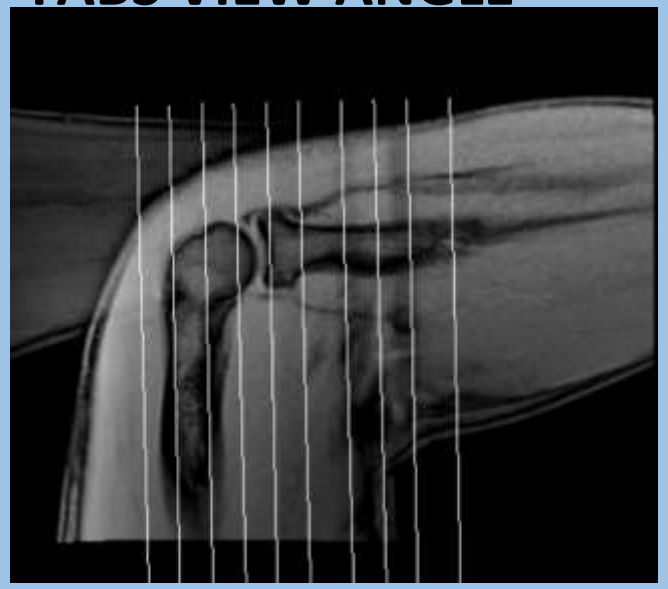
AXIAL COVERAGE





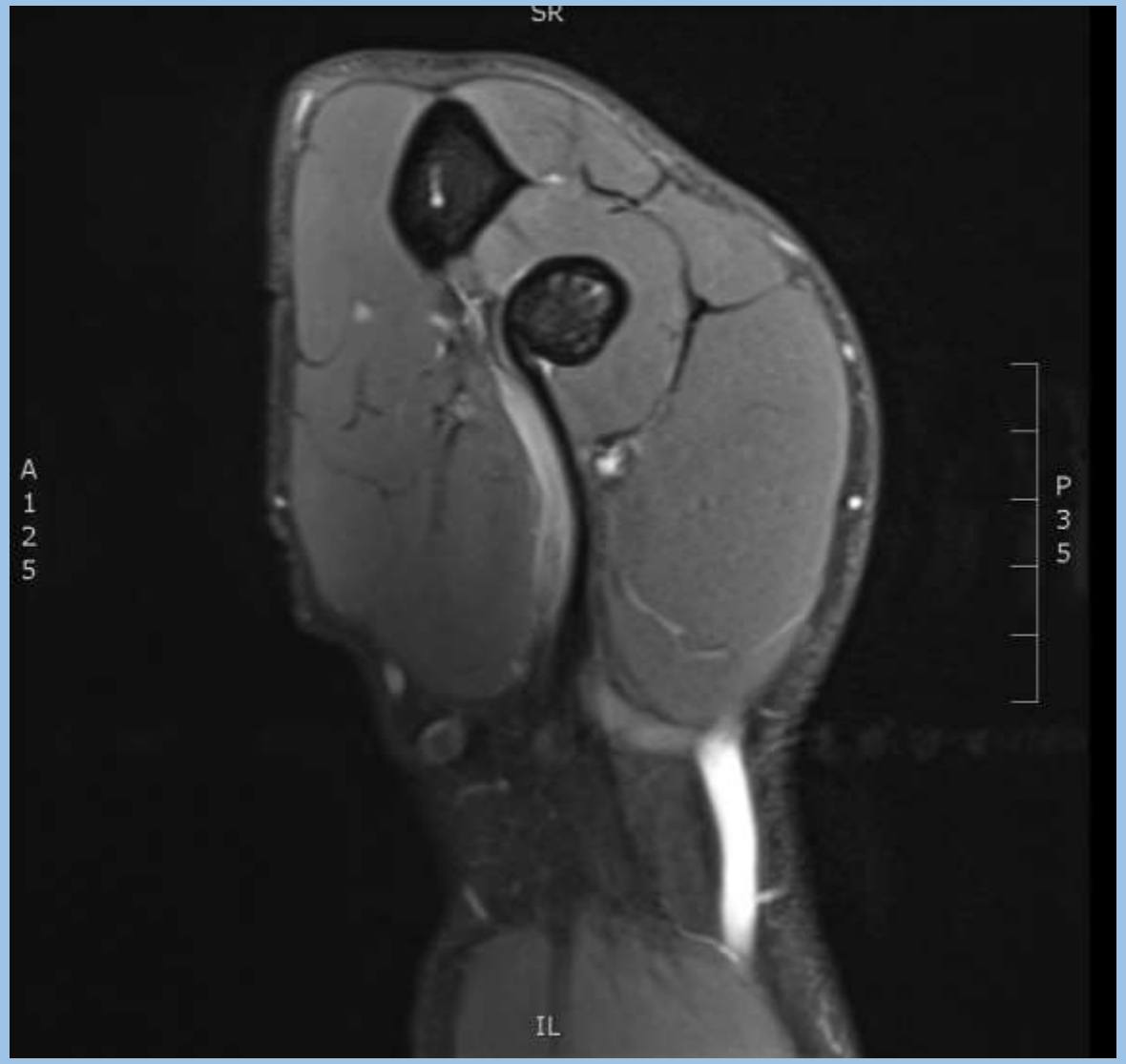
Bicep Tendon - The distally inserting short head component (blue) has a larger footprint and covers the apex of the bicipital (radial) tuberosity while the long head component (red) inserts on the proximal portion of the bicipital (radial) tuberosity in a more posterior location.

FABS VIEW ANGLE



Keep elbow at 90 degree angle with thumb supinated (pointing up)

RESULTING IMAGE



MR HAND/FINGERS INDICATIONS

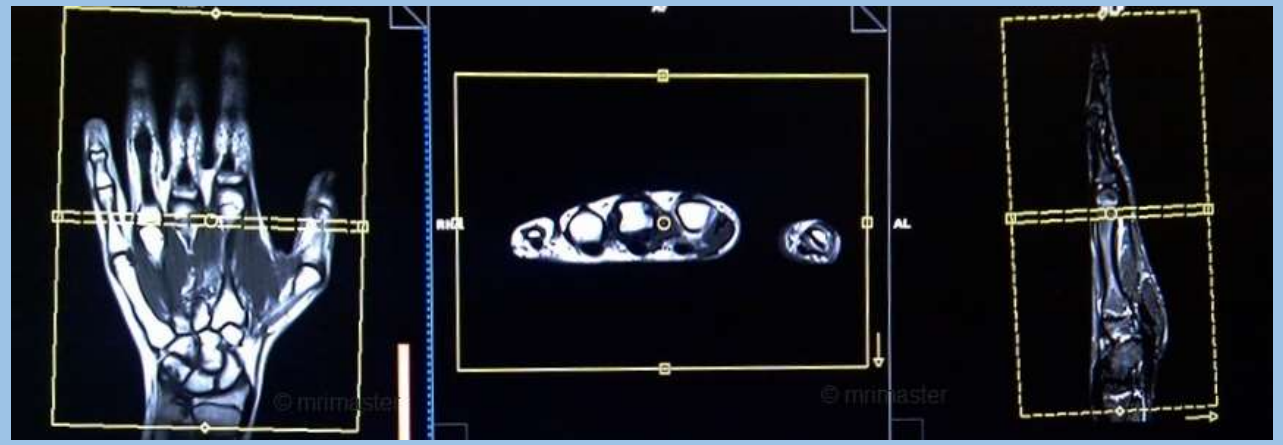
- **Routine Hand/Fingers**
  - Indications
    - Traumatic injuries of the hand/fingers
    - Collateral ligament injuries
    - Flexor/Extensor tendon injuries
    - Volar plate and flexor pulley lesions
    - Collateral ligament injuries
    - Arthropathies of the hand and fingers

- **Hand/Fingers with Contrast**
  - Indications
    - Rheumatoid Arthritis
    - Tenosynovitis/Synovitis
    - Mass/Tumor
    - Infection

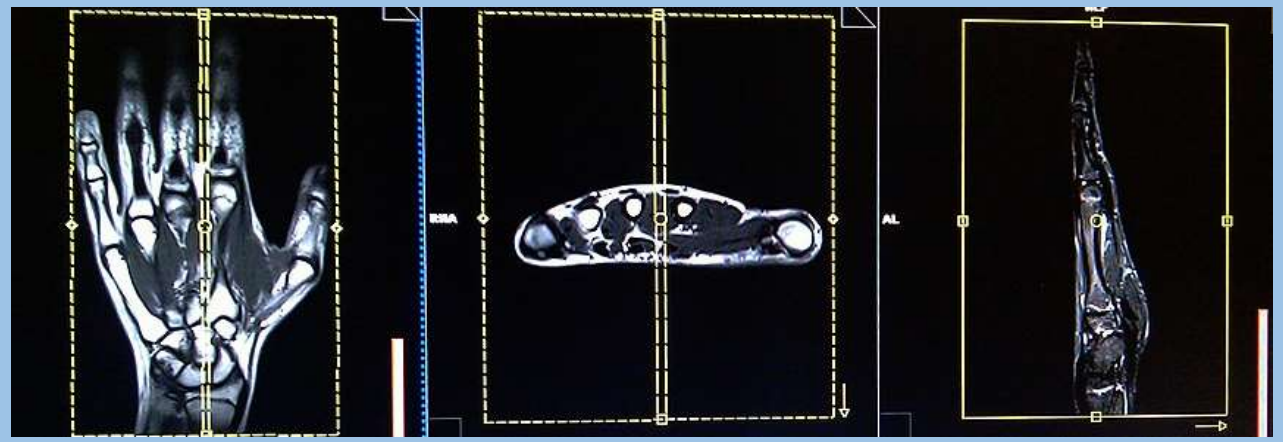
HAND ROUTINE

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
COR T1	220	2.0/0.2		
COR T2 FS	220	2.0/0.2		
COR DESS	220	0.4/.08 (1 SLAB)		
AX T1	180	4.0/0.4		
AX T2 FS	180	4.0/0.4		
SAG STIR	220	4.0/0.4		
POST CONTRAST				
AX T1 FS GD	180	4.0/0.4		
COR VIBE FS GD	220	0.3/0.6 (1 SLAB)	Vibe for Hand post only	
*Post Contrast Subtraction sequence			Mark area of concern/pain	

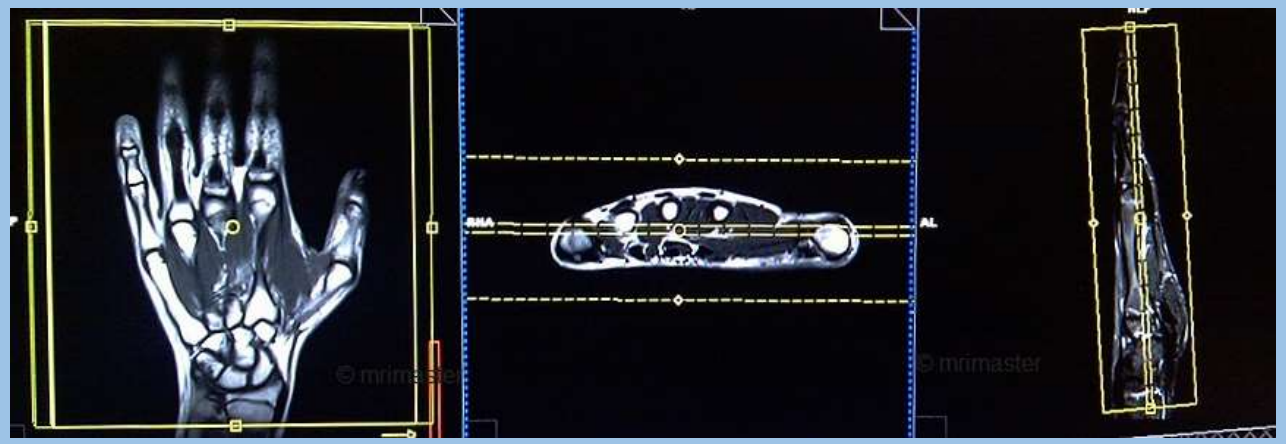
***ALL POST CONTRAST STUDIES MUST HAVE A PRE-CONTRAST AXIAL T1 FS**



HAND AXIAL COVERAGE



HAND SAGITTAL COVERAGE



HAND CORONAL COVERAGE

Image source: www.mrimaster.com

FINGER ROUTINE

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
COR T1	220	2.0/0.2		
COR T2 FS	220	2.0/0.2		
COR DESS	220	0.4/.08 (1 SLAB)		
AX T1	180	4.0/0.4		
AX T2 FS	180	4.0/0.4		
SAG STIR	220	4.0/0.4		
POST CONTRAST				
AX T1 FS GD	180	4.0/0.4	*Post Contrast Subtraction sequence	
COR T1 FS GD	220	2.0/0.2		

***ALL POST CONTRAST STUDIES MUST HAVE A PRE-CONTRAST AXIAL T1 FS**

AXIAL FINGER COVERAGE – SCAN FROM PROXIMAL METACARPAL THROUGH ENTIRE FINGER

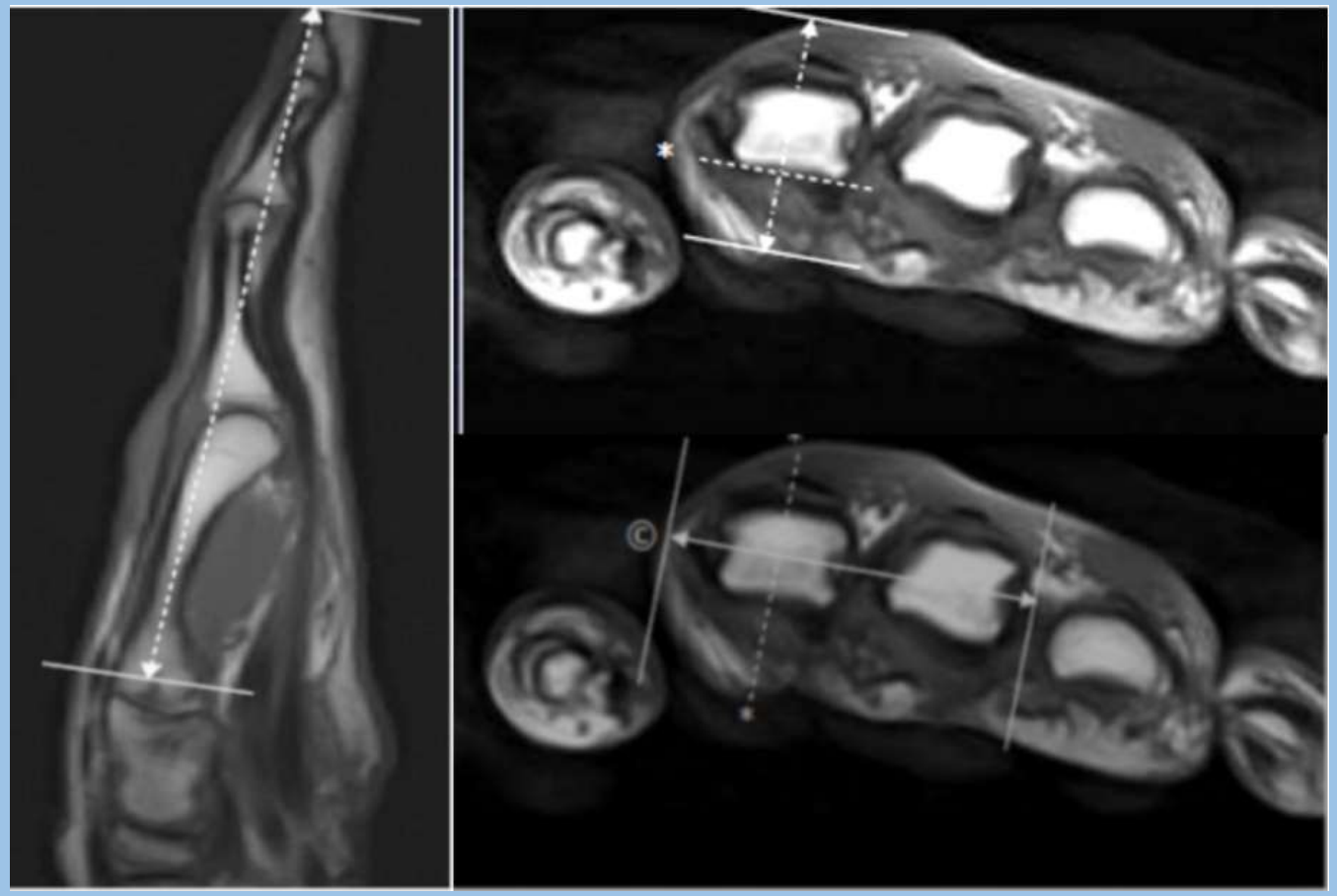


Image source: www.radiologykey.com

***TIP - Sagittals - Scan through entire finger. Be sure to include two adjacent fingers. Mark area of concern.**

ANGLE FOR SAG/COR PLANE - FINGER

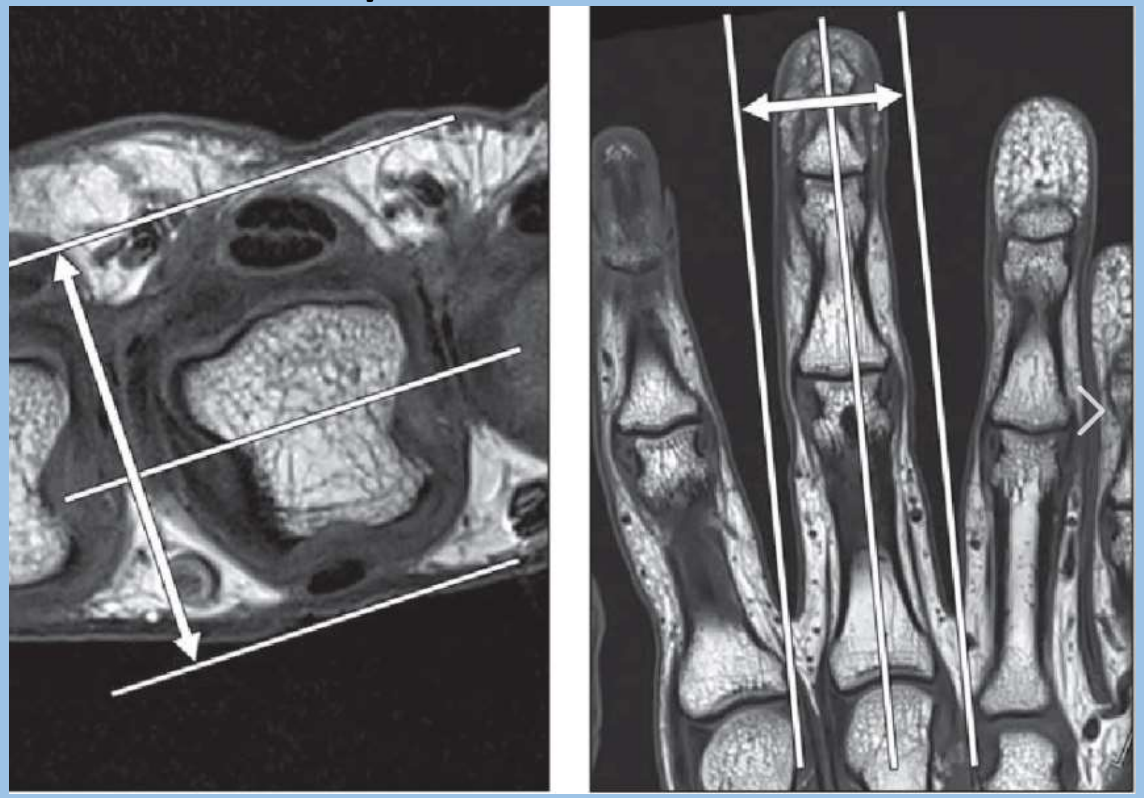


Image source: www.radiologykey.com

MR THUMB INDICATIONS

- **Routine Thumb**
  - Indications
    - Gamekeeper's thumb (Ulnar Collateral Ligament tear)
    - Flexor/Extensor Tendon Tear
    - R/O Occult Fracture

