

MSK MRI PROTOCOLS

0.7T – 1.5T



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Upper Extremity

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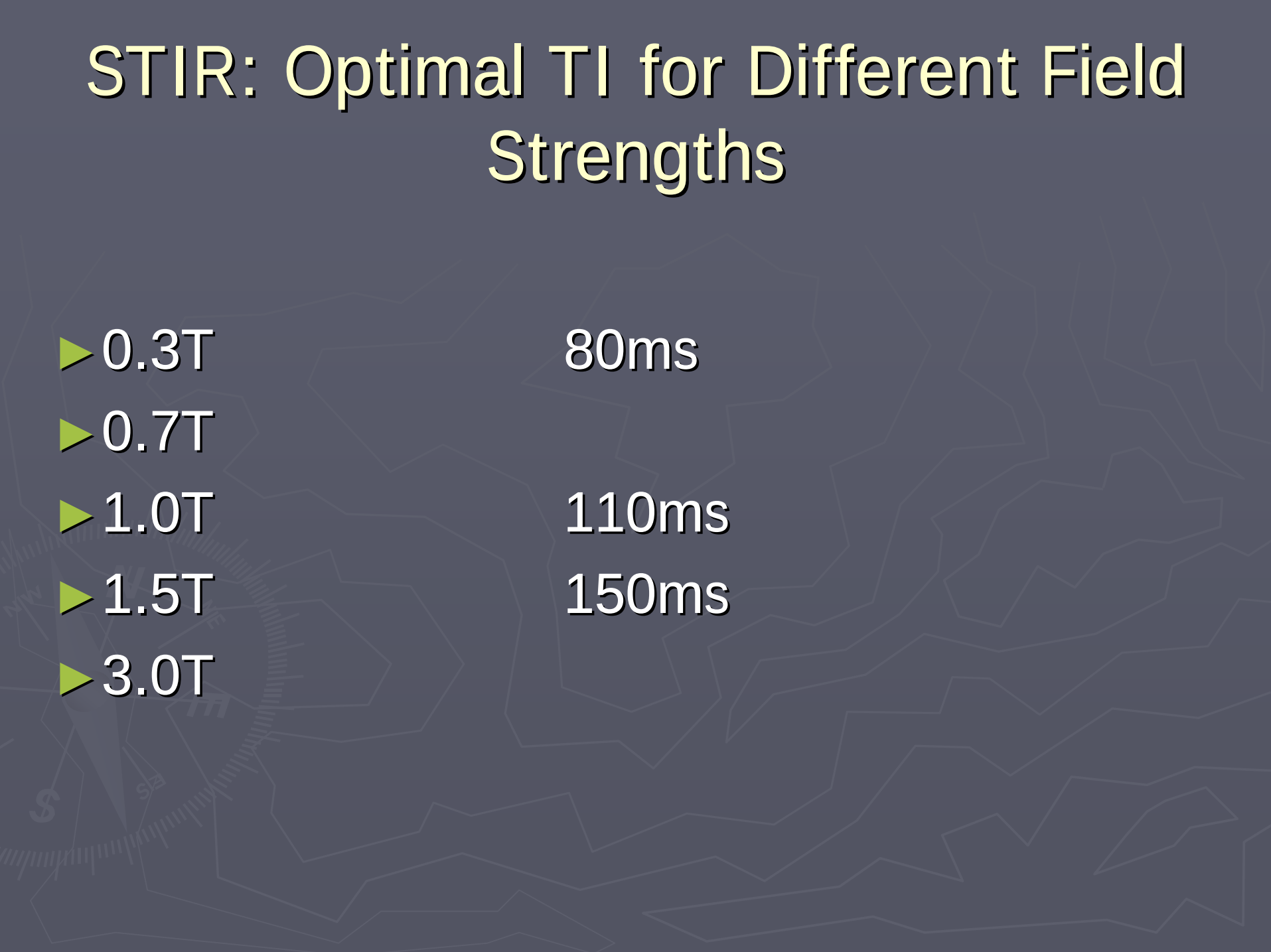
Lower Extremity

- Hip
- Bony Pelvis **Follow Hip Imaging Planes**
- Thigh **Follow Hip Imaging Planes**
- Athletic Pubalgia/Sports Hernia
- Knee
- Lower Extremity/Shin
- Ankle
- Foot

Special Cases

- Soft Tissue Mass
- Dynamic Enhanced Imaging for Osteomyelitis and Avascular Necrosis
- Metal Protocol

STIR: Optimal TI for Different Field Strengths



▶ 0.3T	80ms
▶ 0.7T	
▶ 1.0T	110ms
▶ 1.5T	150ms
▶ 3.0T	

UPPER EXTREMITY



MR SC Joint Exam Selection

► Routine SC Joint

- Indications:
 - SC Joint Traumatic Injury
- Special Instructions to Reduce Artifact:
 - May Need to Flip Phase/Frequency Encoding Gradients
 - Can reduce respiratory motion artifact in prone position
 - May be useful to add respiratory comp
- Coil: 5 inch Flex (Use TMJ holder if patient supine)

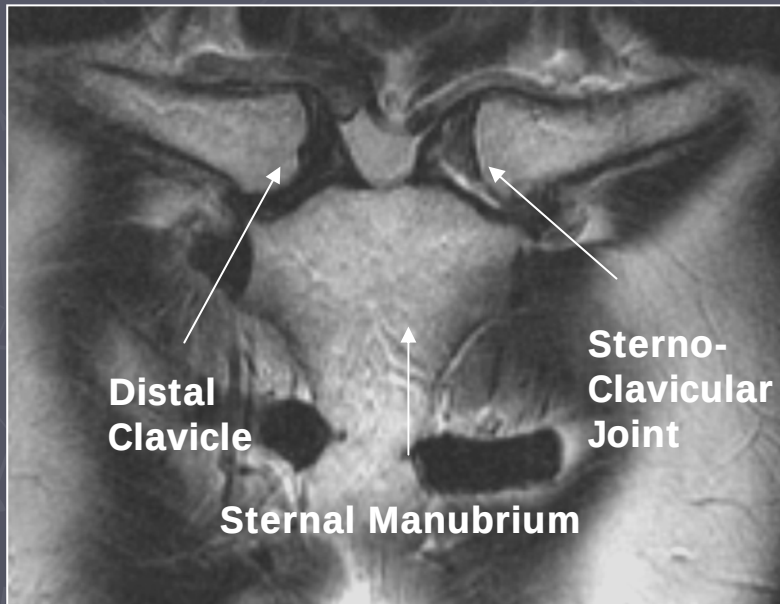
Routine SC Joint

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
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Sag T2 FSE Fat sat	24	256x192 3	4 / 1	>2000	50-60			8	16
Cor FSE-STIR	20	256x192 3	4 / 1	>2000	20-40	150		8	16
Cor T1 SE	20	256x192 2	4 / 1	400-800	minimum				16
Axial T2 FSE fat sat	20	256x192 3	4 / 1	>2000	50-60			8	16
Axial T1 SE	20	256x192 2	4 / 1	400-800	Min				16

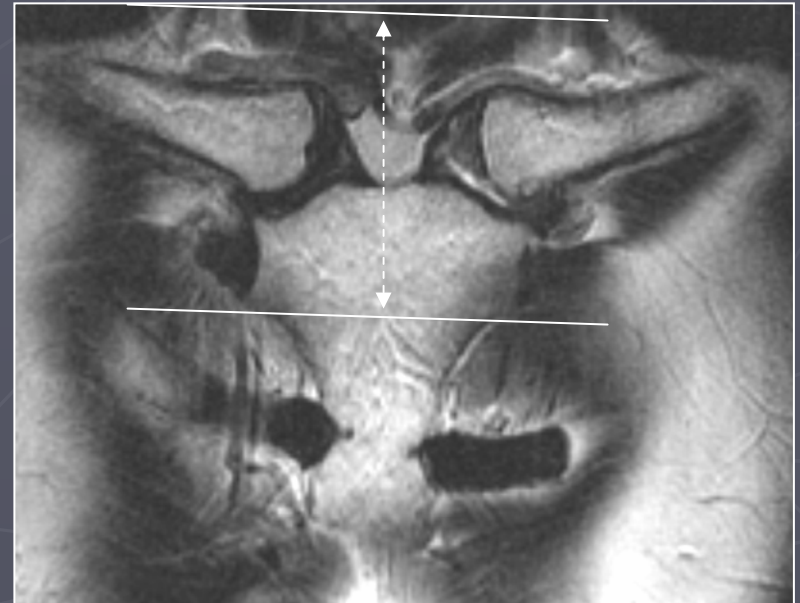
SC Joint-Axial Imaging Plane

Relevant Anatomy



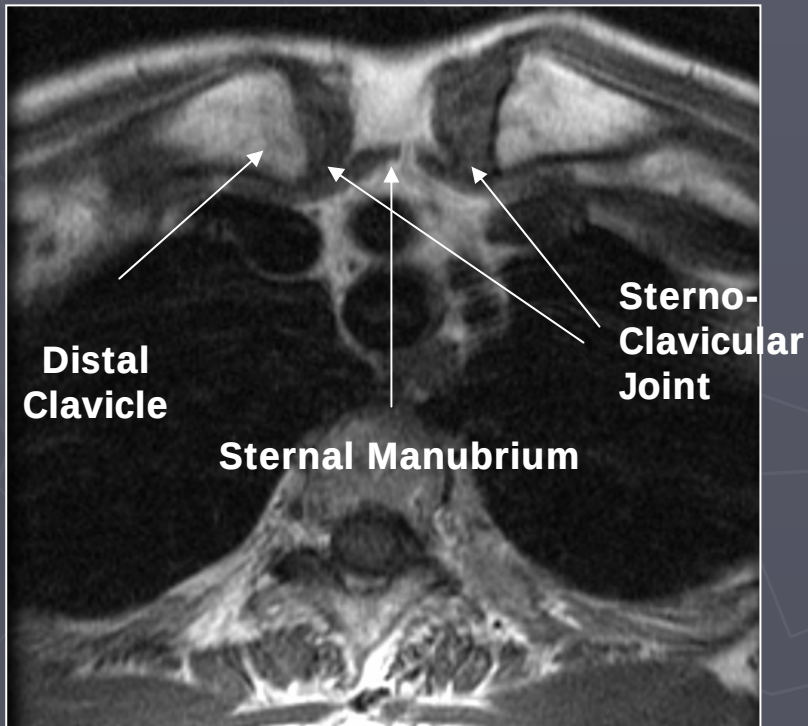
Axial Imaging Plane

Center on sternum and prescribe plane perpendicular to line through sternum. Scan through sternoclavicular Joint.