THUMB ROUTINE

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T1	80	3.0/0.3		PLACE MARKER OVER AREA OF INTEREST
AXIAL T2 FS	80	3.0/0.3		
COR T1	110	2.0/0.2	COR. SHOULD BE PARALLEL WITH SESAMOIDS	
COR T2 FS	110	2.0/0.2		
COR DESS	110	1.0/0.2		
SAG T2 STIR	110	2.0/0.2	ANGLE PERP. TO COR	
POST CONTRAST				
AX T1 FS GD	80	3.0/0.3	*Post Contrast Subtraction sequence	
COR T1 FS or SAG T1FS GD			Select COR or SAG plane post dependent on best view of pathology	

***ALL POST CONTRAST STUDIES MUST HAVE A PRE-CONTRAST AXIAL T1 FS**

CORONAL ANGLE IS PARALLEL WITH SESAMOIDS; SAGITTAL IS PERPENDICULAR TO CORONAL

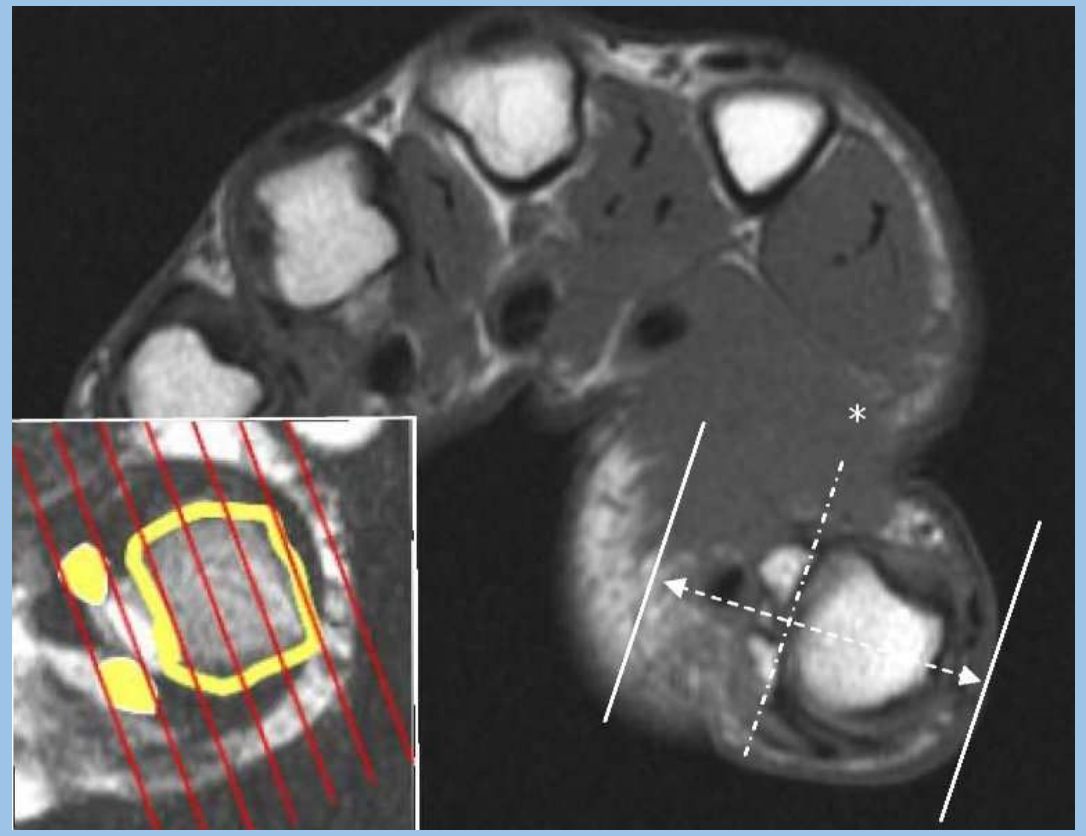
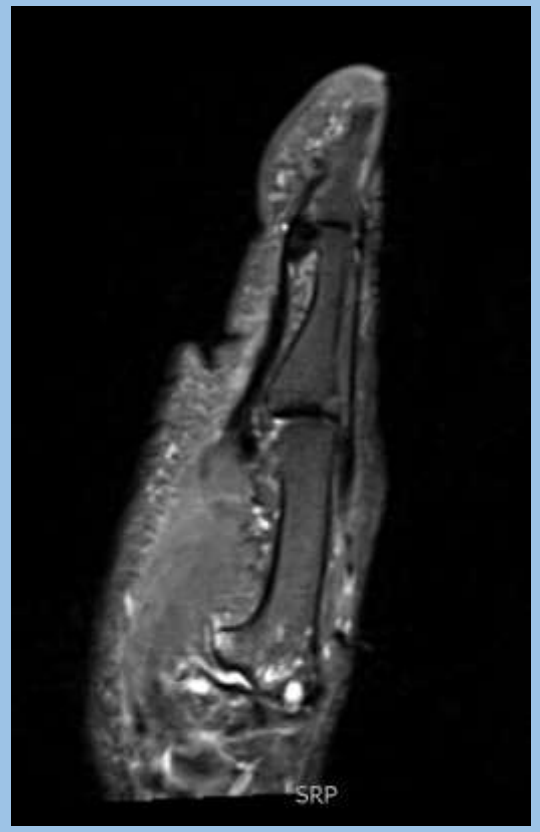


IMAGE FROM: MRIPROTOCOLS.BLOGSPOT.COM

CORONAL IMAGE

SAGITTAL IMAGE



AXIAL COVERAGE

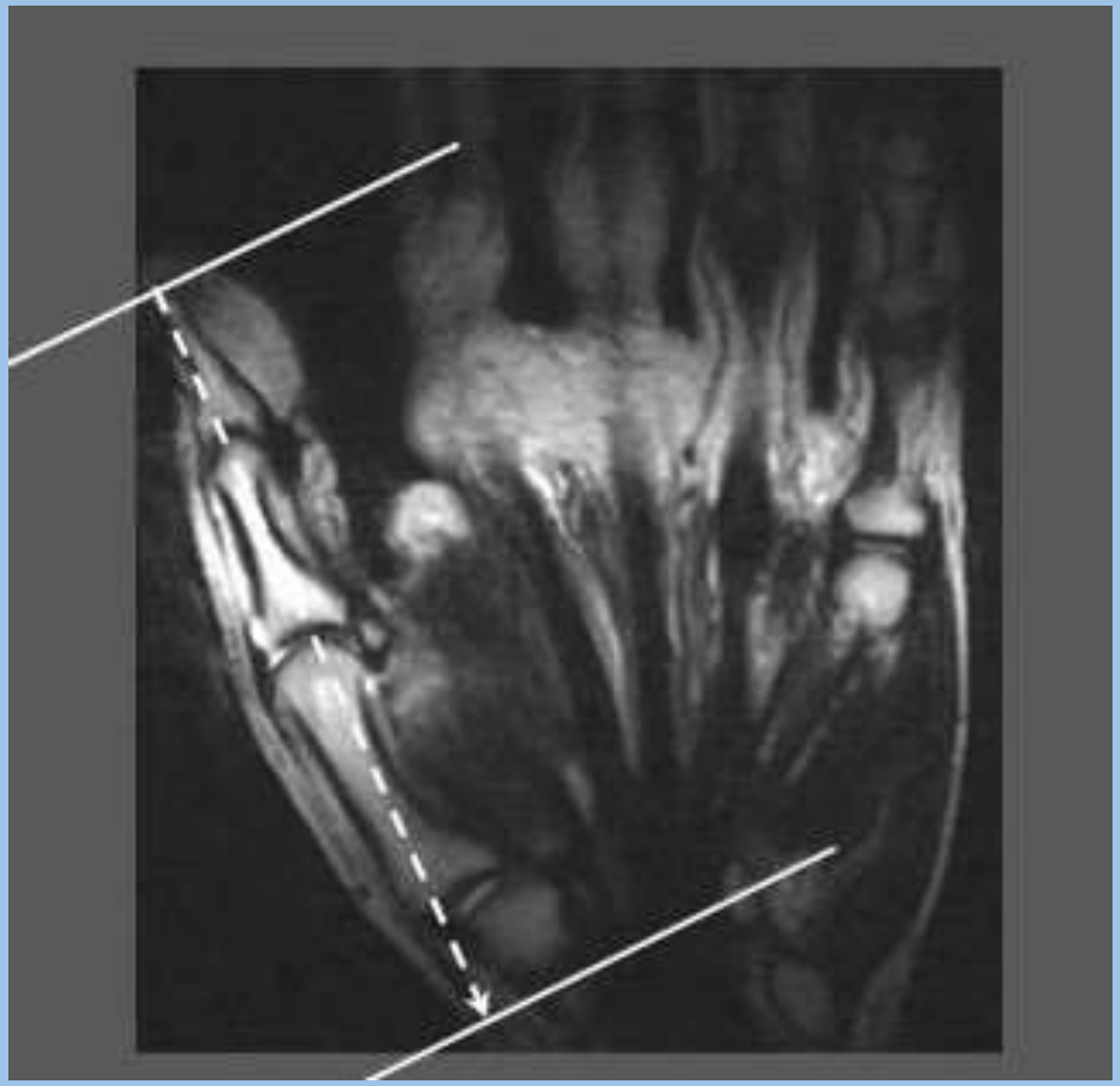
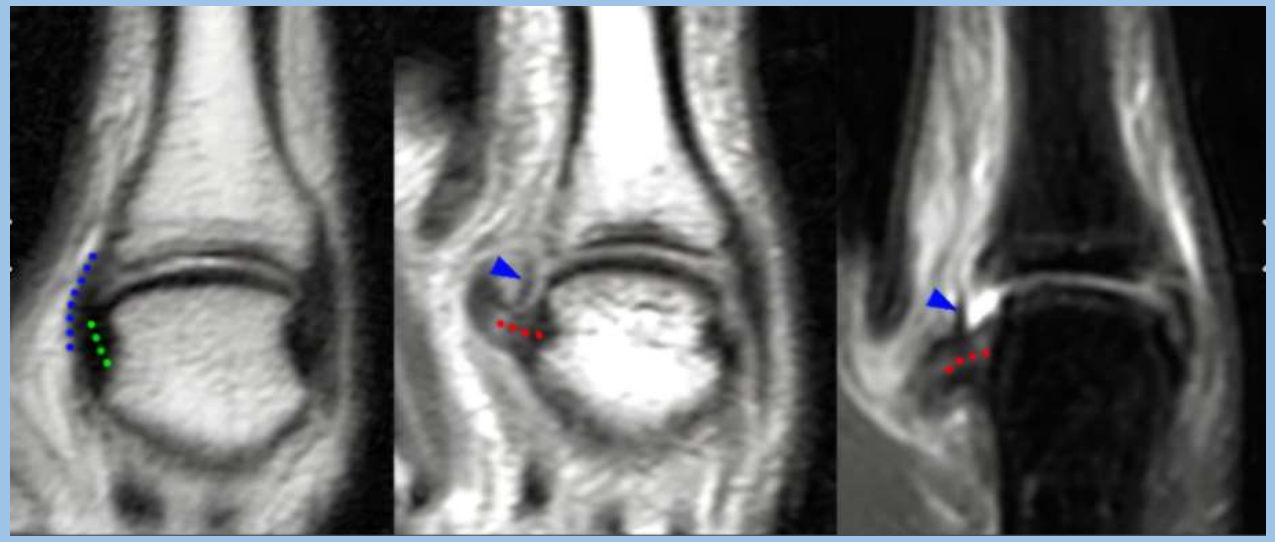


Image : Radsource.com

EXAMPLE OF UCL TEAR



WRIST ROUTINE

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AX T1	100	3.0/0.3		
AX T2 FS	100	3.0/0.3		
COR T1	120	3.0/0.3		
COR T2 FS	120	3.0/0.3		
SAG T2 FS	120	3.0/0.3		

WRIST ARTHROGRAM

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AX T1 FS POST GD	100	3.0/0.3		
AX T2 FS POST GD	100	3.0/0.3		
COR T1 FS POST GD	120	3.0/0.3		
COR PD FS POST GD	120	3.0/0.3		
COR DESS FS POST GD	120	0.4/.08 (1 slab)		
SAG T2 FS POST GD	120	3.0/0.3		
SAG T1 FS POST GD	120	3.0/0.3		

WRIST–INFECTION/INFLAMMATION

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AX T1	100	3.0/0.3		
AX T2 FS	100	3.0/0.3		
COR T1	120	3.0/0.3		
COR T2 FS	120	3.0/0.3		
SAG T2 FS	120	3.0/0.3		
AX T1 FS PRE	120	3.0/0.3		
POST CONTRAST				
AX T1 FS GD	120	3.0/0.3	*Post Contrast Subtraction sequence	
COR T1 FS GD	120	3.0/0.3		