SC Joint-Sagittal Imaging Plane

Relevant Anatomy



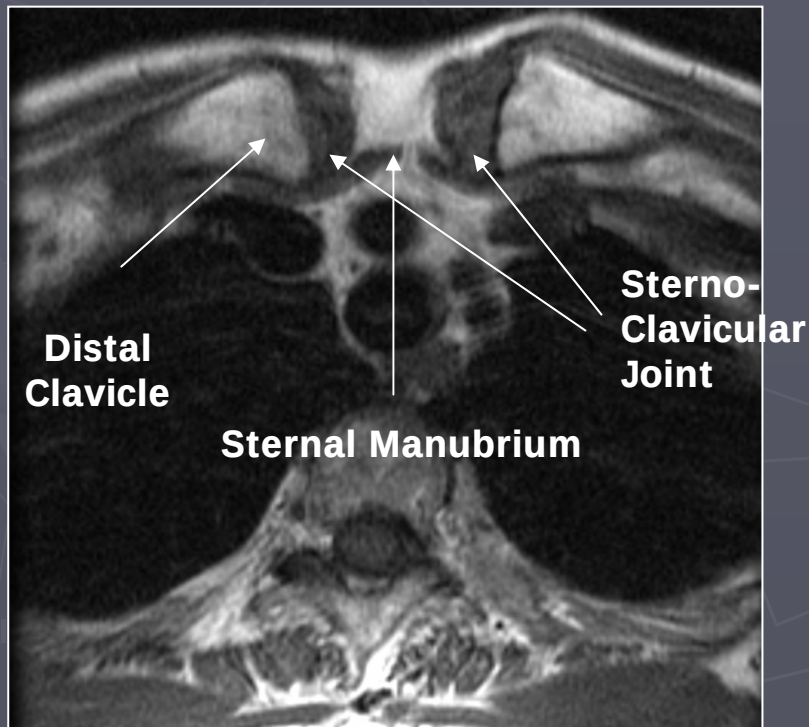
Coronal Imaging Plane

*Prescribe plane perpendicular to SC joint
Scan through both clavicles.



SC Joint-Coronal Imaging Plane

Relevant Anatomy



Coronal Imaging Plane

*Prescribe imaging plane with line through anterior cortex. Scan through both SC joints.



MR Shoulder Exam Selection:

► Routine Shoulder

- Indications:

- Rotator Cuff Pathology/Evaluation, Proximal Long Head Biceps, AC Joint Pathology

- Special Instructions:

- If proximal biceps tear is a concern, extend axial images to mid humeral diaphysis

► MR Arthrogram (Direct or Indirect)

- Indications:

- Labrum Pathology

Shoulder-Routine

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
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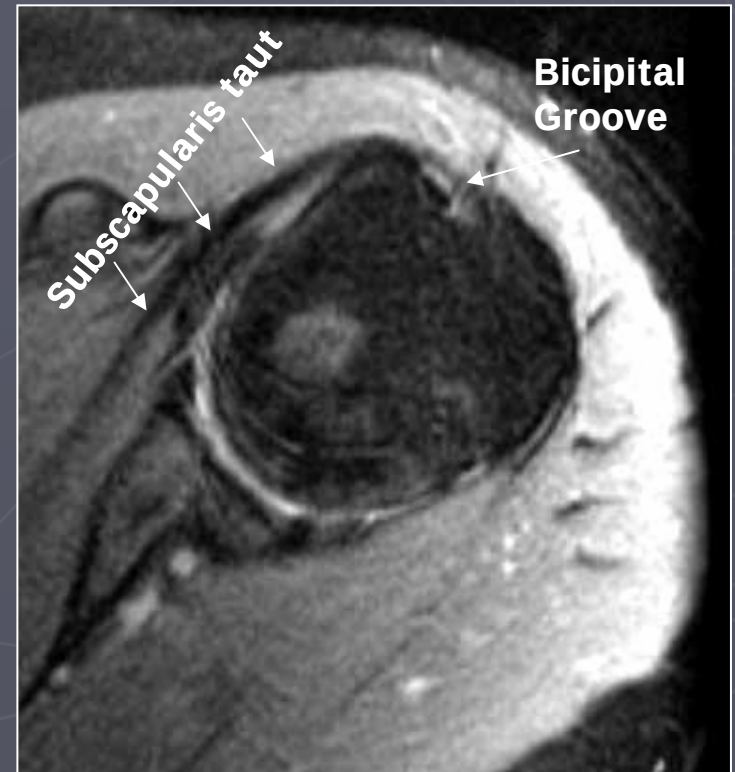
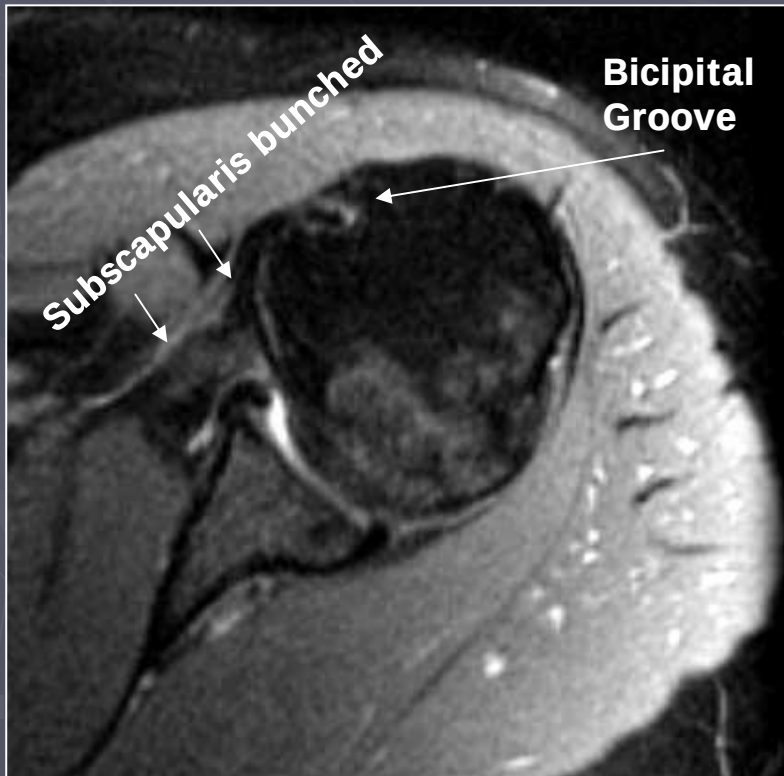
Axial Proton FSE FatSat	12	256 x 256 3	4/0.5	1500-	35	-	-	8	16
Cor Oblique T2 FSE Fat Sat	14-16	256x 256 3	3/0.5	>2000	50-60			8	16
Cor Oblique T1 SE	14-16	256 x 256 2	3/0.5	400-800	400-800	-	-		16
Sag Oblique T2 FSE Non Fat Sat	14-16	256x 256 2	3/0.5	>2000	110	-	-	8	16

MR Arthrogram Shoulder

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Axial T1 SE FatSat	14	256 x 192 2	3/0.5	400-800	minimum				16
Cor Oblique T1 SE FatSat	14	256 x 192 2	3/0.5	400-800	minimum				16
Cor Oblique T2 FSE FatSat	14	256 x 256 3	3/0.5	>2000	50-60			8	16
Sag Oblique T1 SE Non FatSat	14	256 x 192 2	3/0.5	400-800	minimum				16
Axial 3D SPGR	14	256x 256 1	1mm	50-60	min		>40		16
ABER T1 SE Fat Sat	14	256 x 192	3/0.5	400-800	minimum				16
OPTIONAL SEQUENCE									

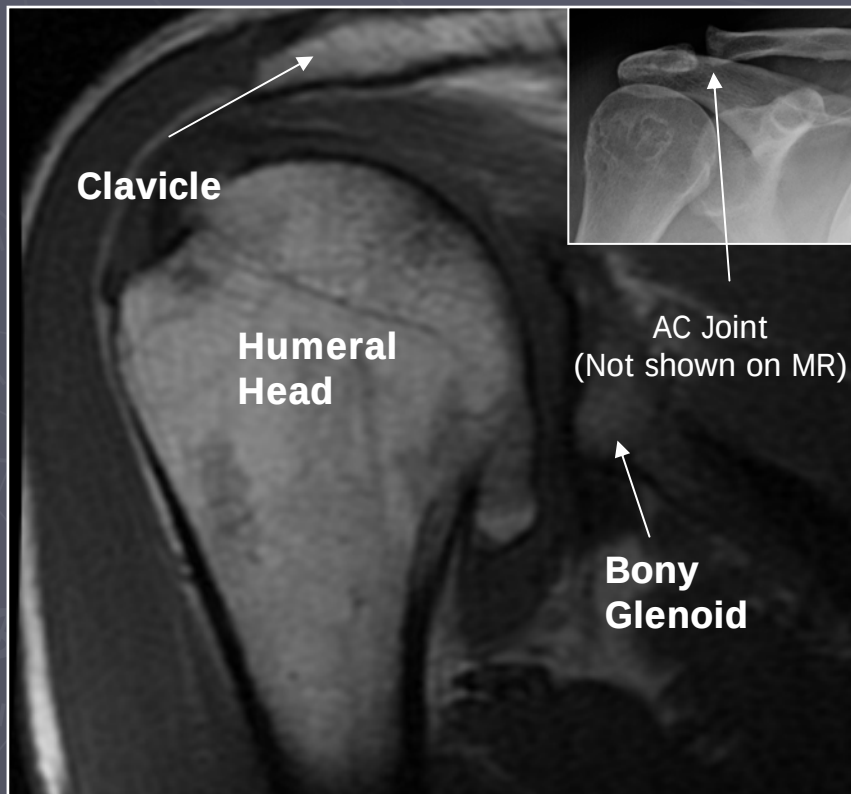
Shoulder-Pointer Axial Imaging Plane

Have patient bend arm at elbow to 90 degrees. Rotate laterally to externally rotate shoulder to assure subscapularis tendon is NOT bunched. Note location of bicipital groove in internal and external rotation.