****ALL POST CONTRAST STUDIES MUST HAVE A PRE-CONTRAST AXIAL T1 FS**

AXIAL PLANE

- Scan from proximal metacarpals through distal radial/ulnar metaphysis

Image source: www.jefferson.edu

SAGITTAL PLANE

- Perpendicular to Coronal plane
- Scan through entire wrist

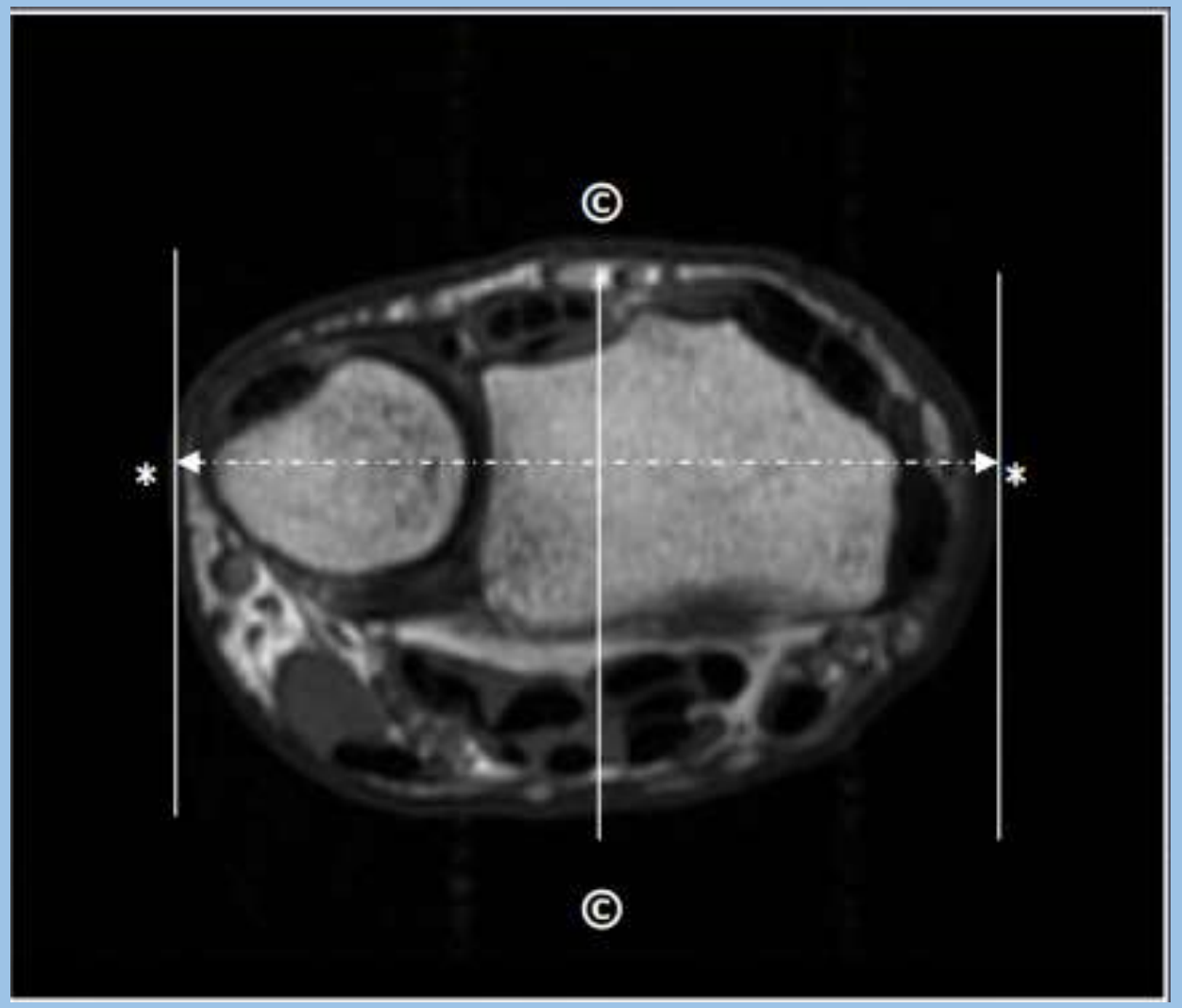
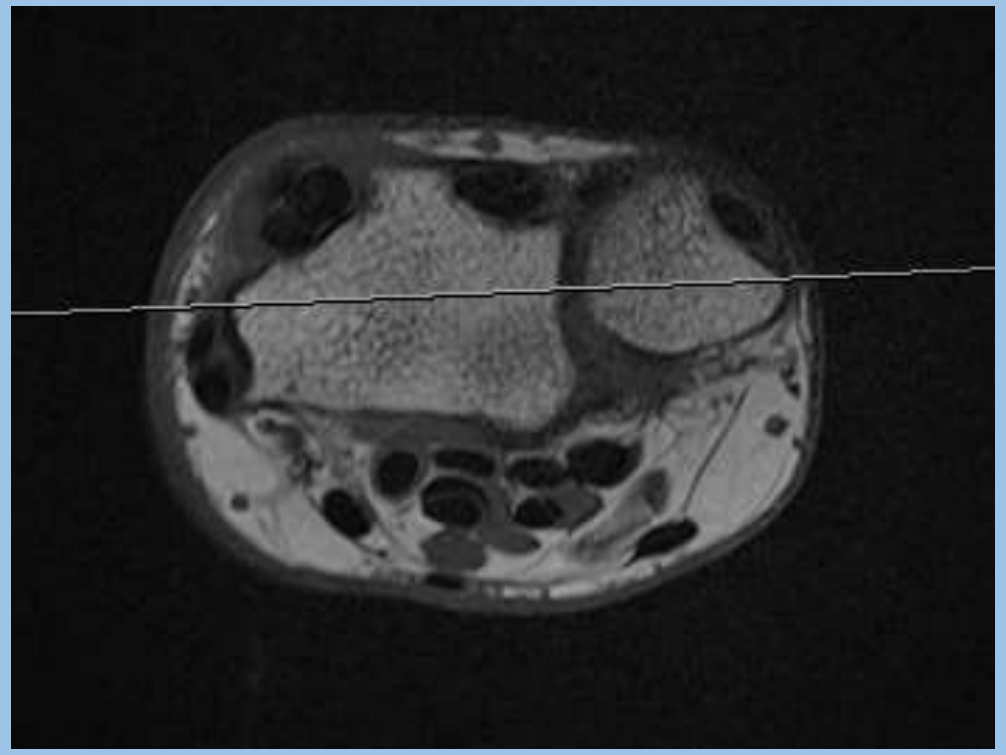


Image source: www.jefferson.edu



CORONAL ANGLE

- Angle is parallel from ulnar styloid to radial styloid
- Be sure to scan entire wrist

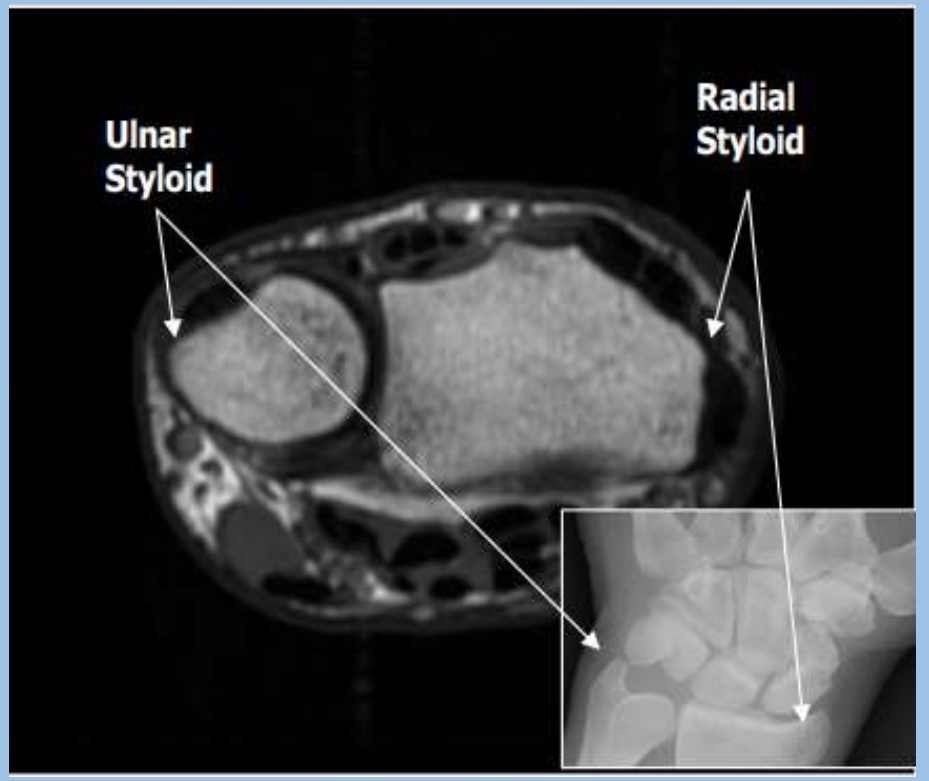


Image source: www.jefferson.edu

Optional way to angle for Coronal

- Angle parallel from hook of hamate to trapezium

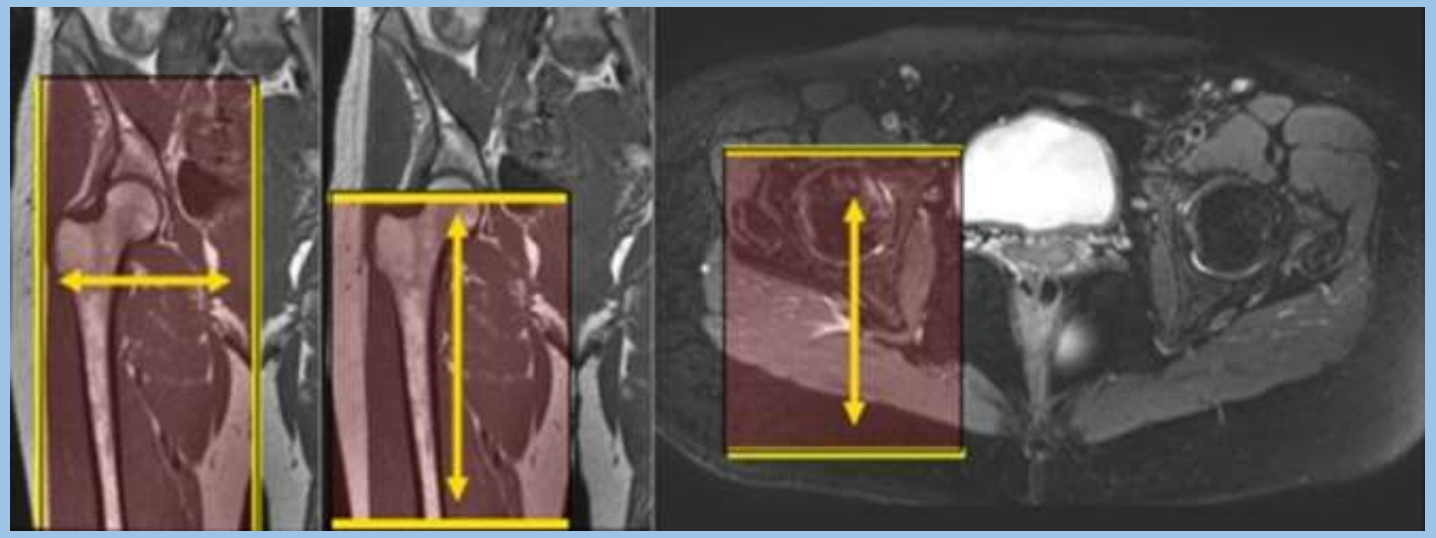
HIP ROUTINE

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
COR T1 BILAT.	380	3.0/0.3	ADUST FOV TO BODY HABITUS	BE SURE TO INVERT TOES
COR T2 FS BILAT	380	3.0/0.3		
AX/OBL T2 FS UNILAT.	180	3.0/0.3		
SAG T2 FS UNILAT	180	3.0/0.3		
OPTIONAL				
AX T2 FS BILAT	380	3.0/0.3	If time allows, please add bilat AX T2 FS	
			*If R/O is hamstring tear, be sure to include insertion and distal enough to see whole tear. See example hamstring tears.	

HIP W/GAD - INFECTION

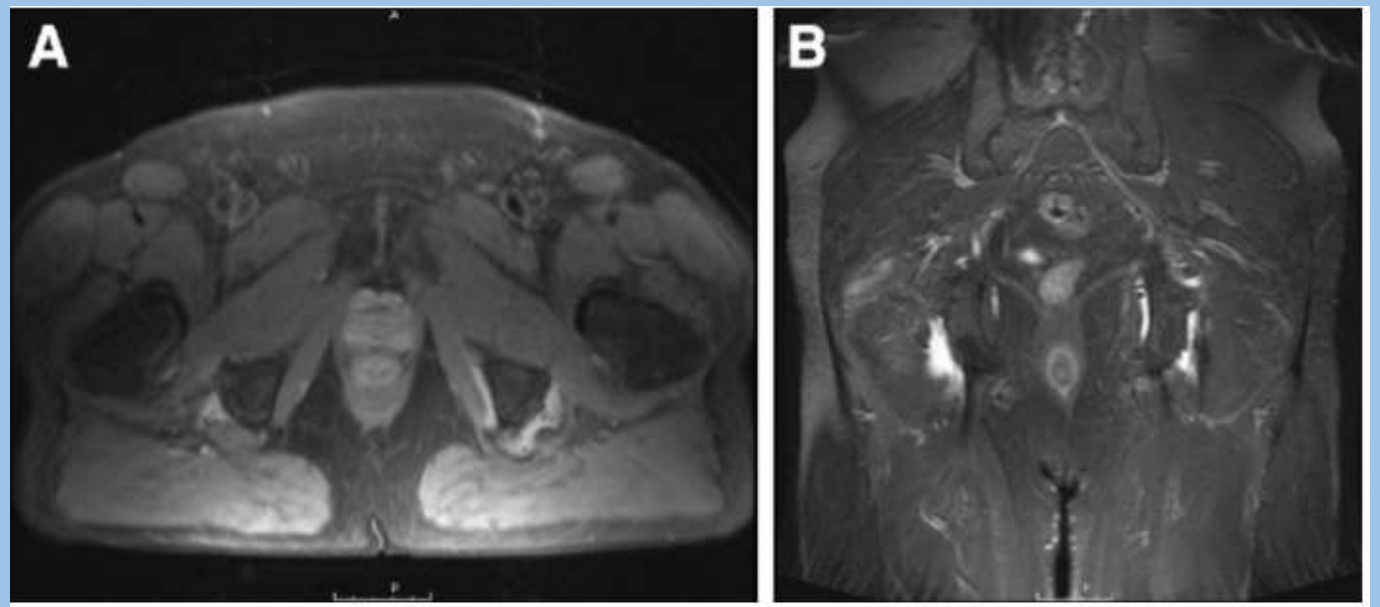
Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
COR T1 BILAT.	380	3.0/0.3	ADUST FOV TO BODY HABITUS	BE SURE TO INVERT TOES
COR T2 FS BILAT	380	3.0/0.3		
AX/OBL T2 FS UNILAT.	180	3.0/0.3		
SAG T2 FS UNILAT	180	3.0/0.3		
AXIAL T1 FS PRE	180	3.0/0.3		
CONTRAST				
AXIAL T1 FS POST	180	3.0/0.3	*Post Contrast Subtraction sequence	
COR T1 FS POST				

****ALL POST CONTRAST STUDIES MUST HAVE A PRE-CONTRAST AXIAL T1 FS**

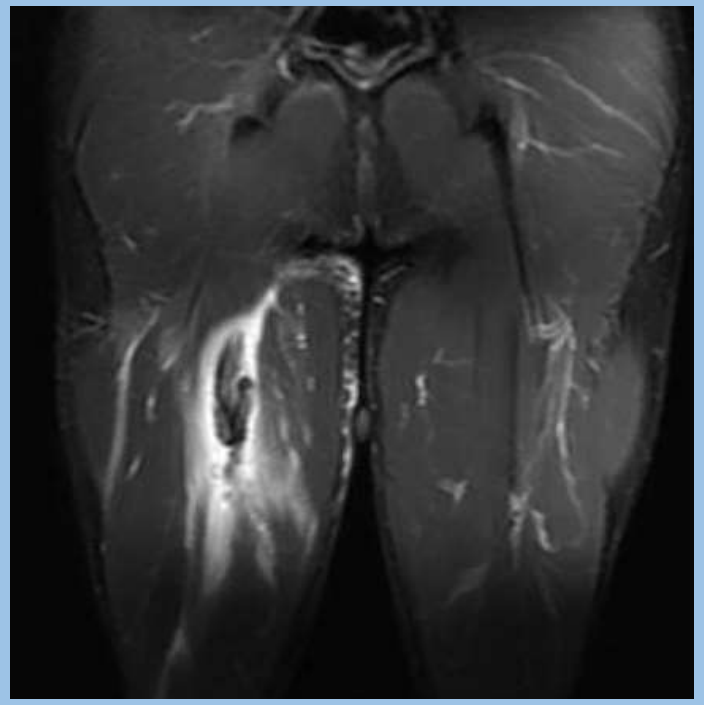


- **TYPICAL COVERAGE NEEDED FOR PROXIMAL HAMSTRING TEARS**

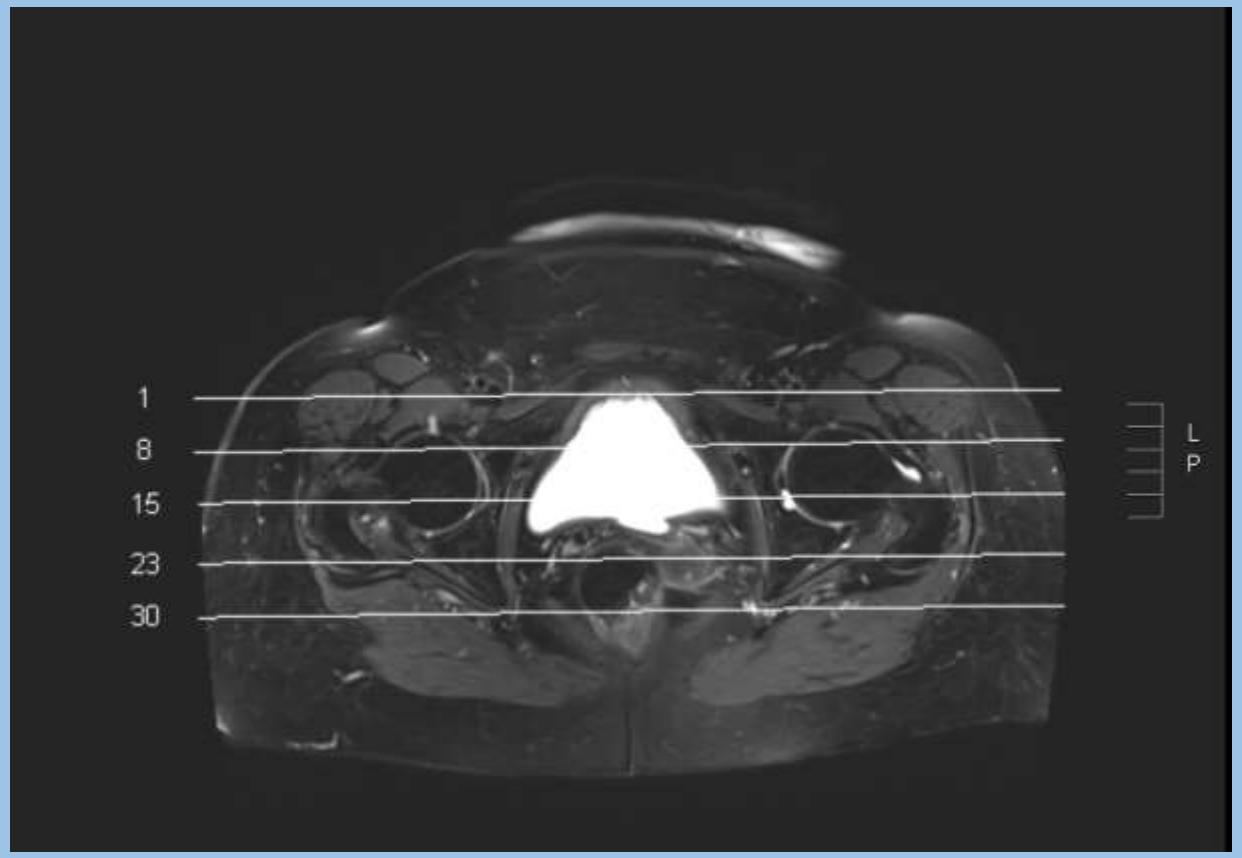
EXAMPLES – HAMSTRING TEAR



(A) Axial and (B) coronal MRI images showing a complete hamstring tear evidenced by hypersignal in the proximal tendon insertion and tendon retraction.

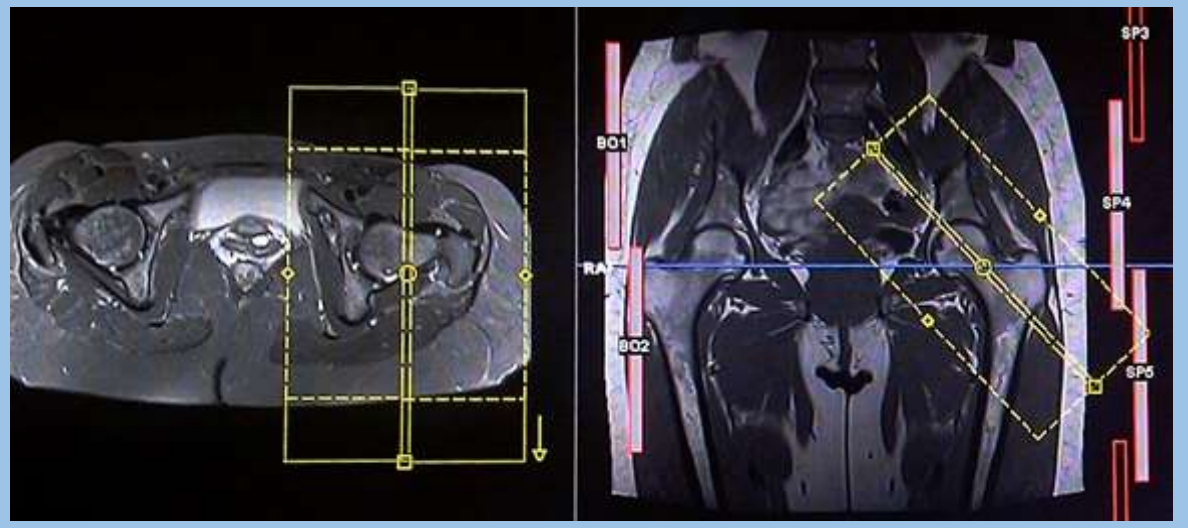


CORONAL BILAT ANGLE

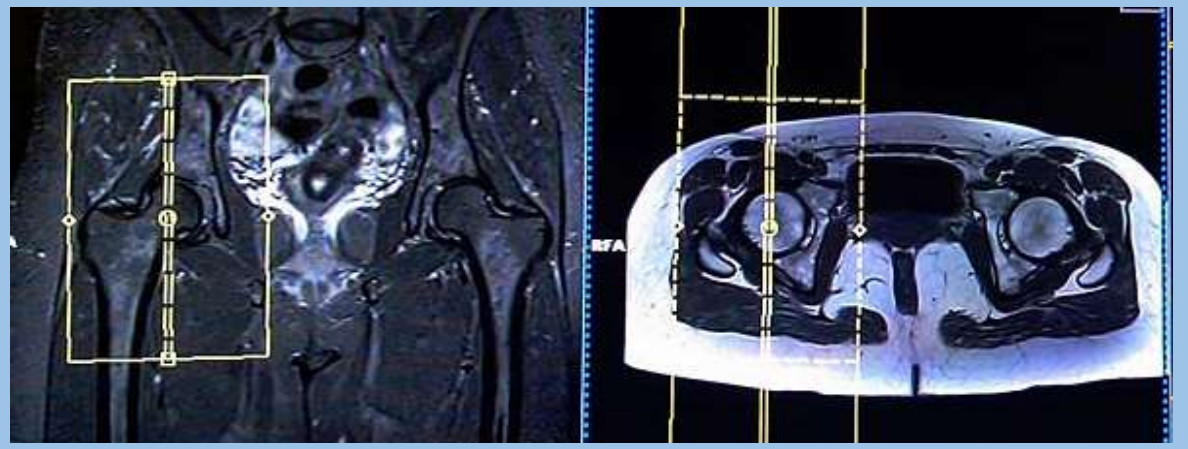


Patient positioned supine with toes inverted.

AXIAL/OBL SM FOV ANGLE



SAG SM FOV



HIP ARTHROGRAM

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
COR T1 FS UNILAT GD	180	3.0/0.3		
COR T2 FS UNILAT GD	180	3.0/0.3		
AX T1 FS UNILAT GD	180	3.0/0.3		
AX T2 FS UNILAT GD	180	3.0/0.3		
SAG T1 FS UNILAT GD	180	3.0/0.3		
SAG T2 FS UNILAT GD	180	3.0/0.3		

HIP- SALINE ONLY ARTHROGRAM

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AX T2 FS UNILAT	180	3.0/0.3		
COR T1 UNILAT	180	3.0/0.3		
COR T2 FS UNILAT	180	3.0/0.3		
SAG T2 FS UNILAT	180	3.0/0.3		

HIP WARP/MARS

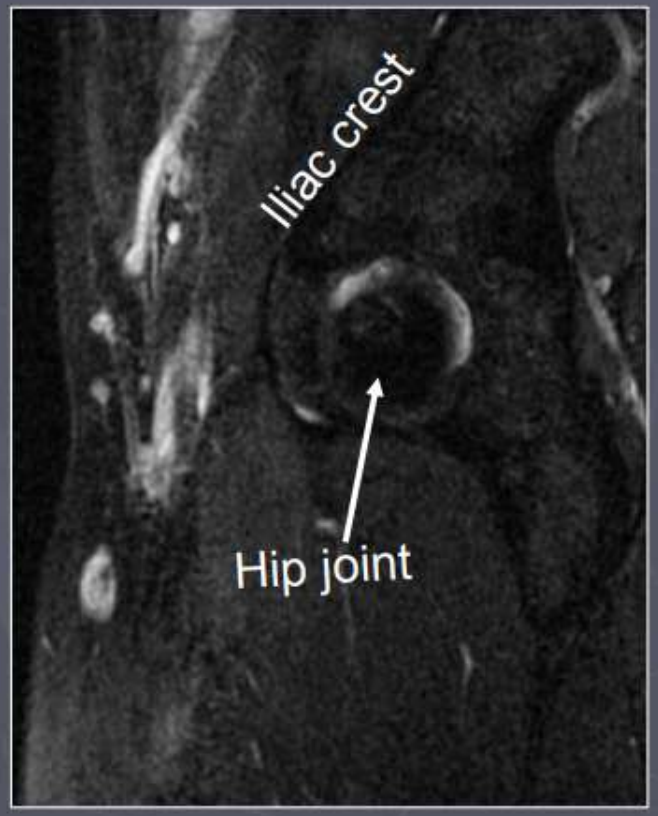
Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
COR T1 BILAT. WARP	380	3.0/0.3	ADUST FOV TO BODY HABITUS	BE SURE TO INVERT TOES
COR T2 STIR BILAT WARP	380	3.0/0.3		
AX T2 STIR UNILAT. WARP	180	3.0/0.3		
SAG T2 STIR UNILAT WARP	180	3.0/0.3		
			Utilize Semac when possible (certain scanners apply)	

ATHLETIC PUBALGIA/SPORTS HERNIA ABDUCTOR INJURY

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
COR T1 BILAT	280	3.0/0.3		
COR T2 FS BILAT	280	3.0/0.3		
AX/OBL T2 FS UNILAT	180	3.0/0.3	*See illustration for angle	
SAT T2 FS UNILAT	180	3.0/0.3		
OPTIONAL				
COR STIR UNILAT	280	3.0/0.3		

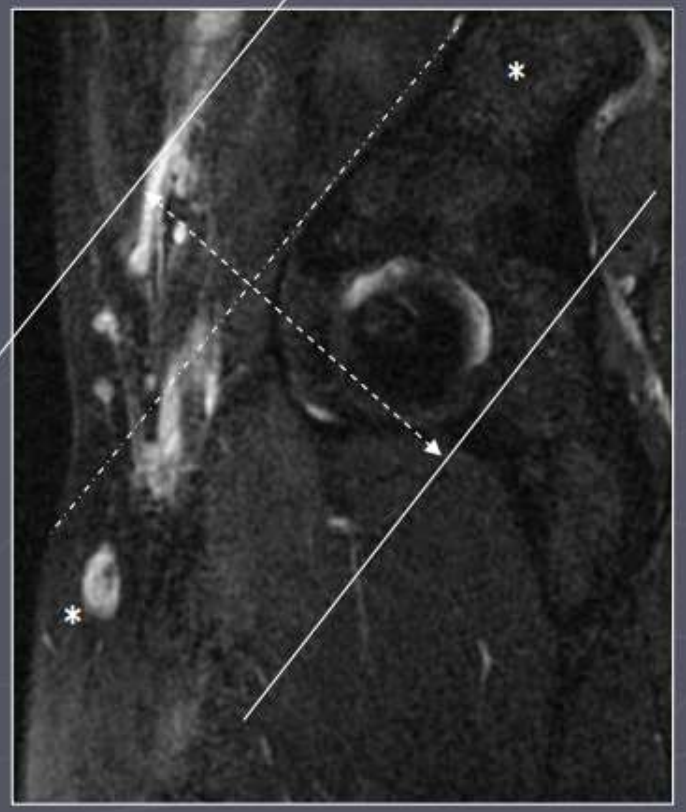
Axial Oblique Imaging Plane (Adductor unfolding plane)

Relevant Anatomy



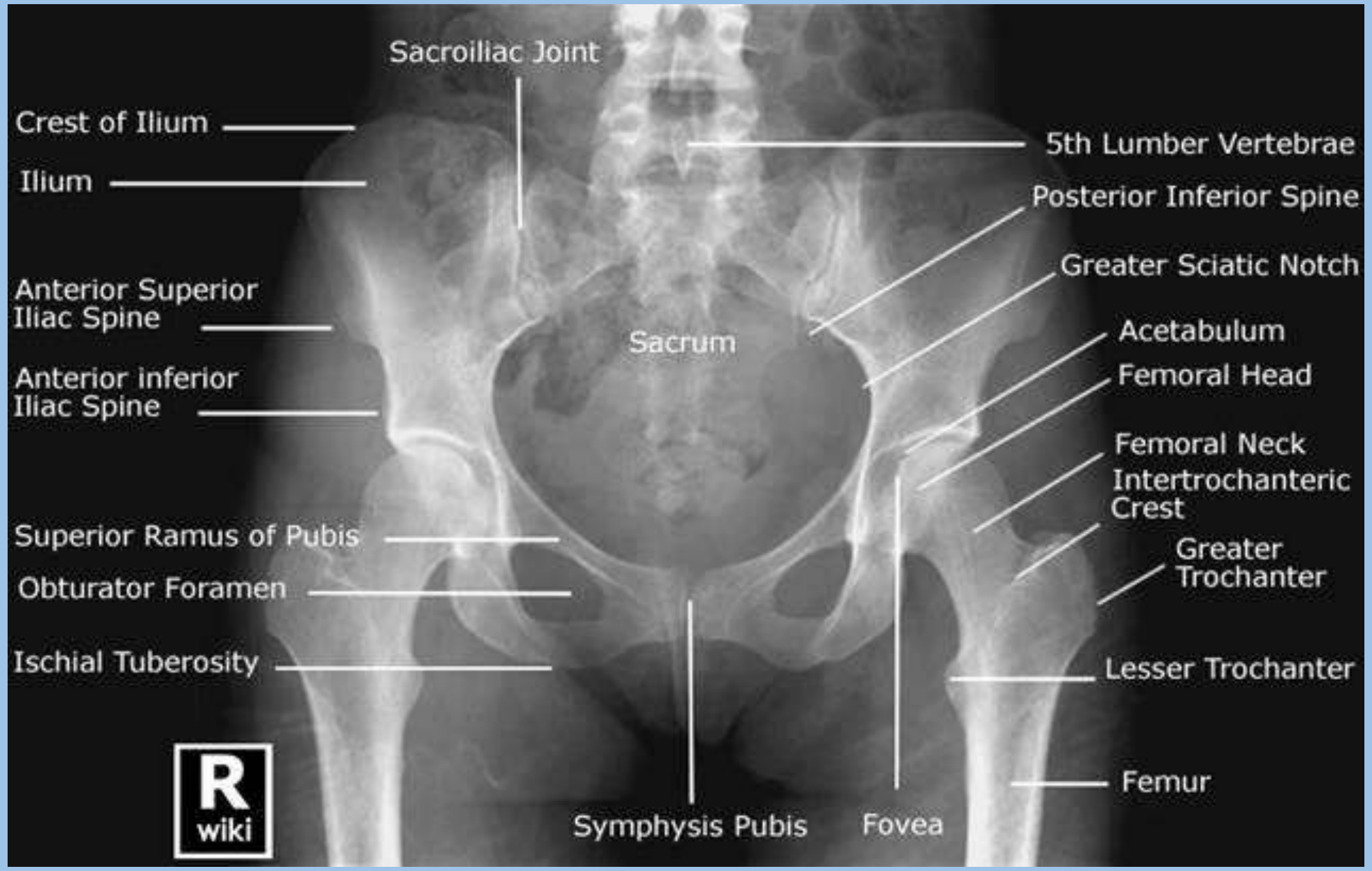
Axial Oblique Imaging Plane

Prescribe plane to line paralleling anterior Iliac crest. Be sure to scan across pubic symphysis at midline



BONY PELVIS

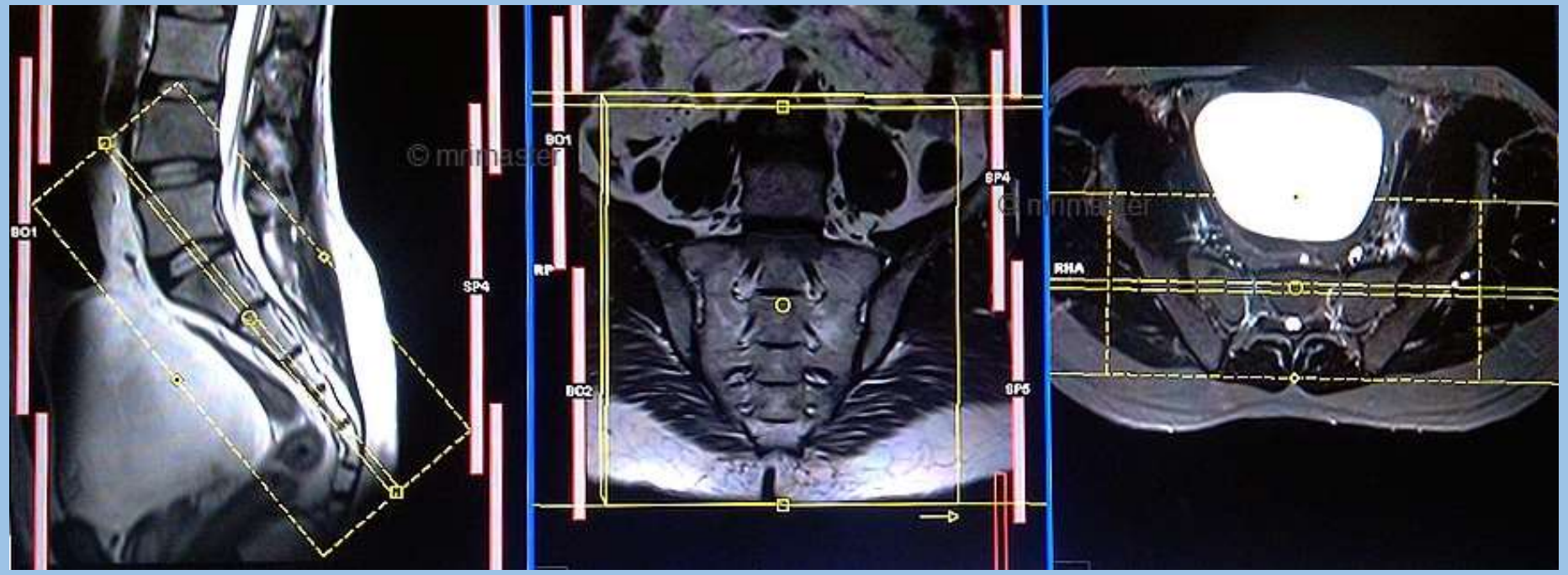
Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
COR T1	380	5.0/2.0	Cover entire bony pelvis A-P skin to skin L-R	
COR T2 STIR	380	5.0/2.0		
AXIAL T1	380	5.0/2.0		
AX T2 FS	380	5.0/2.0	Cover entire bony pelvis , symphysis to iliac crest	
SAG T2 FS	300	5.0/2.0		
AXIAL T1 FS PRE (if ordered)	380			
CONTRAST			Make sure to include subtractions for Axial T1 FS pre/post	
AXIAL T1 FS GD	380	5.0/2.0		
COR T1 FS GD	380	5.0/2.0		
SAG T1 FS GD	300	5.0/2.0		


Sacroiliac Joint
Crest of Ilium
Ilium
Anterior Superior Iliac Spine
Anterior inferior Iliac Spine
Superior Ramus of Pubis
Obturator Foramen
Ischial Tuberosity
Sacrum
5th Lumber Vertebrae
Posterior Inferior Spine
Greater Sciatic Notch
Acetabulum
Femoral Head
Femoral Neck
Intertrochanteric Crest
Greater Trochanter
Lesser Trochanter
Femur
Symphysis Pubis
Fovea
R wiki