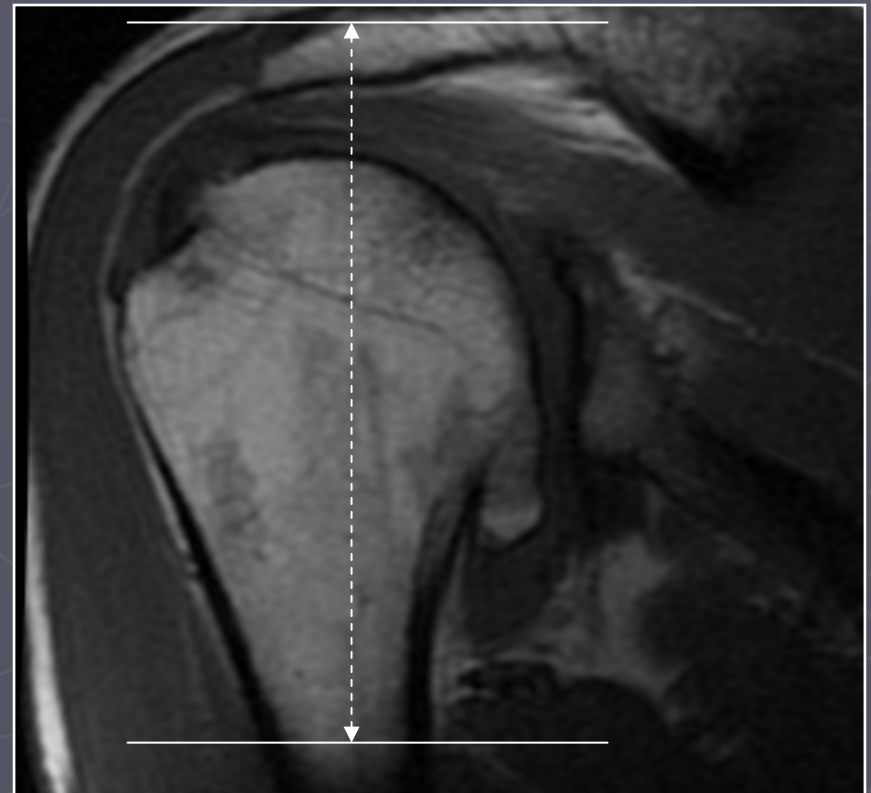
Shoulder-Axial Imaging Plane

Relevant Anatomy



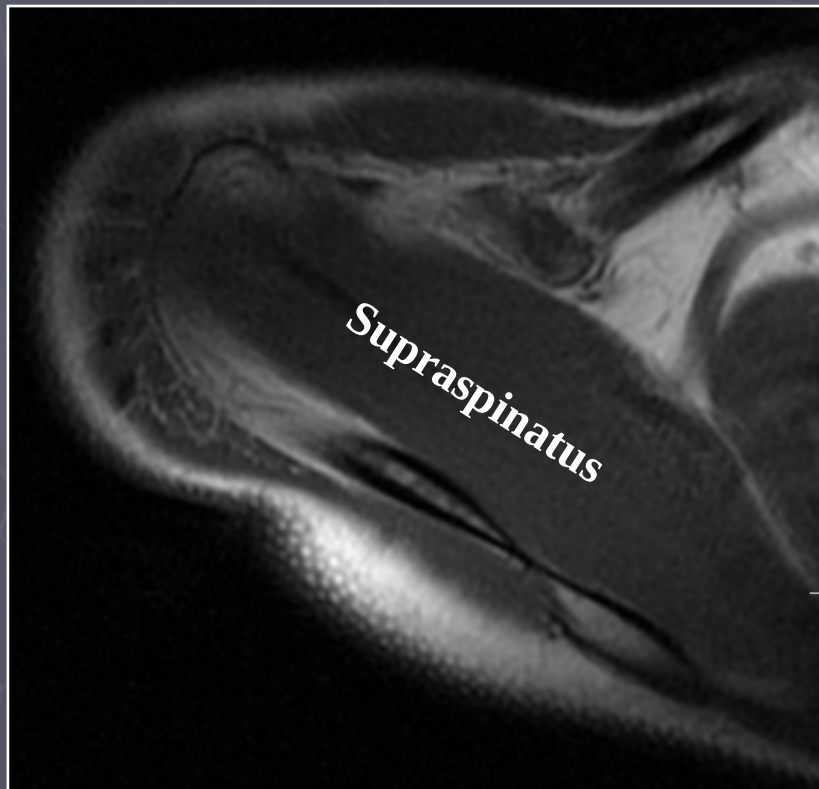
Axial Imaging Plane

Prescribe plane parallel to humeral shaft. Cover from AC joint through proximal humeral diaphysis.



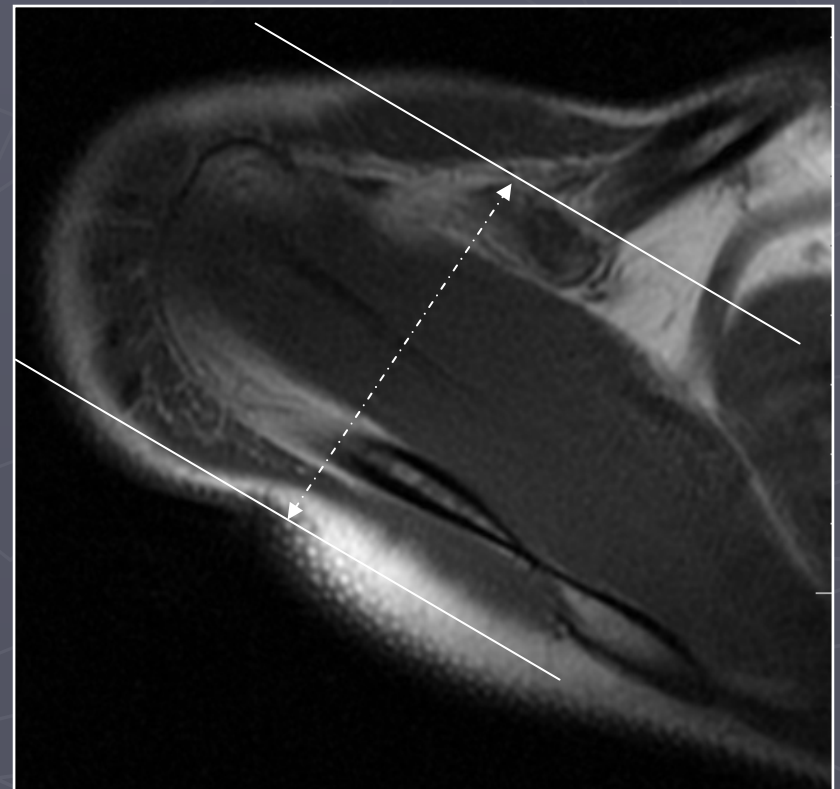
Shoulder-Coronal Imaging Plane

Relevant Anatomy



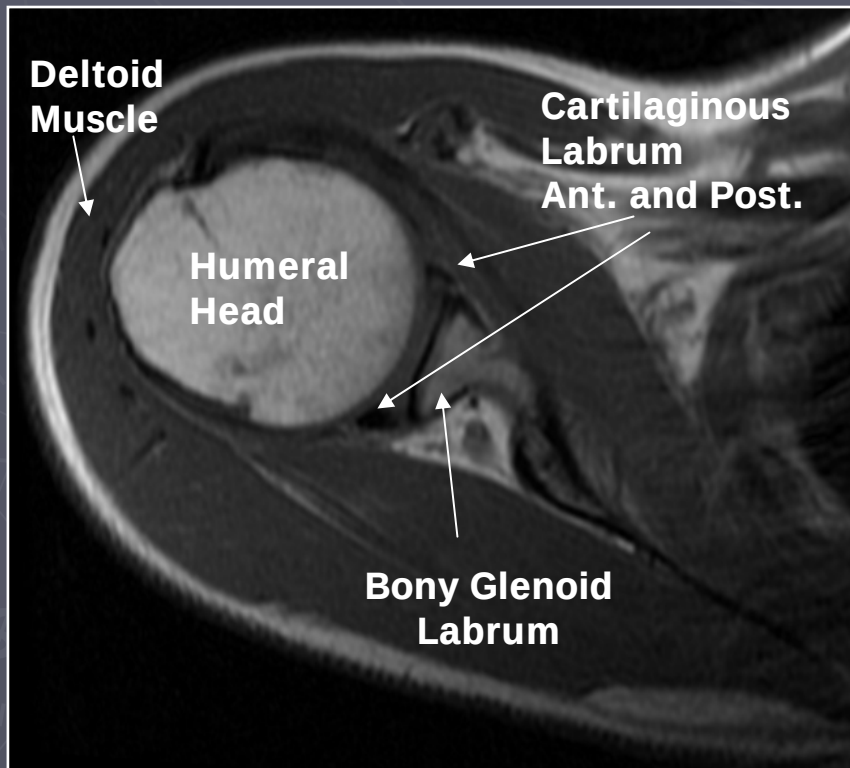
Coronal Imaging Plane

Prescribe coronal plane off of axial images parallel to supraspinatus muscle



Shoulder-Sagittal Imaging Plane

Relevant Anatomy



Sagittal Imaging Plane

Prescribe sagittal plane off axial images with line parallel to bony glenoid. Image from scapular wing through deltoid muscle.



ABER Imaging Plane

- ▶ **AB**duction **E**xternal **R**otation
- ▶ Surface Coils
- ▶ Coronal Localizer
- ▶ ABER prescribed oblique along axis of humerus



ABER Imaging Plane



Pectoralis Major Exam Selection

► Routine Pectoralis Major

- Indications:

- Pectoralis Major Tear

- Special instructions to reduce respiratory artifact

- May Need to Flip Phase/Frequency Encoding Gradients

- Can reduce respiratory motion artifact in prone position

- May be useful to add respiratory comp

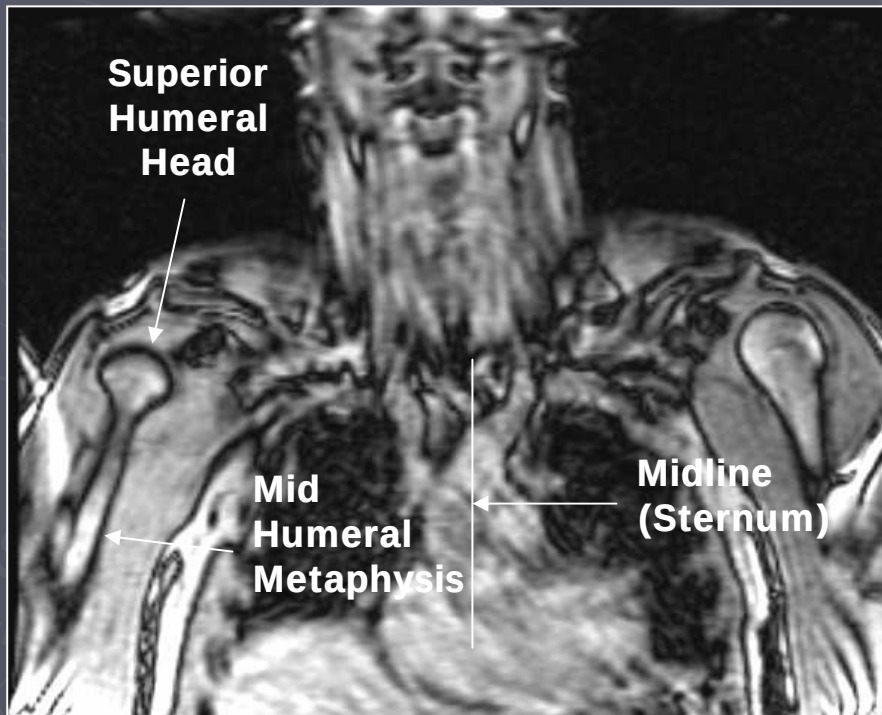
MR Pectoralis Major

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
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Axial T1 SE	24-32	256 x 256 2	4 / 1	400-800	minimal				16
Axial FSE STIR	24-32	256x192 3	4 / 1	>2000	20-40	150		8	16
Axial T2 FSE Fat Sat	24-32	256 x 256 3	4 / 1	>2000	50-60			8	16
Coronal FSE STIR	24-32	256x192 3	4 / 1	>2000	20-40	150		8	16
Sagittal FSE STIR	24-32	256x192 3	4 / 1	>2000	20-40	150		8	16

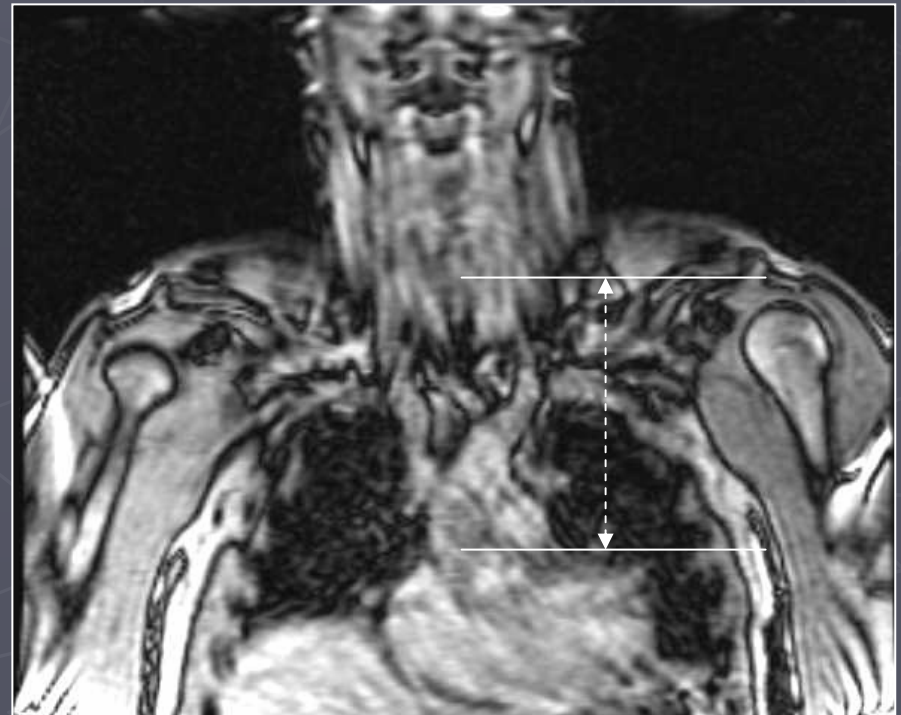
Pectoralis-Axial Imaging Plane

Relevant Anatomy



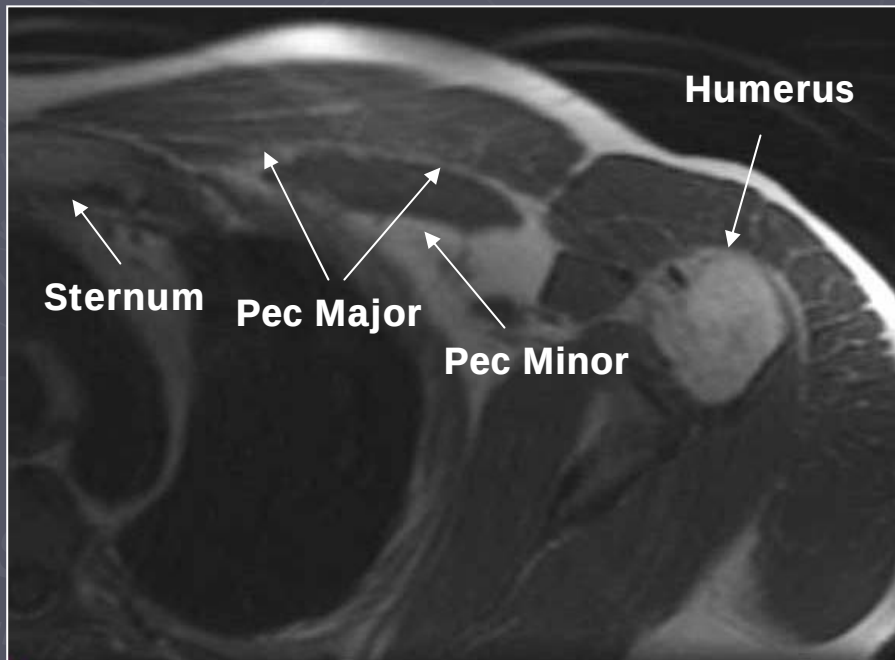
Axial Imaging Plane

Scan in axial plane from superior humeral head through the mid humeral metaphysis, being sure to cover from the sternum (midline) through the humerus laterally.