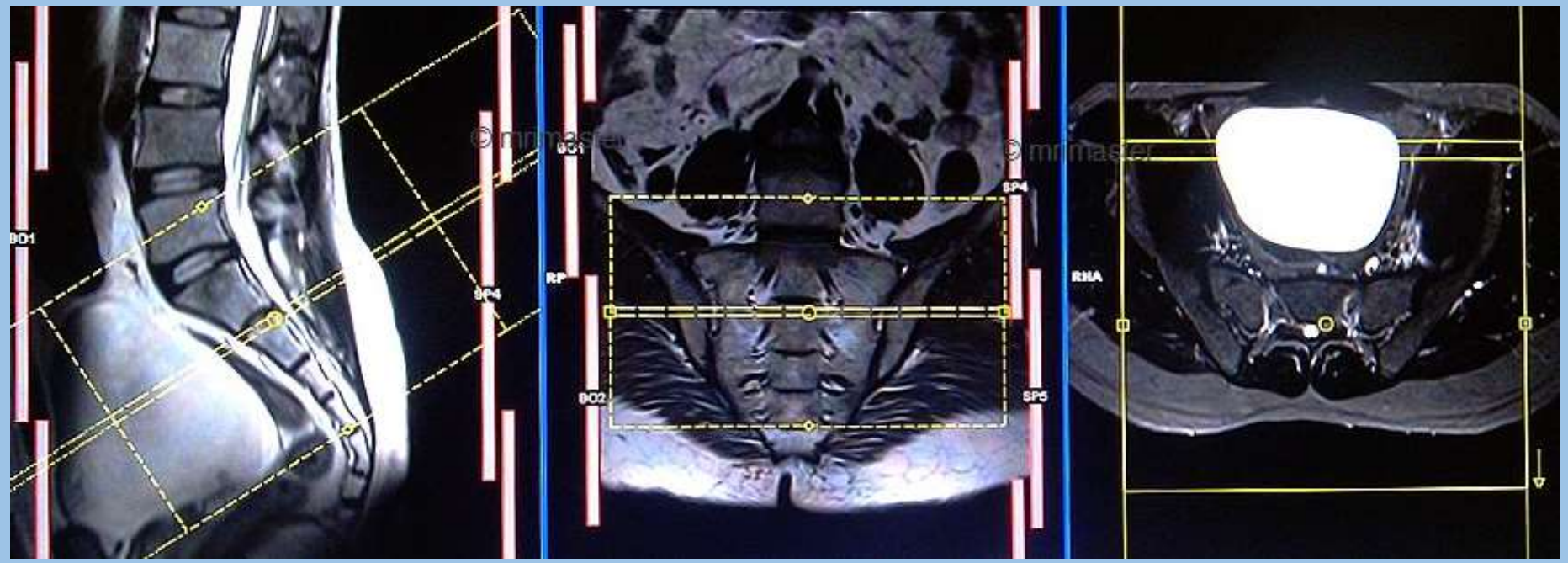
SACRUM – SACROILIAC JOINTS

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
COR OBL T1	180-220	3.0/0.5		
COR OBL T2 FS	180-220	3.0/0.5		
AXIAL OBL T2 FS	180-220	3.0/0.5		
AXIAL OBL T1	180-220	3.0/0.5		
SAG T2 FS	180-220	3.0/0.5	Be sure to scan thru SI Joints	

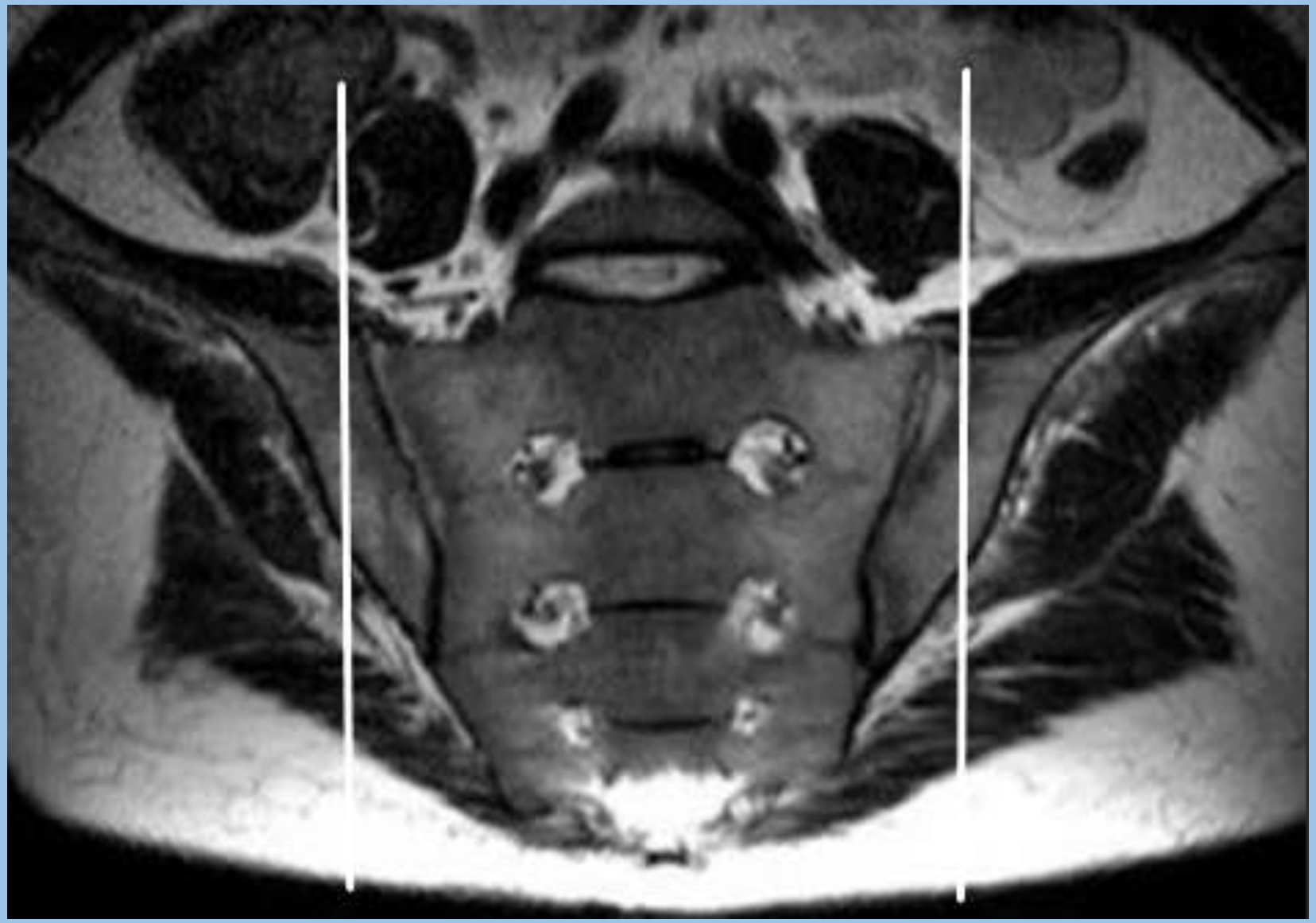
COR OBL



AXIAL OBL



SAGITTAL COVERAGE



- **BE SURE SAGITTAL SLICES COVER ALL THE WAY THRU SI JOINTS**

MR TIB/FIB INDICATIONS

- **Routine Tib/Fib**
  - Indications
    - Stress fracture
    - Ligament tear
    - Bone contusions
    - Nerve impingement
- **Tib/Fib with Contrast**
  - Indications
    - Soft Tissue Mass
    - Osteomyelitis
    - Neoplasms of bone, joint or soft tissue

LONG BONE – TIB/FIB

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
COR T1	220	4.0/1.0	May need upper and lower stacks for all sequences if entire tib/fib or femur is ordered	
COR T2 STIR	220	4.0/1.0		
AX T2FS	240	5.0/1.0		
AX T1	240	5.0/1.0		
SAG IR	220	4.0/1.0		
IF CONTRAST STUDY- AX T1 FS PRE	240	5.0/1.0	Be sure to place a marker above and below patient area of concern/mass	
AX T1 FS POST	240	5.0/1.0	*Post Contrast Subtraction sequence	
COR OR SAG T1 FS POST	220	4.0/1.0		

IF LESION OR MASS IS MEDIAL OR LATERAL, RUN THE COR T1 FS POST ALONG WITH THE AX T1FS
IF LESION OR MASS IS ANTERIOR OR POSTERIOR, RUN THE SAG T1 FS POST ALONG WITH THE AX T1 FS

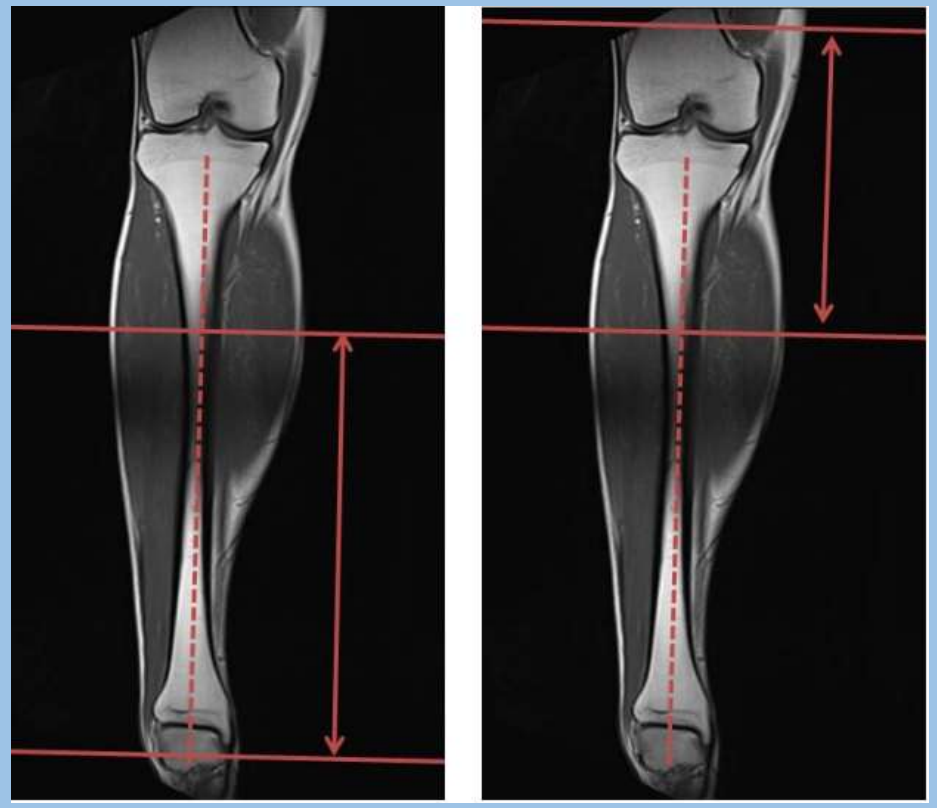


Image source: www.bonepit.com

AXIALS SHOULD BE ACQUIRED IN 2 STACKS (OVERLAPPING)
FOR MANY SHORT BORE SCANNERS AND FOR MORE HOMEOGENIC FATSATS, ACQUIRE CORONALS AND SAGITTALS IN 2 STACKS. COMPOSE STACKS TO 1 SEQUENCE IF SCANNER IS CAPABLE

COR PLANE/COVERAGE

Image source: www.bonepit.com

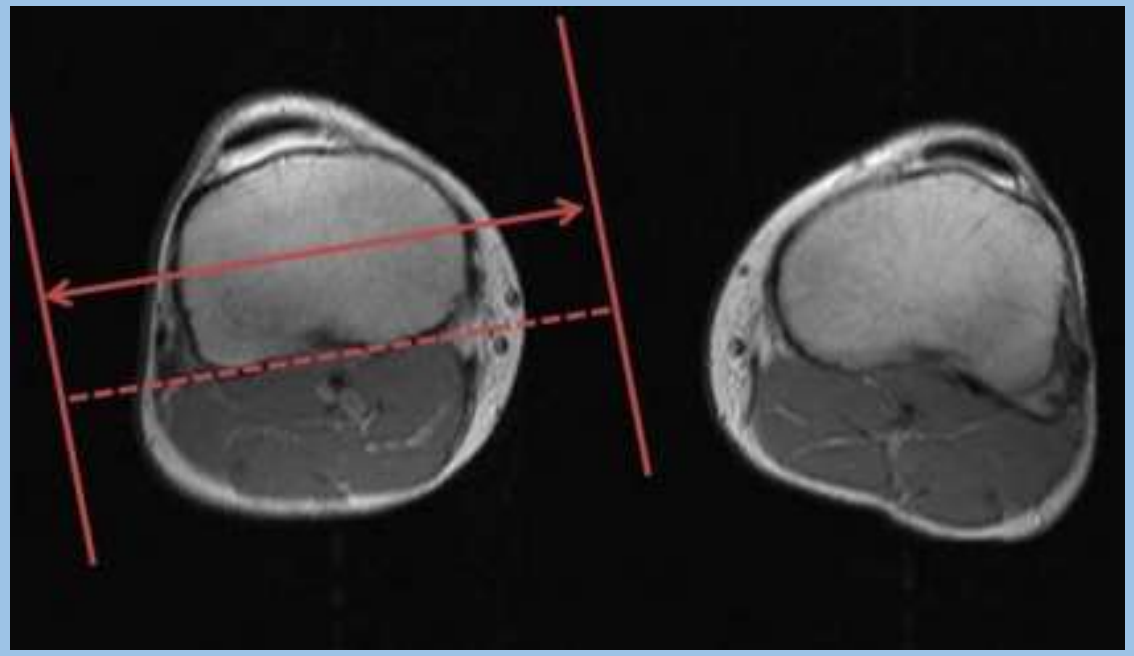
SAG PLANE/ COVERAGE

Image source: www.bonepit.com

ANGLE COR PLANE TO TIBIAL SHAFT

Image source: www.bonepit.com

UNILATERAL COR PLANE



BILAT COR PLANE

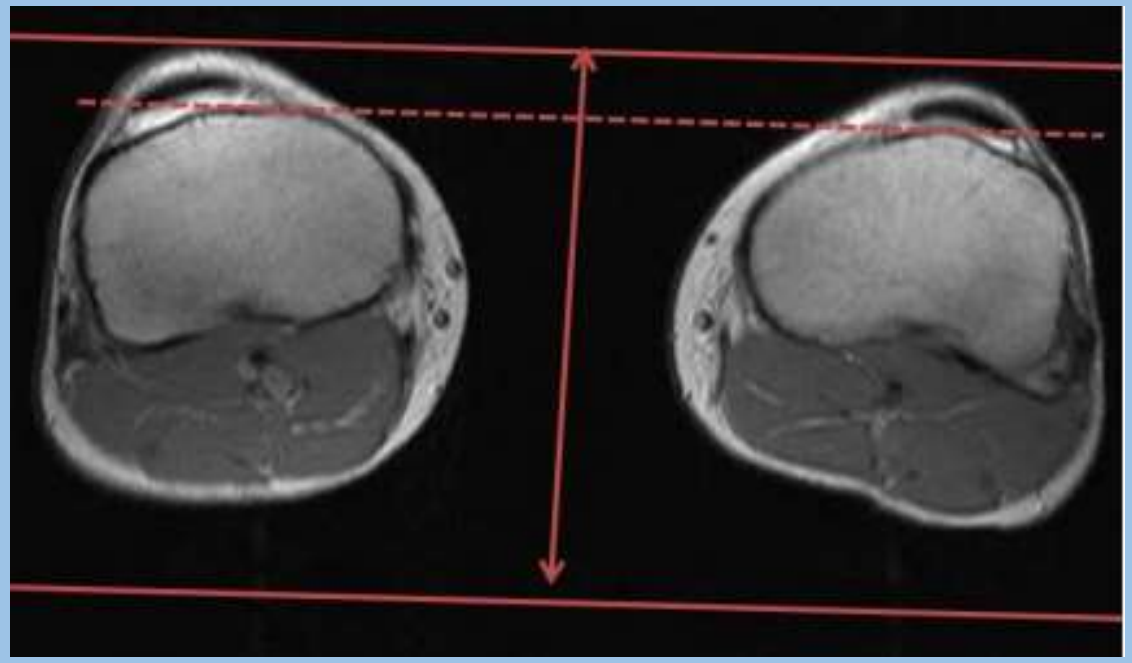
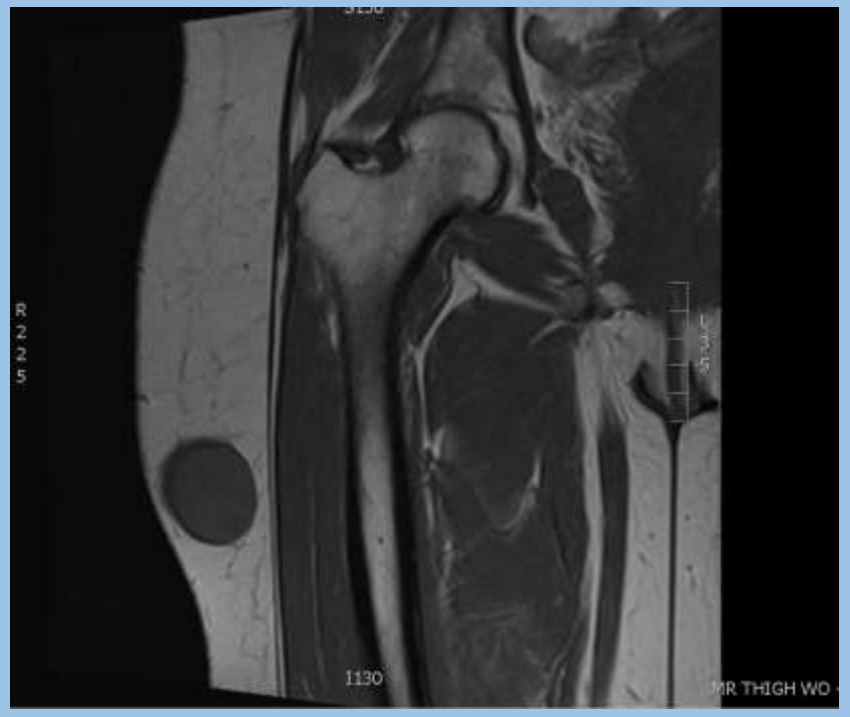


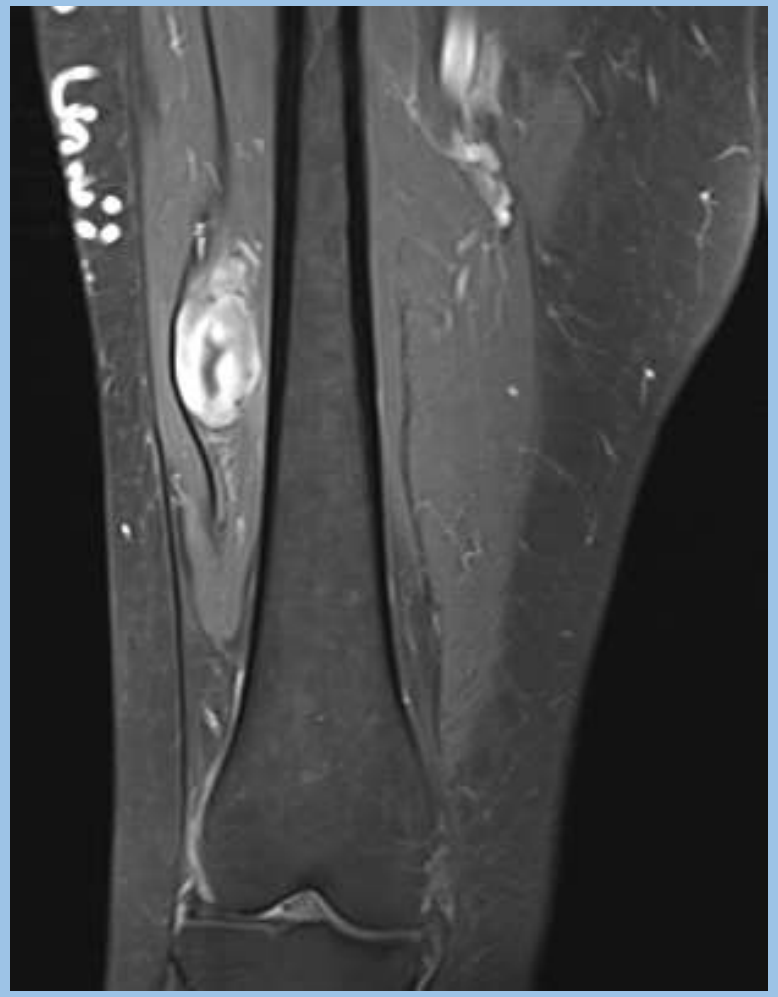
Image source: www.bonepit.com

***NOTE- You may not always need to scan entire long bone. If r/o is for localized mass, mark mass and include closest joint space in imaging field.**

Example: Thigh mass, hip joint included



Example: Thigh mass, knee joint included



Example: proximal tib/fib mass, knee joint included

KNEE ROUTINE

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T2 FS	160	3.0/0.3		
COR T1	160	3.0/0.3		
COR T2 FS	160	3.0/0.3		
SAG PD FS	160	3.0/0.3		
ACL VIEW COR T2 OBL FS	160	3.0/0.3		See illustration

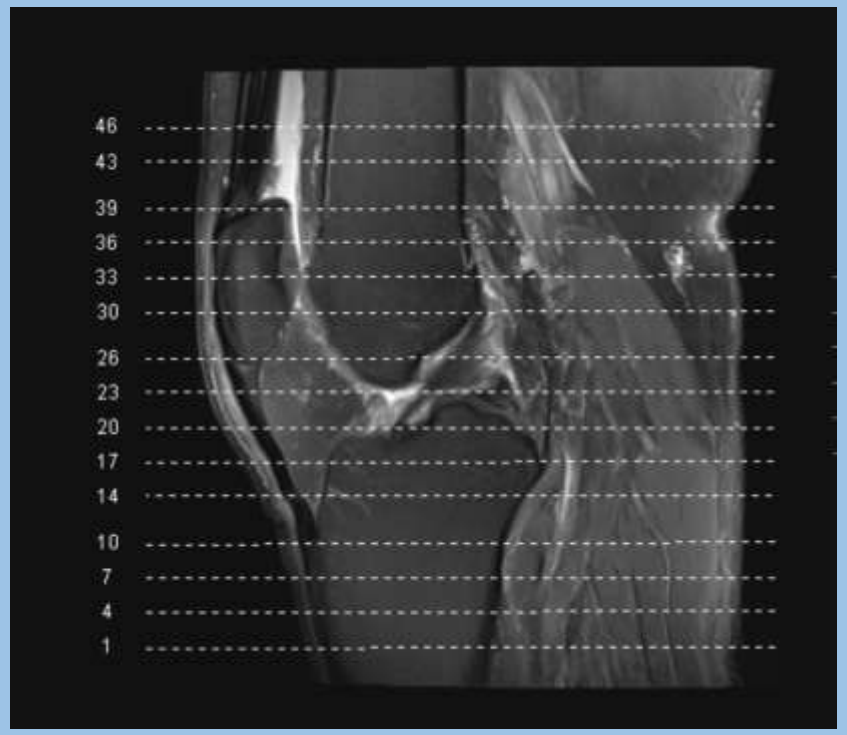
KNEE METAL(WARP)

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL STIR	160	3.0/0.3		
COR STIR	160	3.0/0.3		
COR T1	160	3.0/0.3		
SAG STIR	160	3.0/0.3		

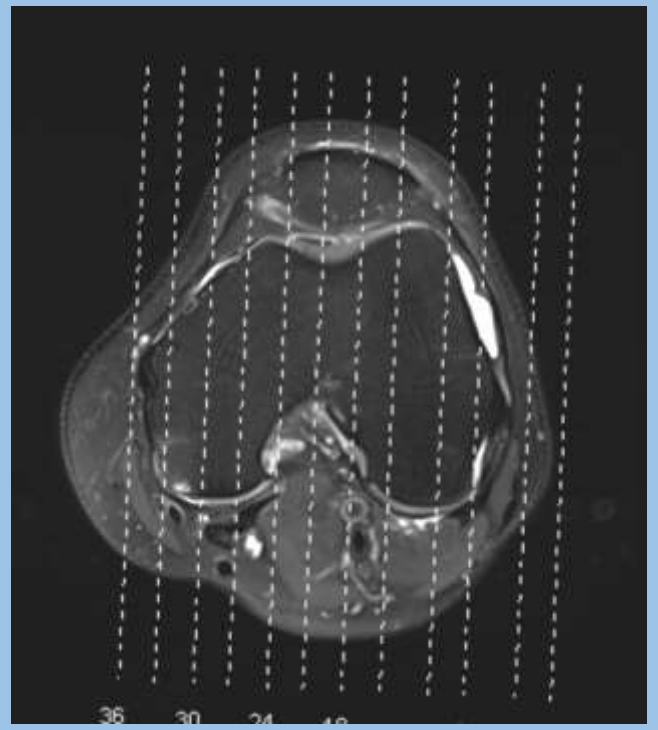
KNEE ARTHROGRAM

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
POST CONTRAST AXIAL T2 FS GD	160	3.0/0.3		
COR T1 GD	160	3.0/0.3		
COR T2 FS GD	160	3.0/0.3		
SAG PD FS GD	160	3.0/0.3		
SAG T1 FS GD	160	3.0/0.3		

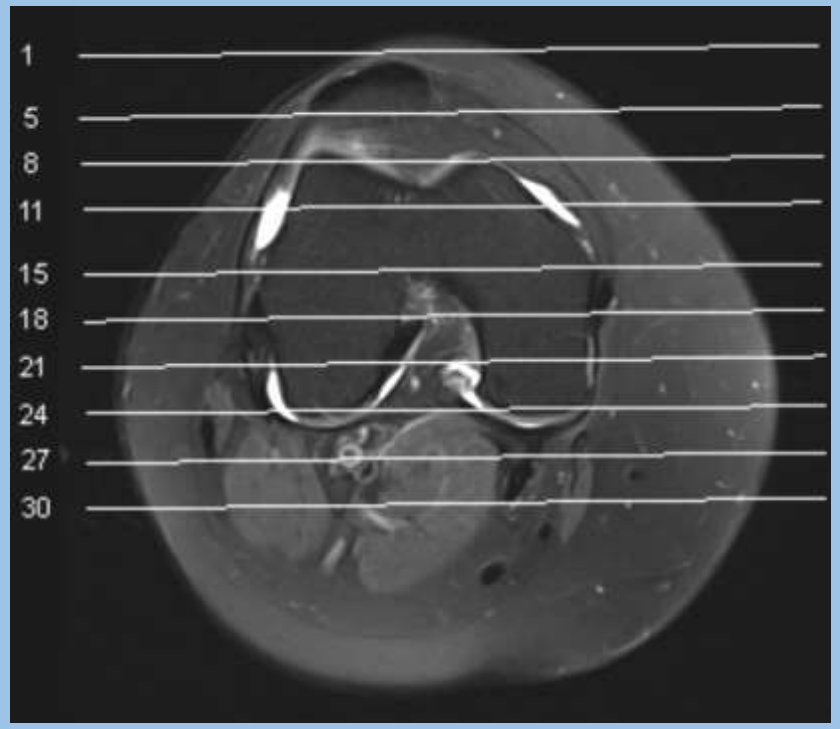
AXIAL COVERAGE



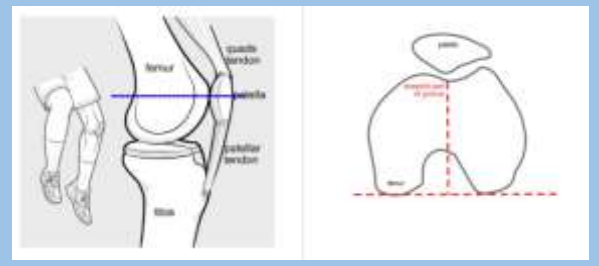
SAG ANGLE/COVERAGE

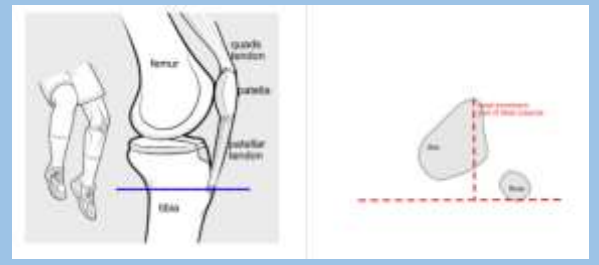


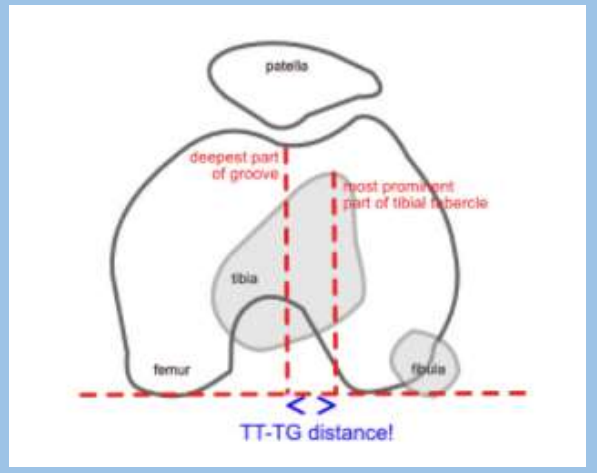
COR ANGLE/COVERAGE



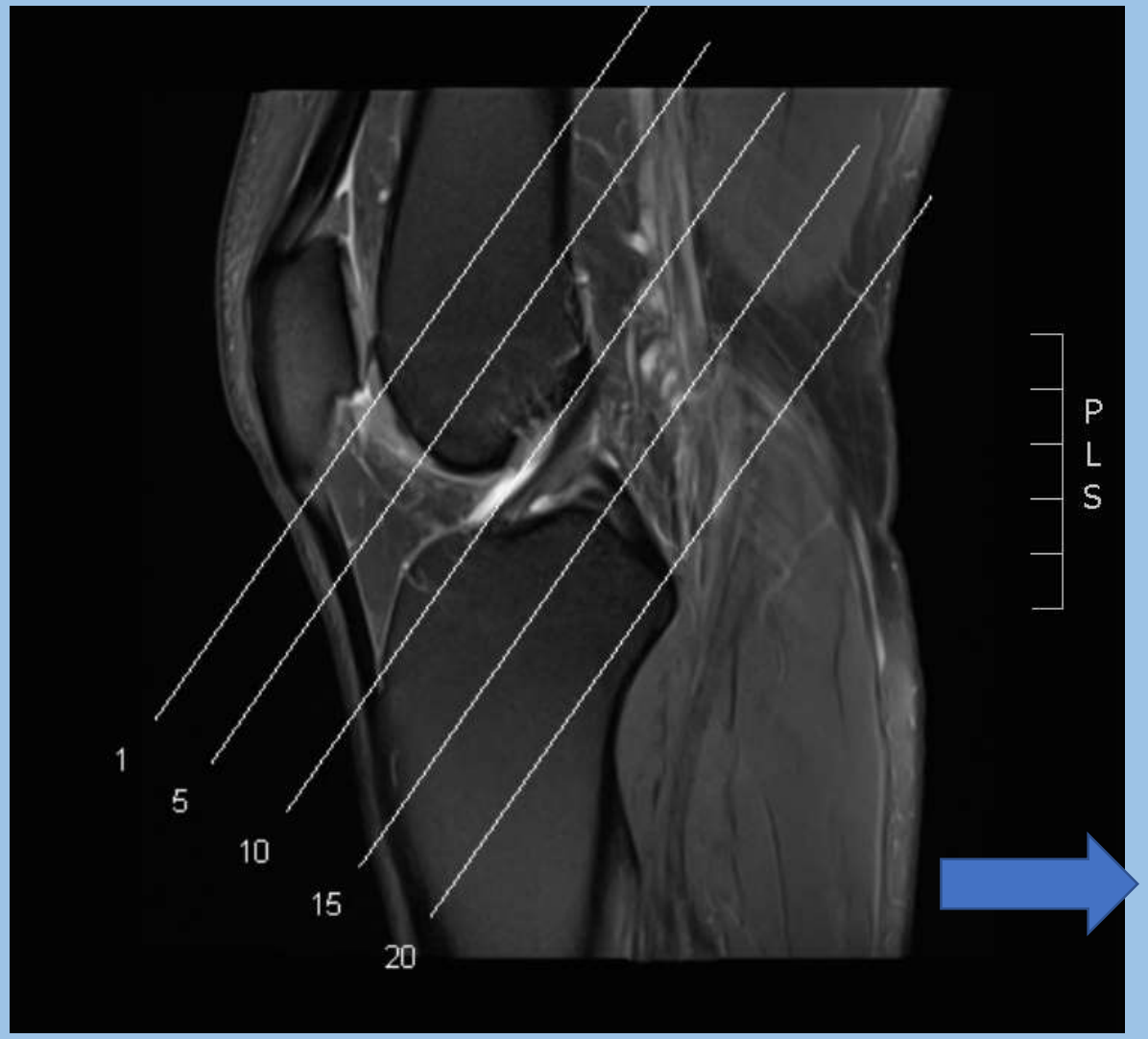
- **BE SURE TO SCAN SUPERIOR OF PATELLA THRU TIBIAL TUBEROSITY – THIS ENABLES THE RAD TO TAKE THE TT-TG DISTANCE MEASUREMENT.**



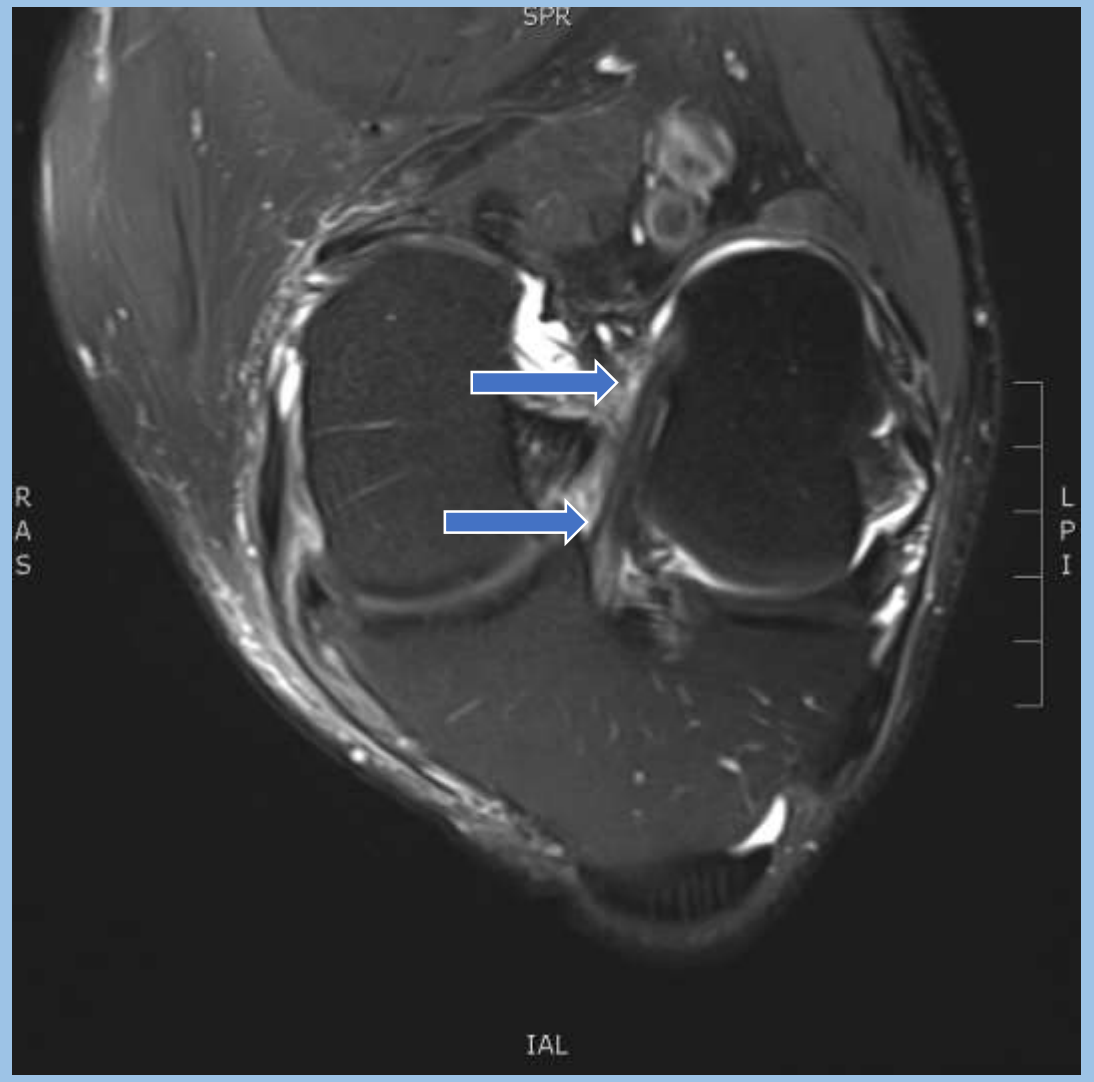




ANGLE FOR ACL VIEW



ACL VIEW



TIP – Be sure to scan thru posterior meniscus.
Pulse sequence should be a COR/OBL T2FS

MRA LOWER EXTREMITY - (popliteal artery entrapment syndrome)

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
SCOUT (bilat lower extremities)				
AXIAL STIR			COVER MID THIGHS TO MID CALVES	
3D TR MRA			**INJECT** .1mmol Gd @ 2ml/s	FEET IN **PLANTAR FLEXION**
3D TR MRA			**INJECT** .1mmol Gd @2ml/s	FEET IN **DORSIFLEXION**
AXIAL T1 VIBE			Center at Popliteal artery, hi-resolution, in phase echo time (4.72 @1.5T)	Cover mid - thigh to mid calves
CORONAL T1 VIBE			Center at Popliteal artery, hi-resolution, in phase echo time (4.72@1.5T)	Cover mid - thigh to mid calves

PROPER COVERAGE

3D coronal maximum intensity projection (MIP) reconstruction of MR angiogram performed in plantar flexion. Occlusion visualized bilaterally by lateral and medial heads of gastrocnemius, and on left by the plantaris muscles. Arrows indicate locations of occlusions.