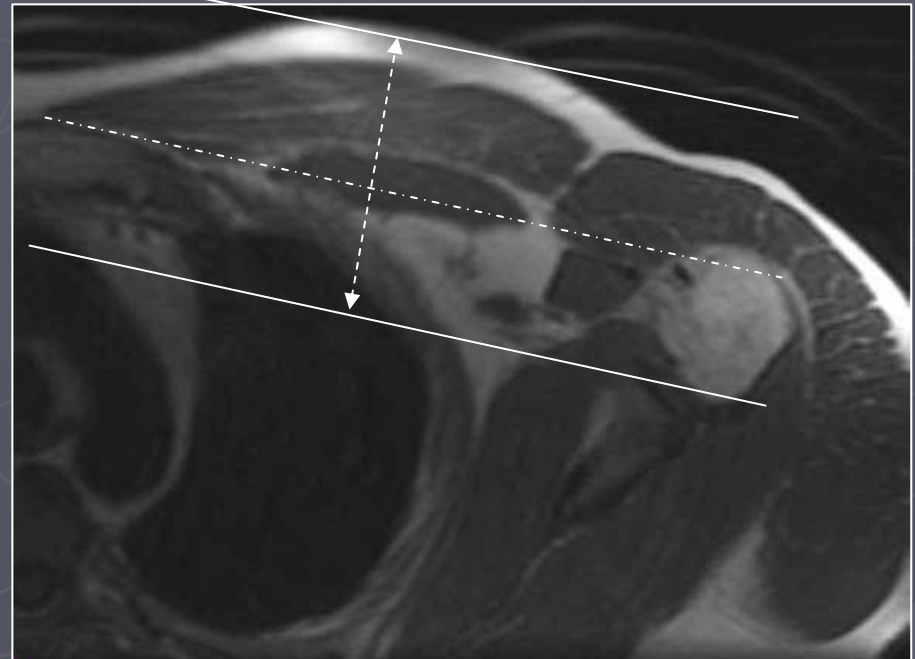
Pectoralis-Coronal Imaging Plane

Relevant Anatomy



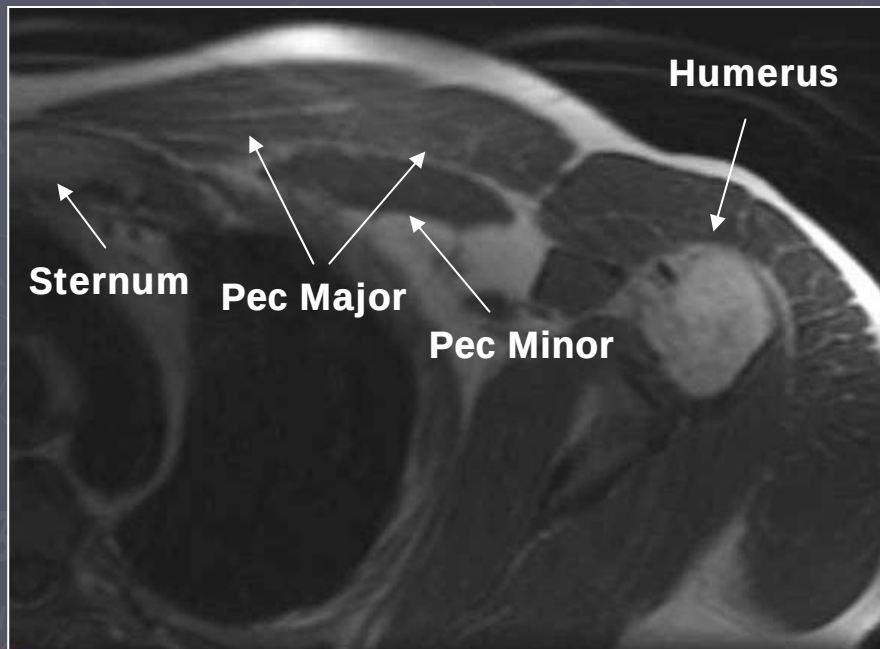
Coronal Imaging Plane

Prescribe plane from line from sternum through Anterior humerus. Scan from skin through Posterior humeral head.



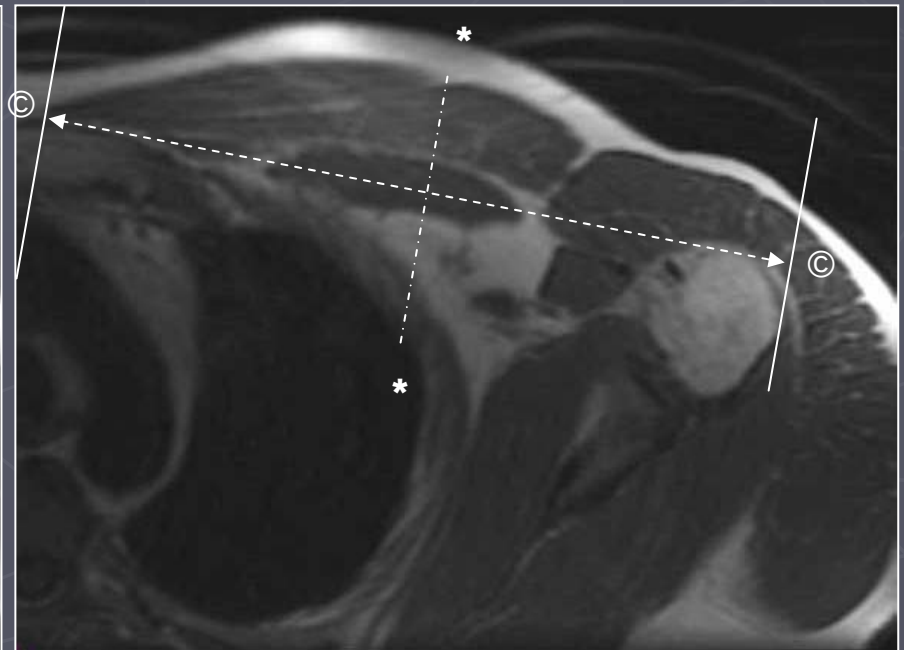
Pectoralis-Sagittal Imaging Plane

Relevant Anatomy



Sagittal Imaging Plane

Prescribe plane perpendicular to coronal plane (©). Scan From sternum through lateral aspect of humerus.



MR Elbow Exam Selection:

► Routine Elbow

■ Indications:

- Biceps/Triceps tear
- Medial/Lateral Collateral Ligament Tears
- Common Flexor/Common Extensor Tendon Pathology
- Nerve impingement
 - **Continue images through mid forearm**

► MR Arthrogram Elbow (Direct or Indirect)

■ Indications:

- Intra-articular Body evaluation/OCD
- Sometimes Medial/Lateral Collateral Ligament Evaluation

Elbow-Routine

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Axial PD FSE Non FatSat	12	512 x 256 2	4 / 1	3000	40			8	16
Axial T2 FSE FatSat	12	256 x 256 3	4 / 1	>2000	50-60			8	16
Coronal T1 SE Non FatSat	14-16	256 x 256 2	4 / 1	400-800	minimal				16
Coronal FSE-STIR	14-16	256x192 3	4 / 1	>2000	20-40	150		8	16
Sag T2 FSE FatSat	16	256 x 256 2	4 / 1	>2000	50-60			8	16

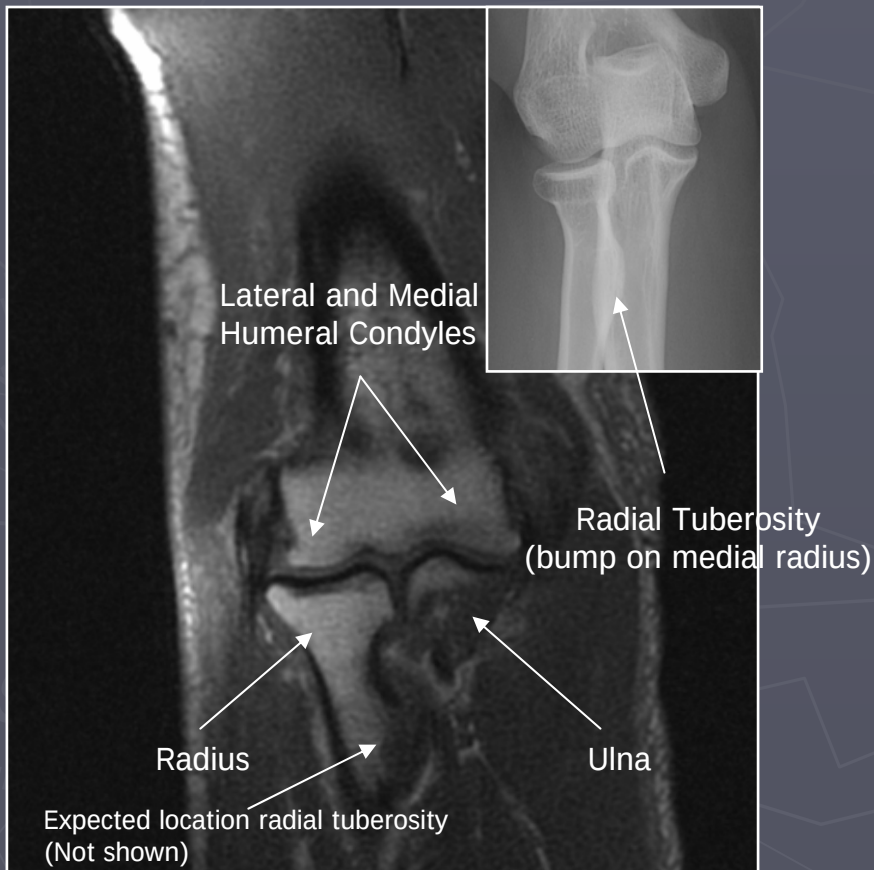
MR Arthrogram Elbow

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
------	-----	----------------	-------	----	----	----	------	-----	----

Axial T1 SE Non FatSat	12-14	256 x 192 2	4/1	400-800	minimum				16
Axial T2 FSE FatSat	12-14	256 x 256 3	4/1	>2000	50-60			8	16
Coronal T1 SE FatSat	12-14	256 x 192 2	4/1	400-800	minimum				16
Coronal T2 FSE FatSat	12-14	256 x 256 3	4/1	>2000	50-60			8	16
Sag T2 FSE FatSat	12-14	256 x 256 3	4/1	>2000	50-60			8	16