Figure 3. (A) MRA demonstrating normal flow within the popliteal artery. (B) Narrowing of the mid popliteal artery due to compression by the medial head of the gastrocnemius muscle due to hypertrophy of the bilateral medial heads of the gastrocnemius muscles in the setting of FPAES.
FPAES, functional popliteal artery entrapment syndrome; MRA, magnetic resonance imaging.

https://journals.sagepub.com/

ANKLE (HINDFOOT) ROUTINE

Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
SAG T1	160	3.0/0.3		
SAG T2 FS	160	3.0/0.3		
COR T1	150	3.0/0.3		
COR T2 FS	150	3.0/0.3		
AX T1	150	3.0/0.3		
AX T2 FS	150	3.0/0.3		
PERONEAL TENDON AX OBL T2 FS	150	3.0/0.3	See illustration for angle	Add sequence for lateral ankle pain
OPTIONAL SEQUENCES				
COR STIR	150	3.0/0.3		
AX STIR	150	3.0/0.3		

ANKLE (HINDFOOT) MASS/INFECTION/LESION

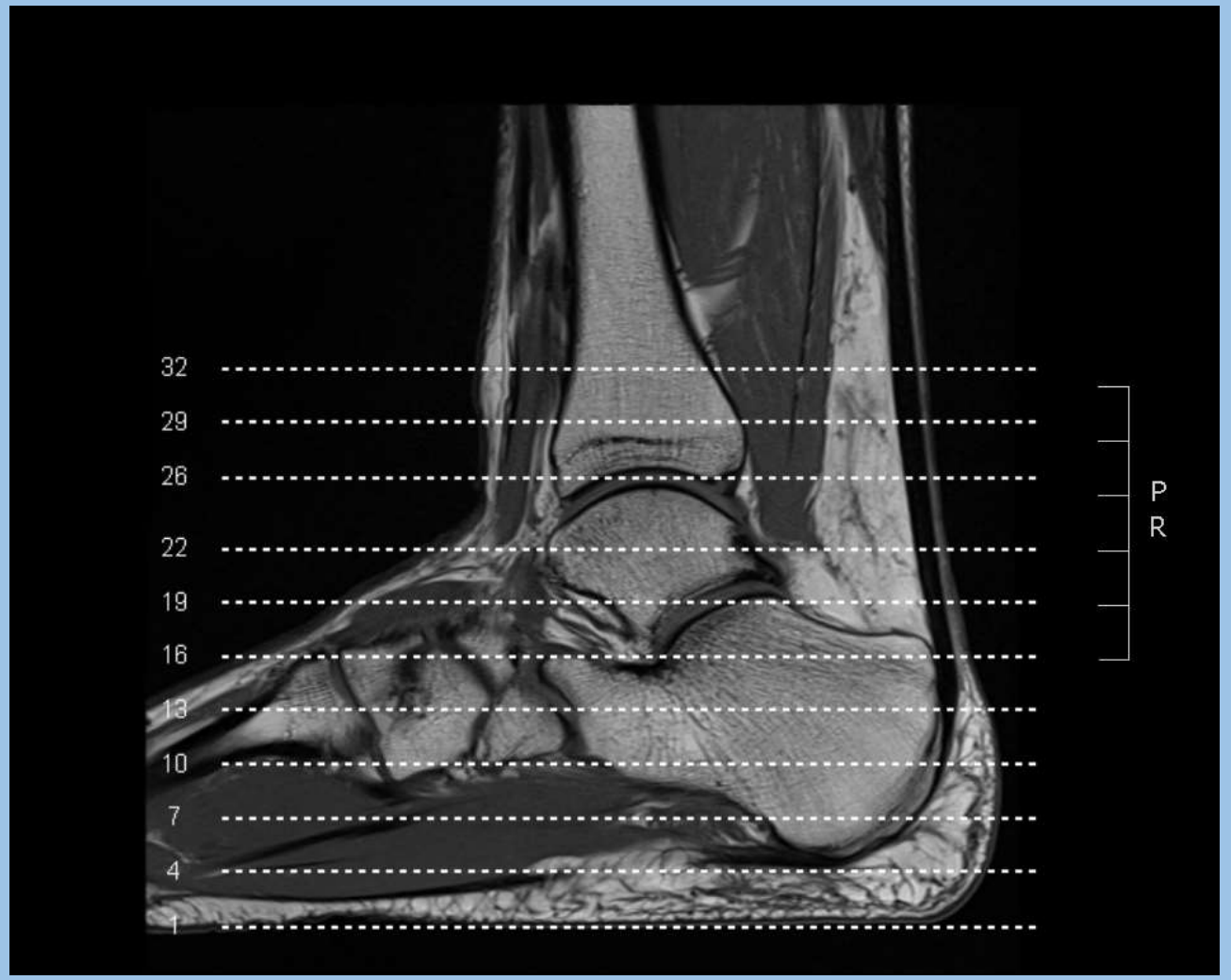
Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
SAG T1	160	3.0/0.3		
SAG T2 FS	160	3.0/0.3		
COR T1	150	3.0/0.3		
COR T2 FS	150	3.0/0.3		
AX T1	150	3.0/0.3		
AX T2 FS	150	3.0/0.3		
PERONEAL TENDON AX OBL T2 FS	150	3.0/0.3	See illustration for angle	Add sequence for lateral ankle pain
AX T1 FS PRE	150	3.0/0.3		
POST CONTRAST				
SAG T1 FS GD	150	3.0/0.3		
COR T1 FS GD	150	3.0/0.3		
AX T1 FS GD	150	3.0/0.3	*Post Contrast Subtraction sequence	

****ALL POST CONTRAST STUDIES MUST HAVE A PRE-CONTRAST AXIAL T1 FS IN CASE SUBTRACTION IMAGES ARE NEEDED**

AXIAL ANGLE

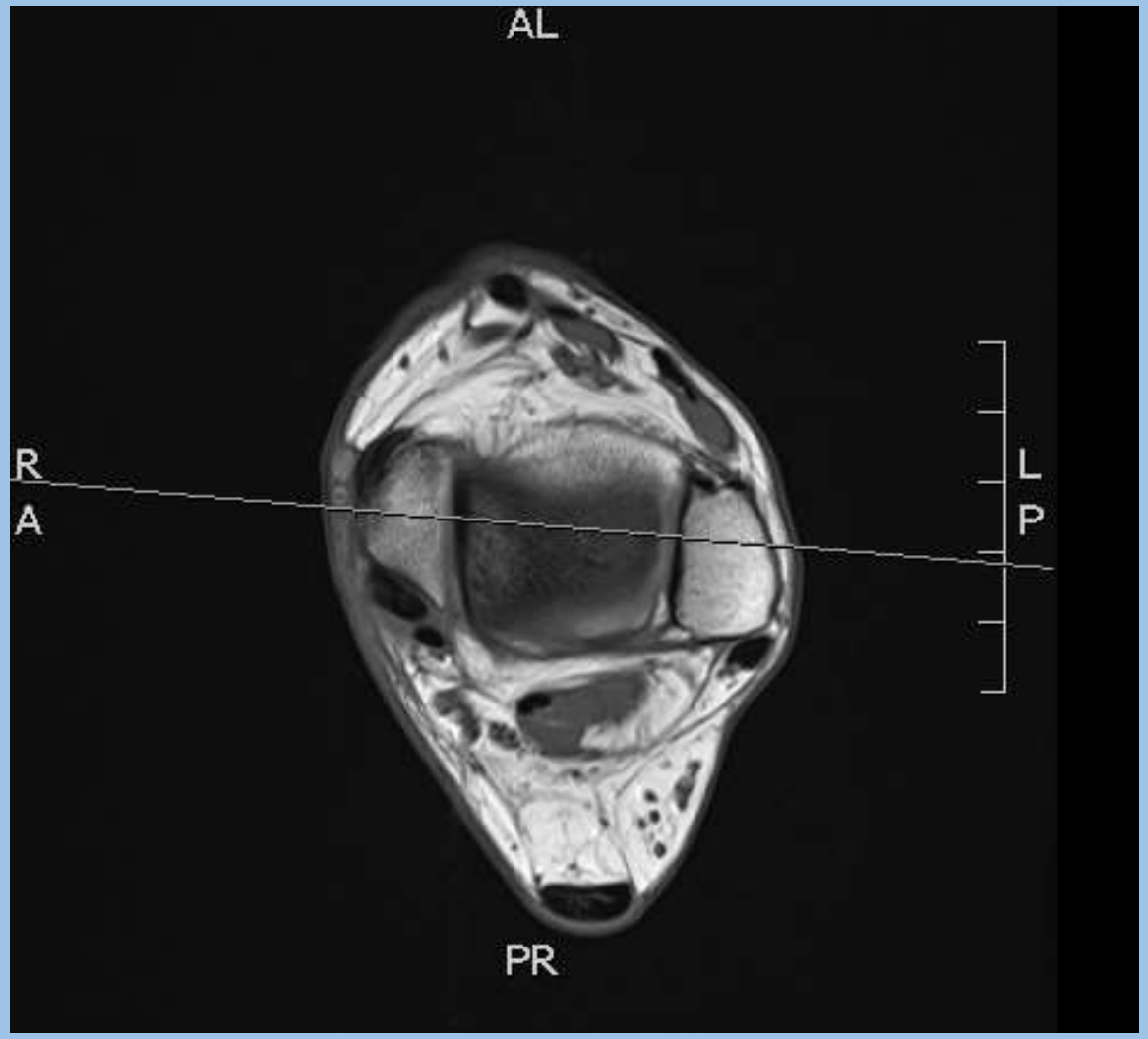
- Angle should be parallel with mortise joint

AXIAL COVERAGE



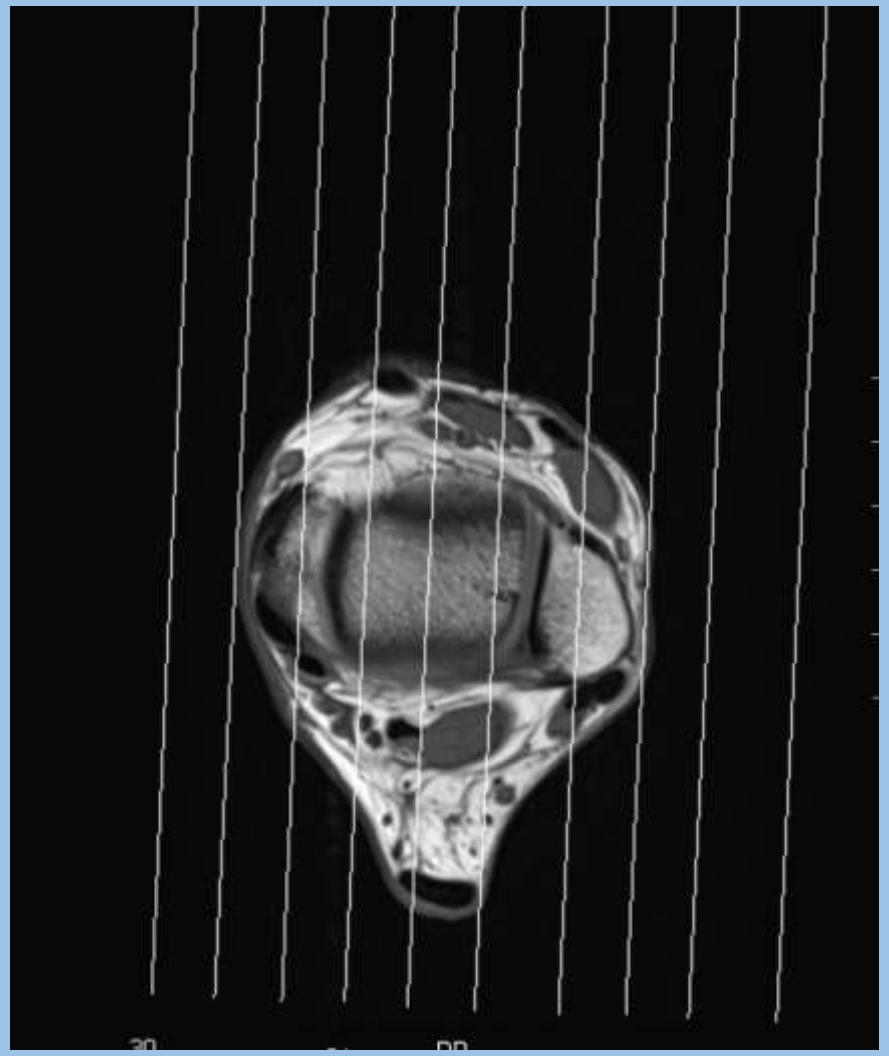
CORONAL ANGLE

- Ø Angle perpendicular to medial and lateral malleoli
- Ø Slices should cover Achilles tendon through midfoot

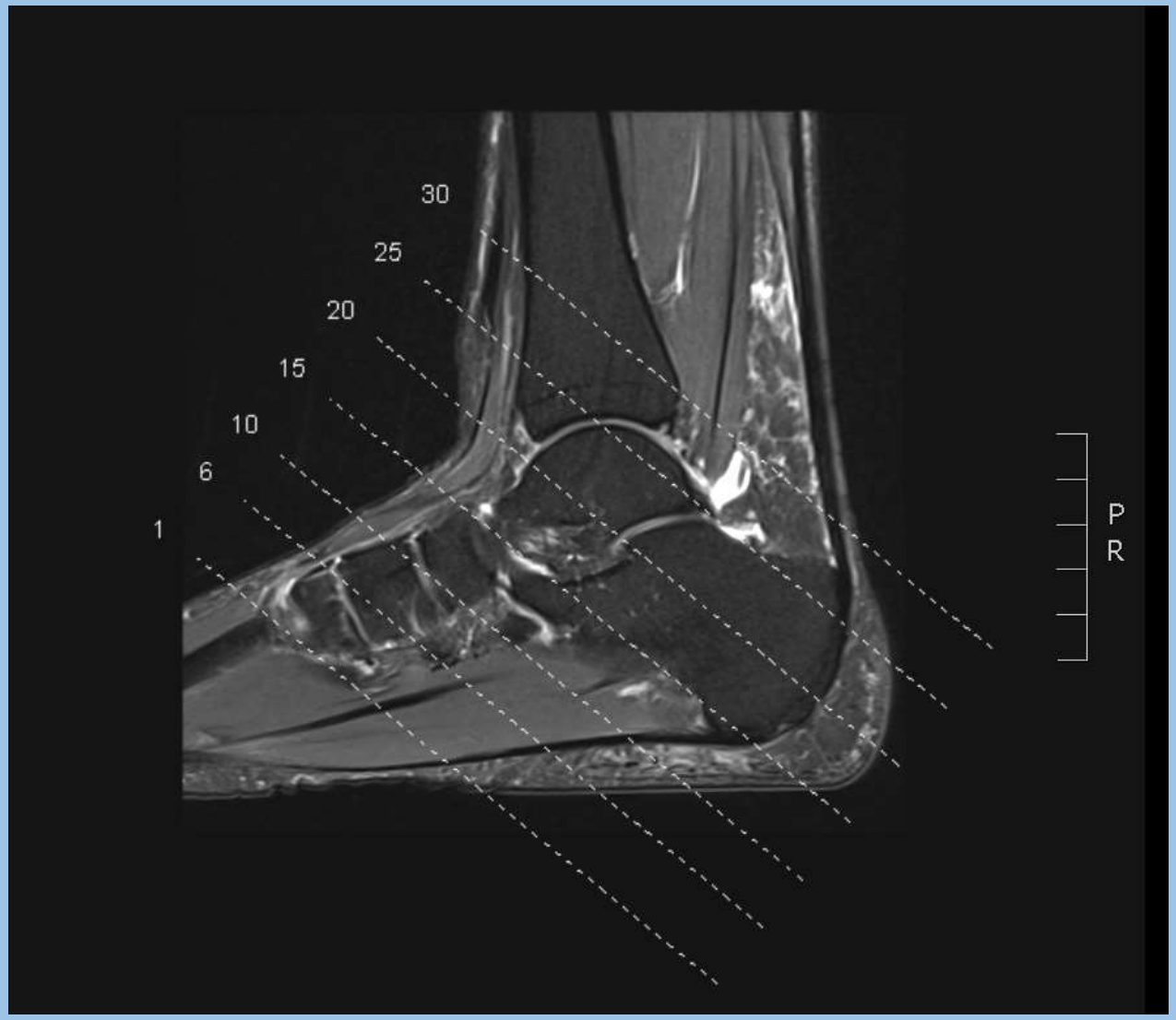


SAGITTAL ANGLE

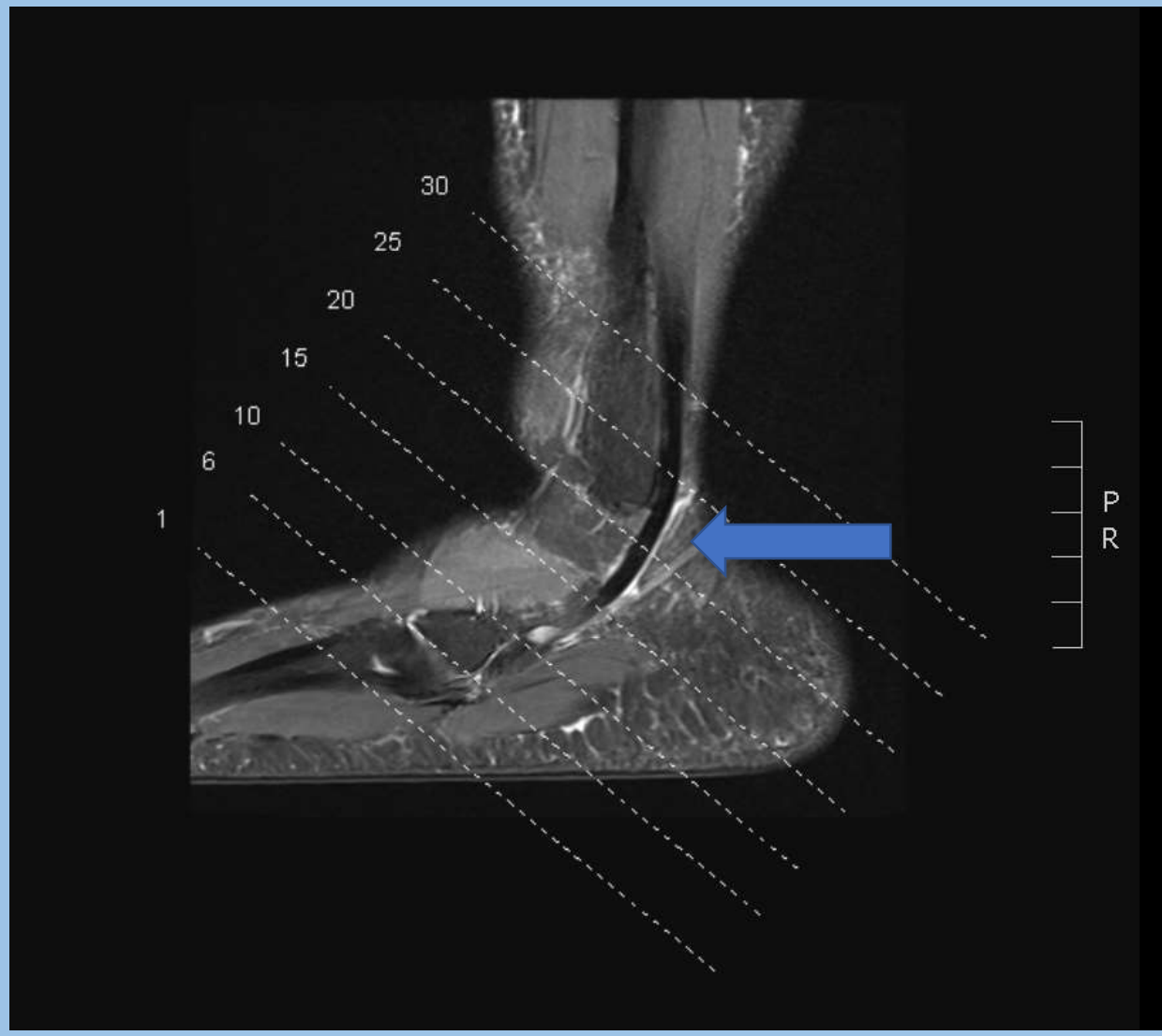
- ➢ Angle parallel to medial and lateral malleoli



AXIAL OBLIQUE T2 FS



ANGLE PERPENDICULAR TO PERONEAL TENDON



FOREFOOT ROUTINE

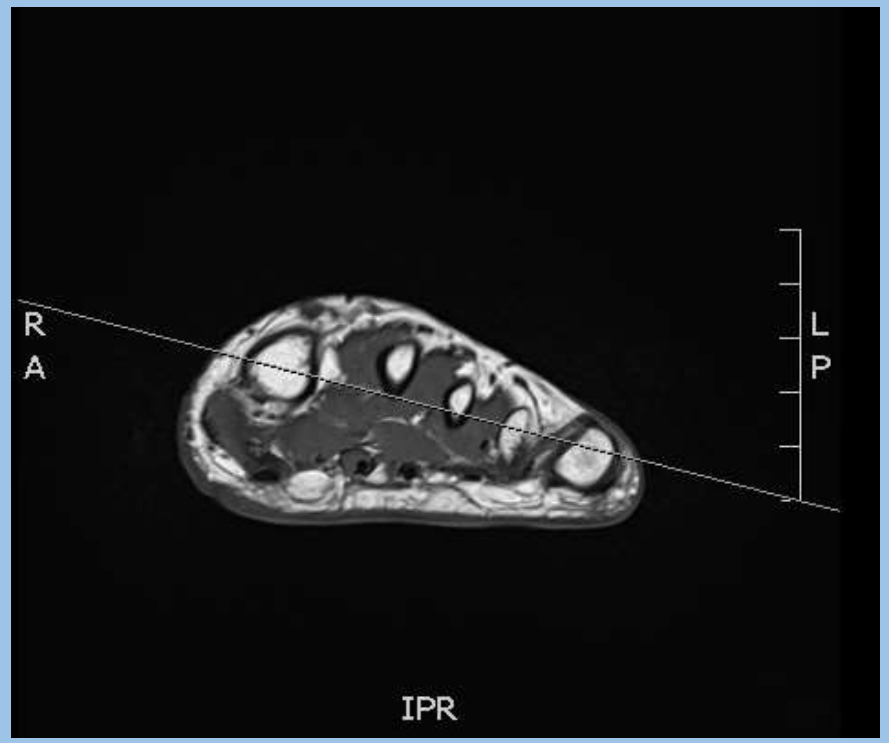
Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
SAG T1	160	3.0/0.3		
SAG STIR	160	3.0/0.6		
COR T1	140	3.0/0.6		
COR T2 FS	140	3.0/0.6		
AX T2 FS	160	2.0/0.2		
AX T1	160	3.0/0.3		
Optional Sequences				
COR STIR	140	3.0/0.3		
AX STIR	160	2.0/0.2		

FOREFOOT (MASS/INFECTION/LESION)

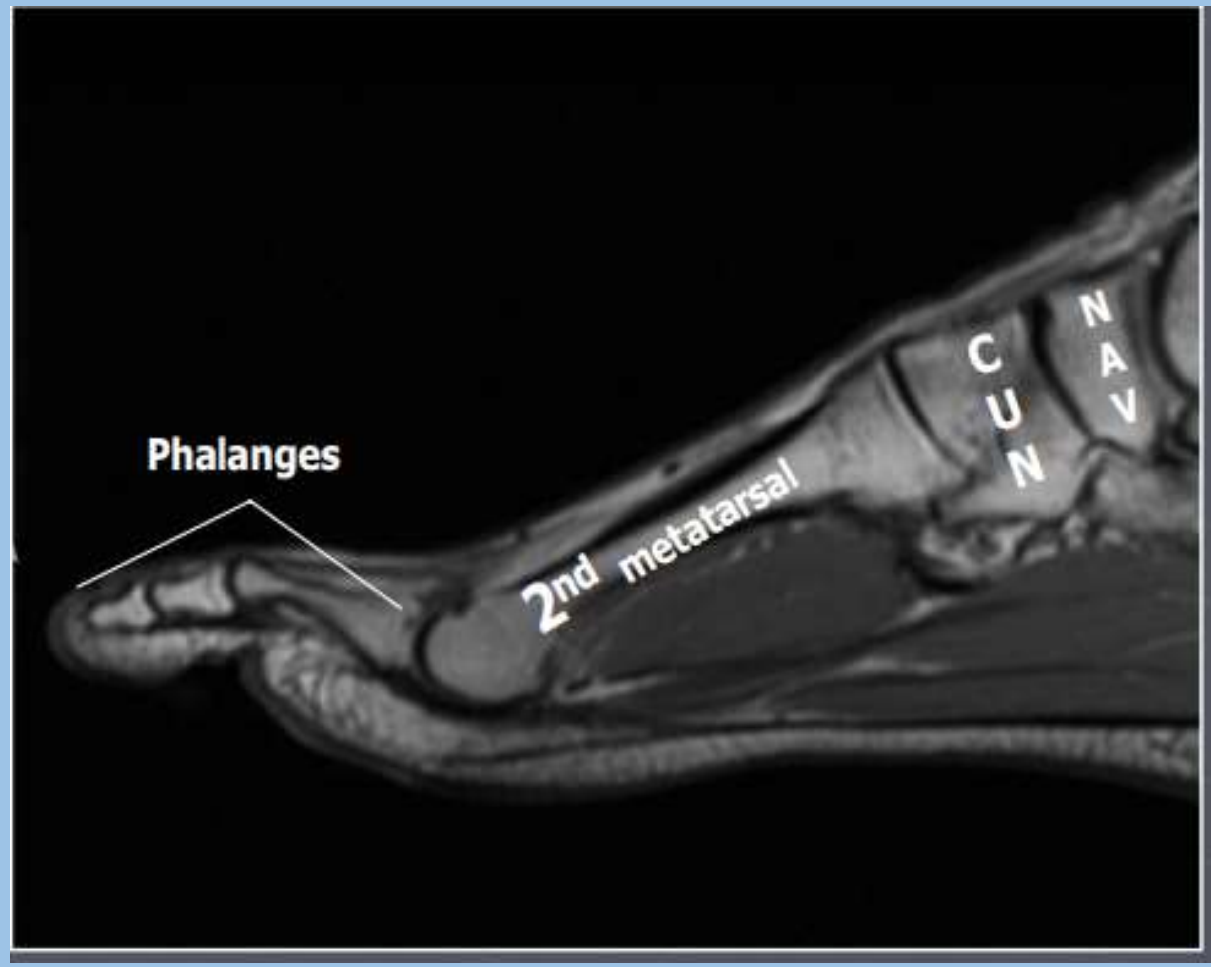
Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
SAG T1	160	3.0/0.3		
SAG T2 FS	160	3.0/0.3		
COR T1	140	3.0/0.6		
COR T2 FS	140	3.0/0.6		
AX T2 FS	160	2.0/0.2		
AX T1	160	2.0/0.2		
AX T1 FS PRE	160	2.0/0.2		
POST CONTRAST				
AX T1 FS POST GD	160	2.0/0.2	*Be sure to subtract pre/post Axial T1 FS images	
COR T1 FS POST GD	140	3.0/0.6		
SAG T1 FS POST GD	160	3.0/0.3		

LONG AXIS FOREFOOT

- **ANGLE TO METATARSALS**



RELEVANT ANATOMY



PROPER COVERAGE

Soft Tissue Mass Protocol-
General Recommendations

- **Place markers above and below mass or area of concern. This will alleviate depressing the skin in the area of concern**
- **FOV will be determined by the area/mass/body part you are scanning**
- **Axial T1 FS pre/post will always be acquired. Speak with Rad to determine if Sag or Cor is best plane in relation to mass location**
- **A joint space should be included for reference**

Soft Tissue Mass Protocol

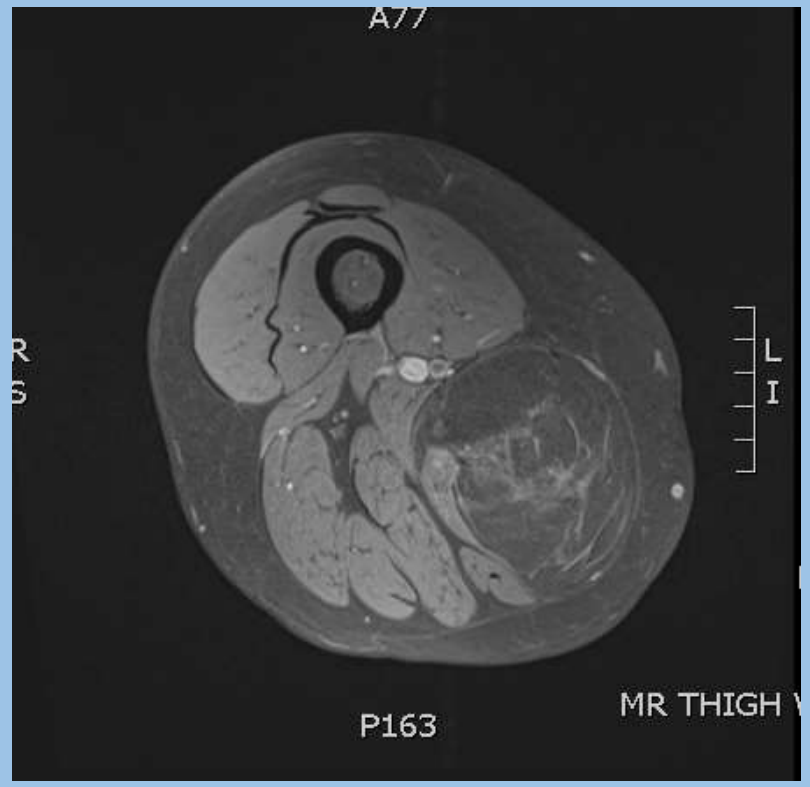
Sequence	Fov	Slice Thickness/ Gap	Comments	Patient Position Tips
AXIAL T1	*Dependent upon body part*	4.0/1.0		*Slice thickness and gap also dependent on body part
AXIAL T2 FS		4.0/1.0		
SAG OR COR T1	*Dependent upon body part*	4.0/1.0		
SAG OR COR STIR		4.0/1.0		
AXIAL T1 FS PRE		4.0/1.0		
CONTRAST		4.0/1.0		
AXIAL T1 FS POST		4.0/1.0		
SAG OR COR T1 FS POST		4.0/1.0		

****ALL POST CONTRAST STUDIES MUST HAVE A PRE-CONTRAST AXIAL T1 FS IN CASE SUBTRACTION IMAGES ARE NEEDED**

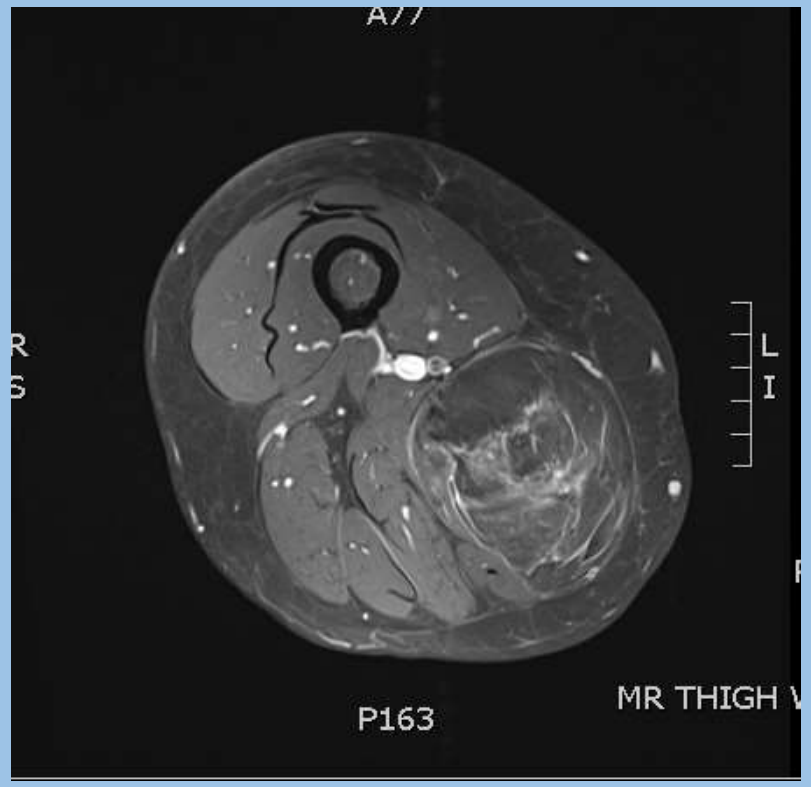
IF LESION OR MASS IS MEDIAL OR LATERAL, RUN THE COR T1 FS POST ALONG WITH THE AX T1FS
IF LESION OR MASS IS ANTERIOR OR POSTERIOR, RUN THE SAG T1 FS POST ALONG WITH THE AX T1 FS

IMPORTANCE OF PRE AND POST AXIAL T1 FS

AXIAL T1 FS PRE



AXIAL T1 FS POST



RESULTING SUBTRACTION