Elbow-Axial Imaging Plane

Relevant Anatomy



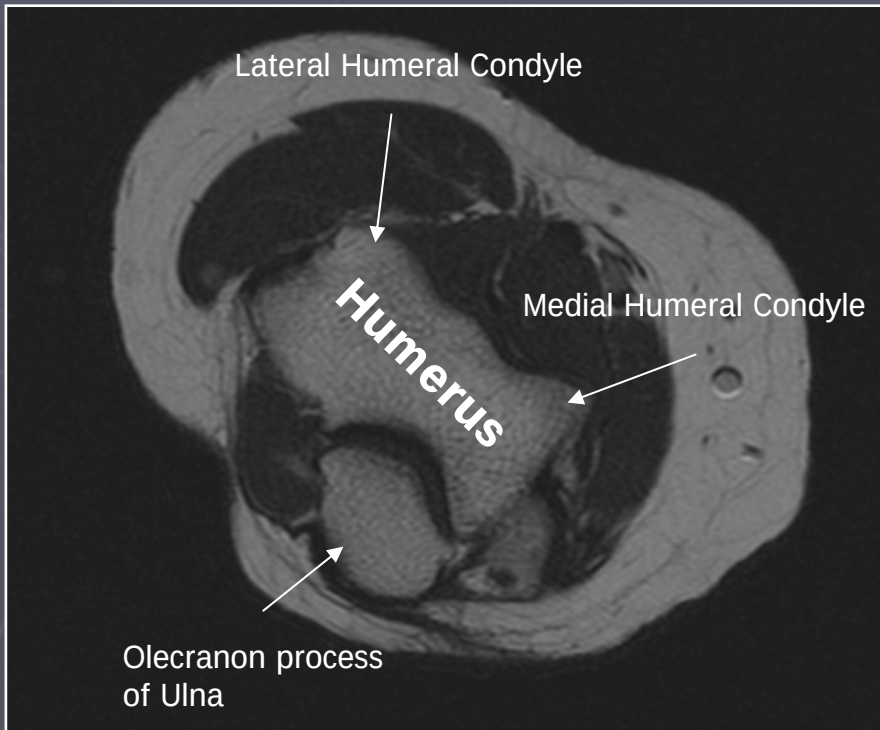
Axial Imaging Plane

*Prescribe plane perpendicular to coronal plane (©). Scan from humeral diaphysis past radial tuberosity.



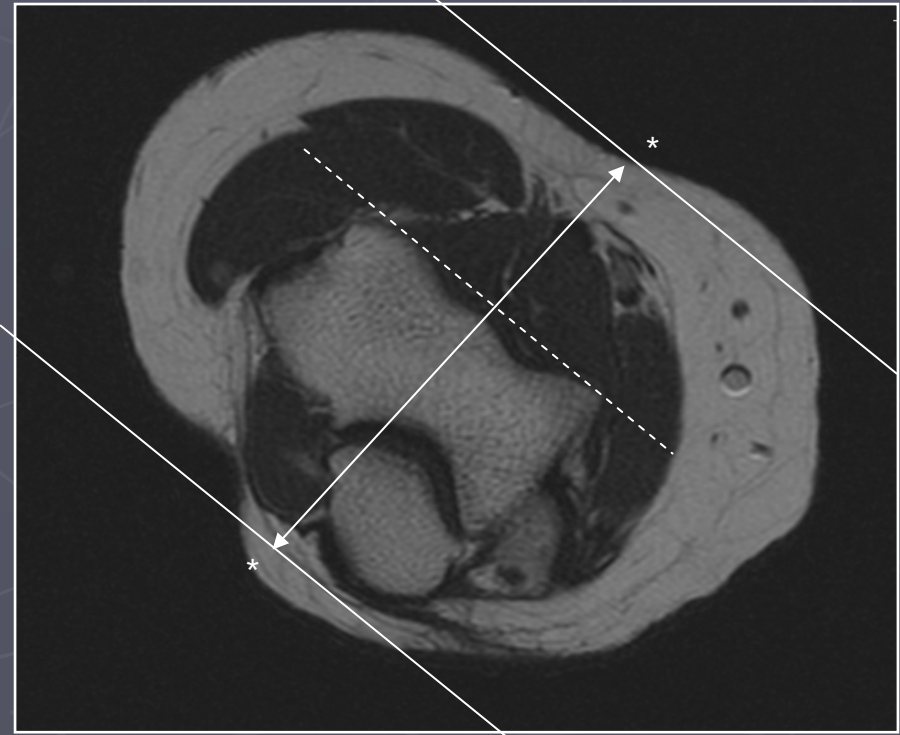
Elbow-Coronal Imaging Plane

Relevant Anatomy



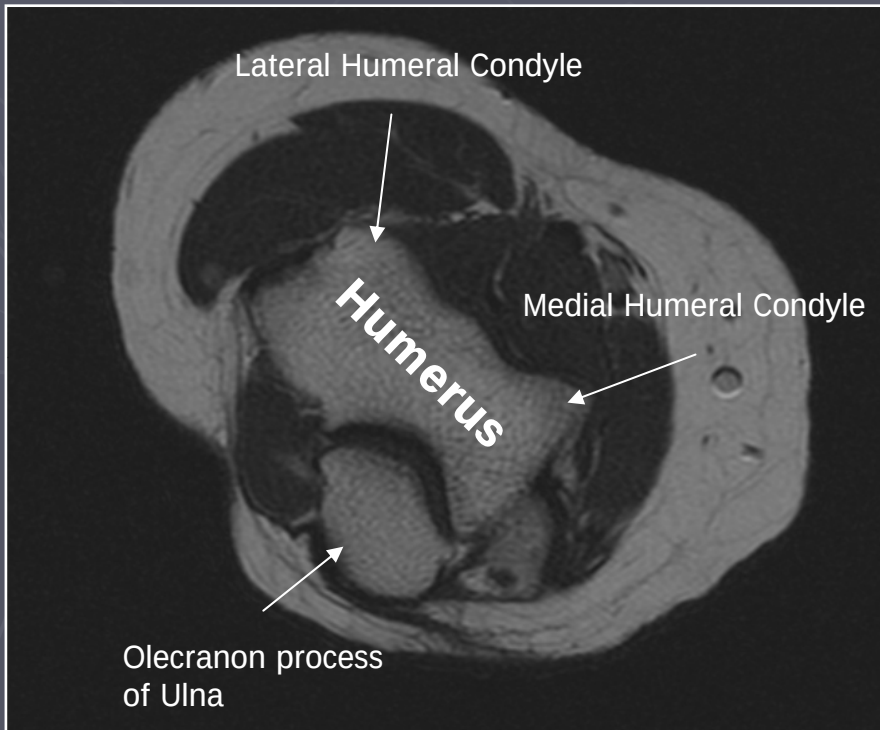
Coronal Imaging Plane

*Prescribe plane parallel to anterior humerus at condyles. Scan through entire elbow.



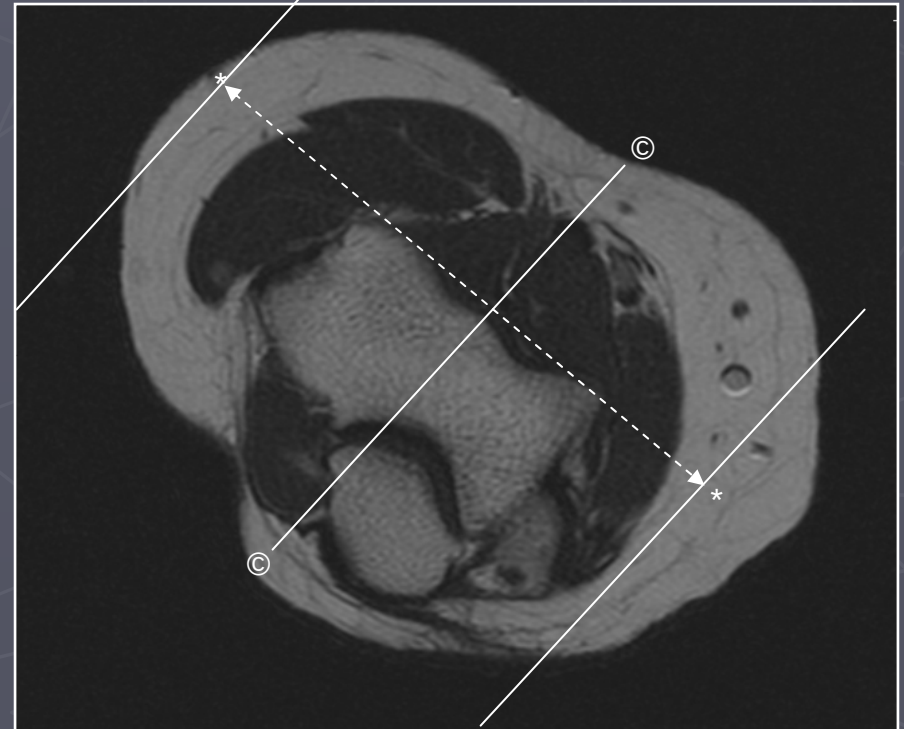
Elbow-Sagittal Imaging Plane

Relevant Anatomy



Sagittal Imaging Plane

*Prescribe plane perpendicular to coronal plane (©). Scan through entire elbow.



MR Wrist Exam Selection:

► Routine Wrist

■ Indications:

- TFCC, Lunotriquetral, Scapholunate tear
- Flexor Tendon/Carpal Tunnel/ Extensor Tendon Pathology
- Evaluation for Occult fracture

► MR Wrist Arthrogram (Direct or Indirect)

■ Indications:

- Some TFCC/LT/SL ligament tears

► **Special Cases**

■ Dynamic Enhanced Wrist

► Indication:

- Evaluation of Avascular Necrosis/Nonunion:
- IMPORTANT: **Perform Routine Wrist PLUS FMPSPGR Fat Sat Pre gadolinium images and three planes FMPSPGR post**

Wrist-Routine

Coronal T1 SE Non FatSat	10-12	256 x 256 2	3/0.3	400-800	minimum				16
Coronal T2 FSE FatSat	10-12	256 x 256 2	3/0.3	>2000	50-60			8	16
Coronal 3D Gradient	10-12	256 x 192 1	1/0	60	minimum		>40		16
Sag FSE-STIR	12-14	256x192 3	3/0.3	>2000	20-40	150		8	16
Axial T2 FSE FatSat	10-12	256 x 256 3	3/0.3	>2000	50-60			8	16
Coronal FMPSPGR FatSat Pre/Post	12	256 x 192 1	1/0	50	5		>40		16

Add Sequence for Scaphoid Nonunion Only

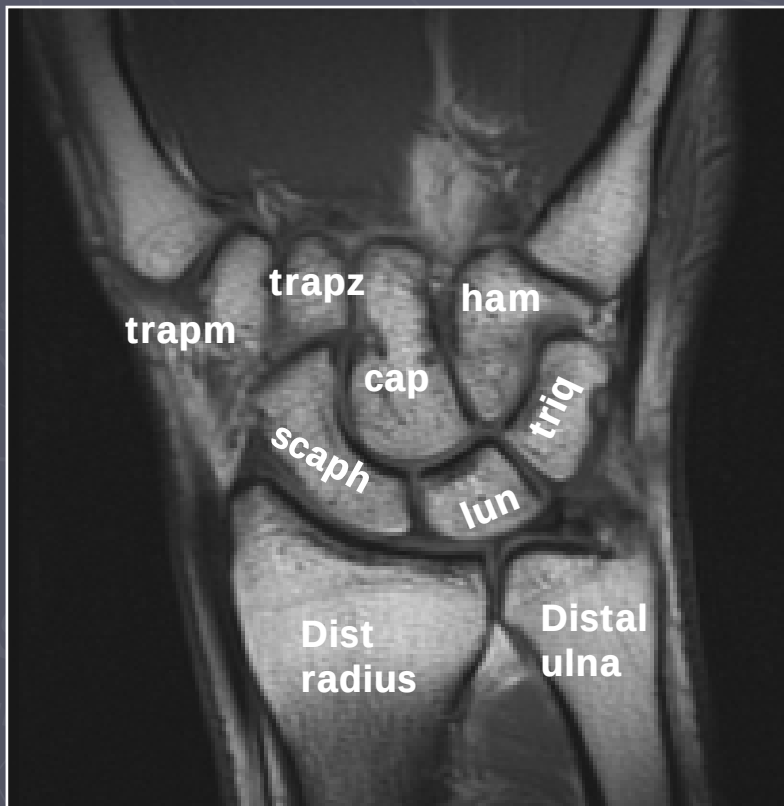
MR Arthrogram Wrist

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
------	-----	----------------	-------	----	----	----	------	-----	----

Coronal T1 SE Non FatSat	8-10	256 x 192 2	3/0.3	400-800	10-20				16
Coronal T2 FSE FatSat	8-10	256 x 256 3	3/0.3	>2000	50-60			8	16
Coronal 3D Gradient	8-10	256 x 192 1	1/0	60	minimum		>40		16
Axial T2 FSE FatSat	8-10	256 x 256 3	3/0.3	>2000	50-60			8	16
Sag T2 FSE FatSat	12	256x192 3	3/0.3	>2000	50-60			8	16

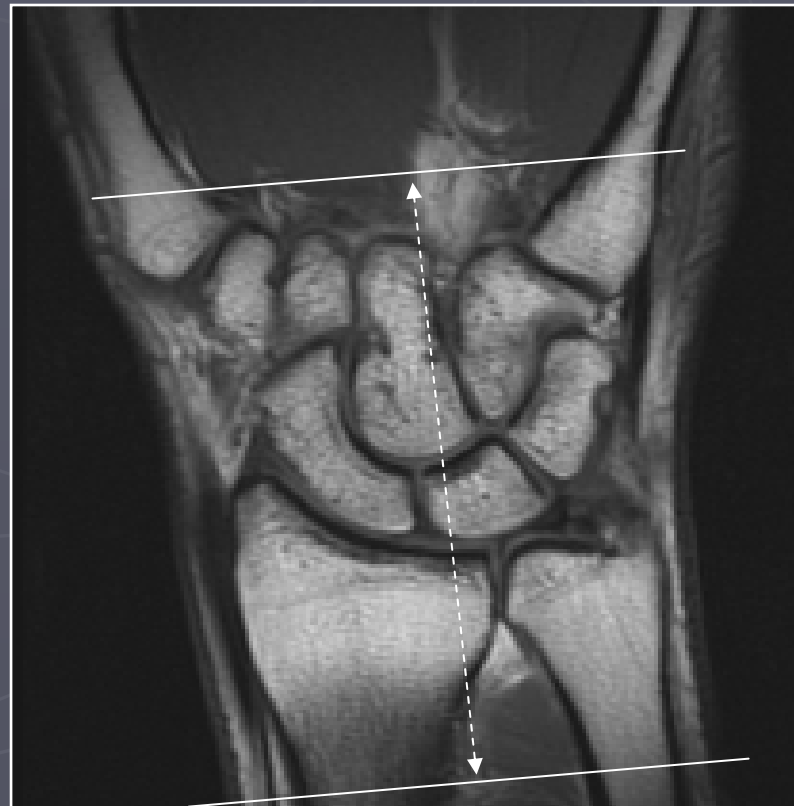
Wrist-Axial Imaging Plane

Relevant Anatomy



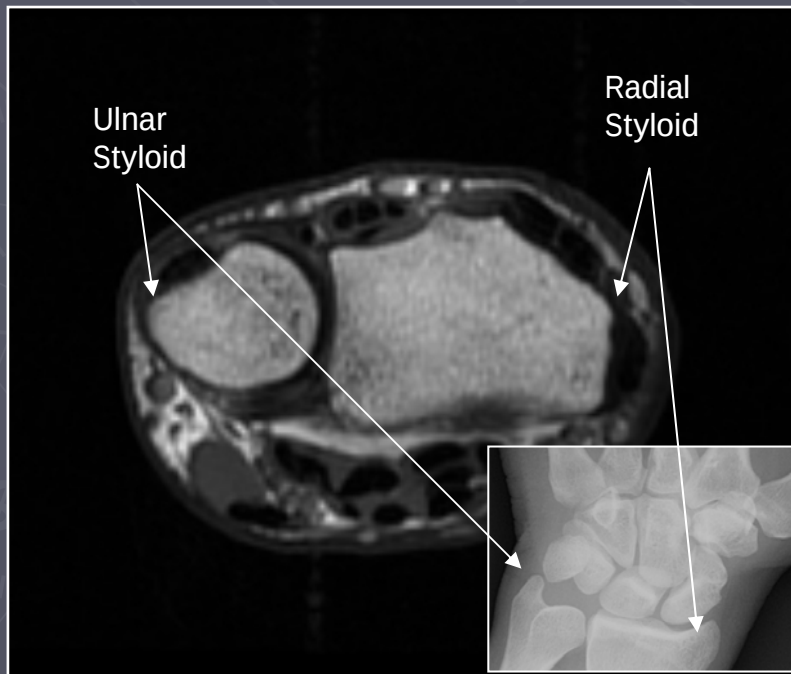
Axial Imaging Plane

Prescribe plane parallel to distal radius. Scan from proximal metacarpals through distal radial/ulnar metaphysis.



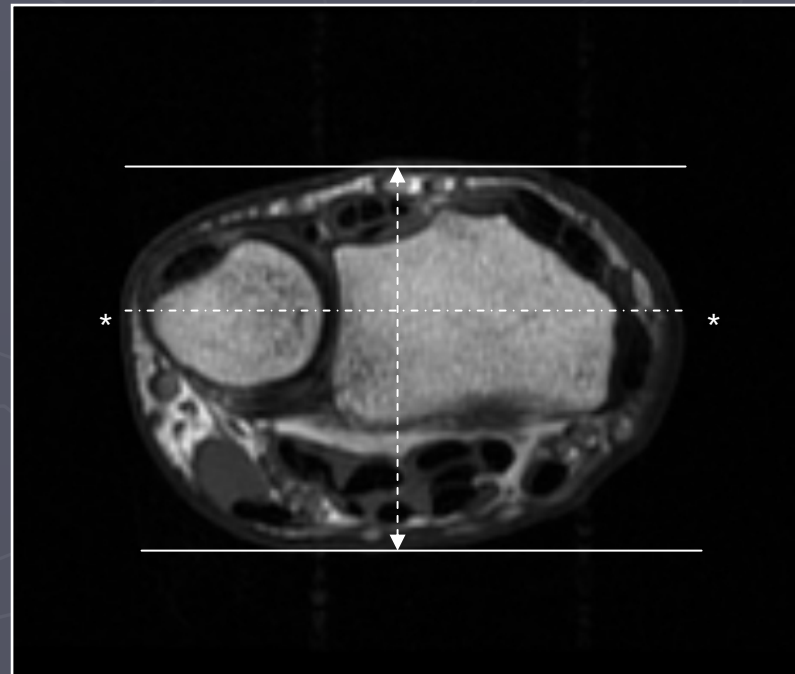
Wrist-Coronal Imaging Plane

Relevant Anatomy



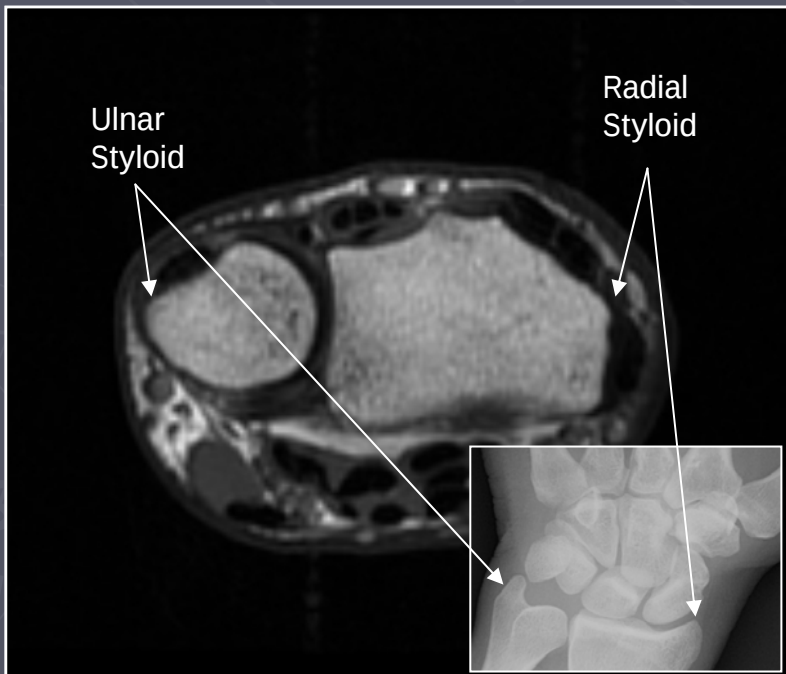
Coronal Imaging Plane

*Prescribe plane parallel to line drawn from ulnar styloid through radial styloid. Scan through entire wrist.



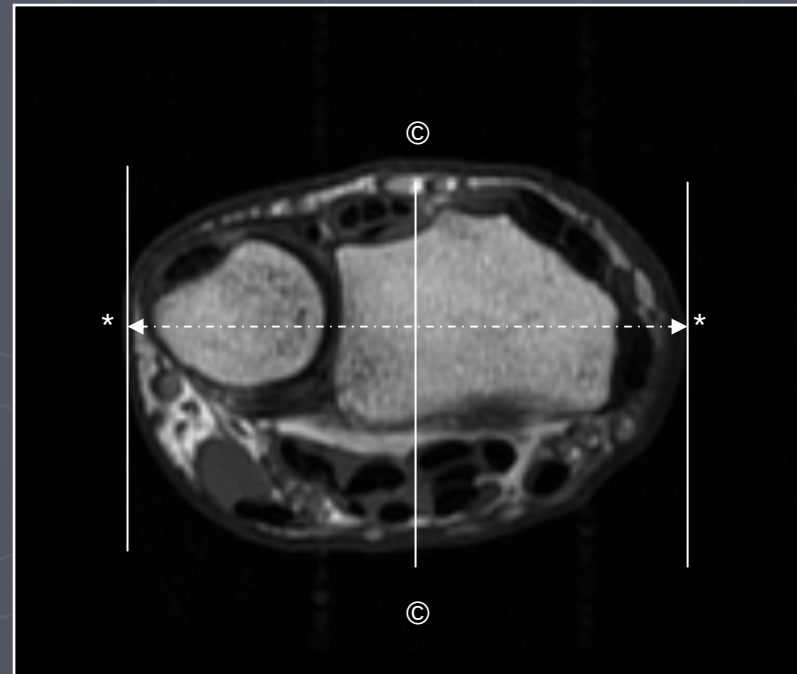
Wrist-Sagittal Imaging Plane

Relevant Anatomy



Sagittal Imaging Plane

*Prescribe plane perpendicular to coronal plane (©).
Scan through entire wrist.



MR Thumb Exam Selection:

► Routine Thumb

■ Indications:

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

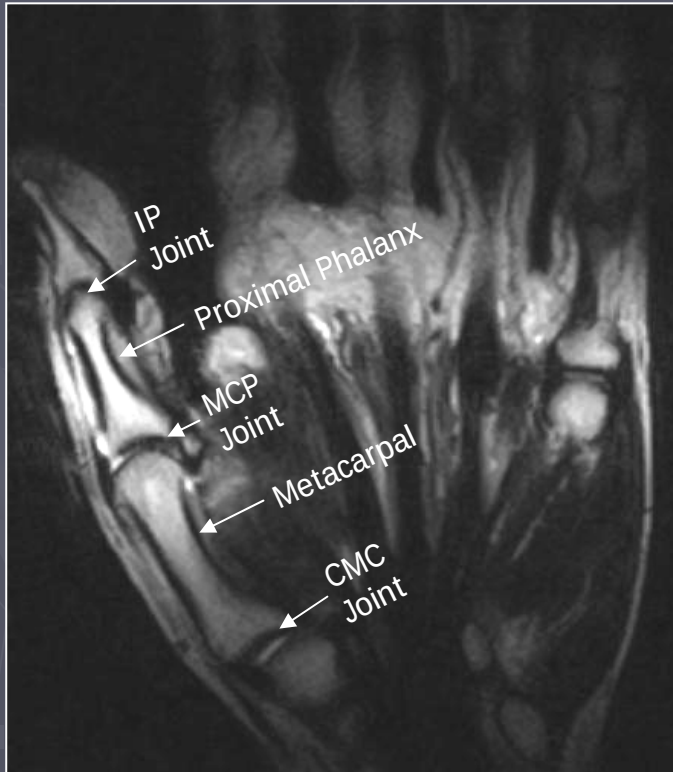
Routine Thumb

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
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Coronal T1 SE Non FatSat	10	256 x 192	3/0.3	400-800	minimal			16	
Coronal T2 FSE Non FatSat	10	256 x 256	3/0.3	2000- 6000	90-110			16	16
Sag FSE-STIR	10	256x192 3	3/0.3	>2000	20-40	150		8	16
Axial T1 SE Non FatSat	10	256 x 192	3/0.3	400-800	minimal			16	
Axial T2 FSE FatSat	10	256 x 256	3/0.3	>2000	50-60			8	16

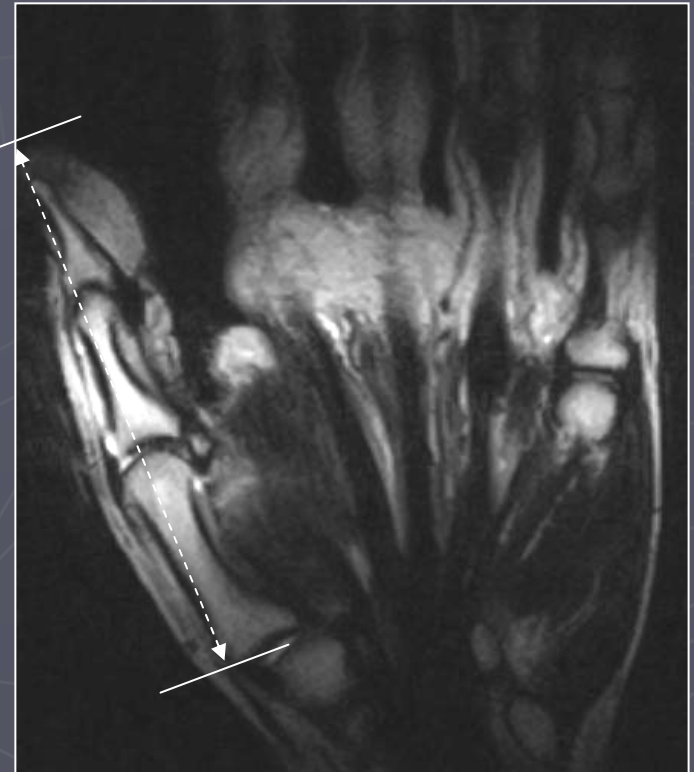
Thumb-Axial Imaging Plane

Relevant Anatomy



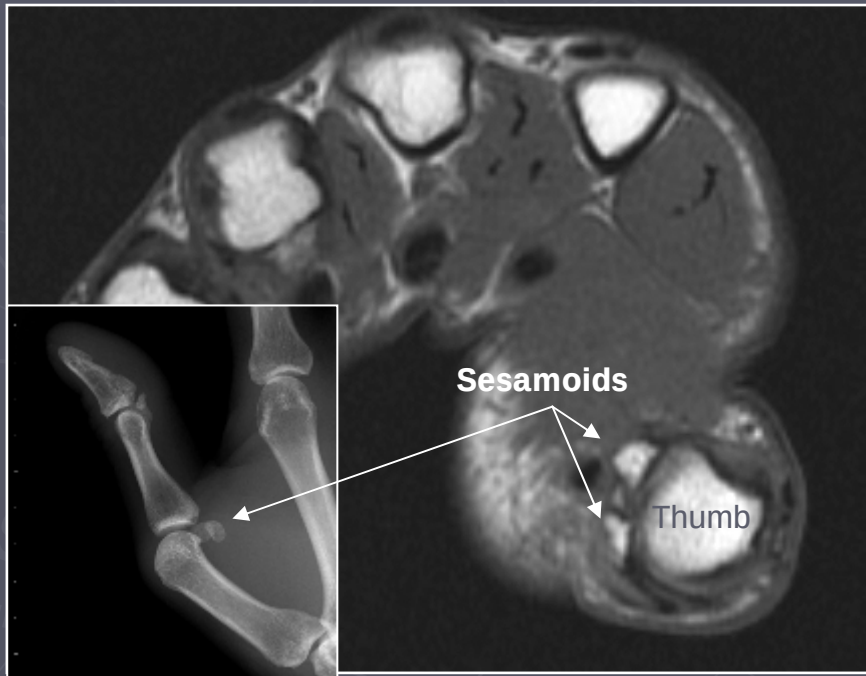
Axial Imaging Plane

Prescribe plane perpendicular to midshaft of proximal 1st phalanx. Scan from CMC joint through thumb.



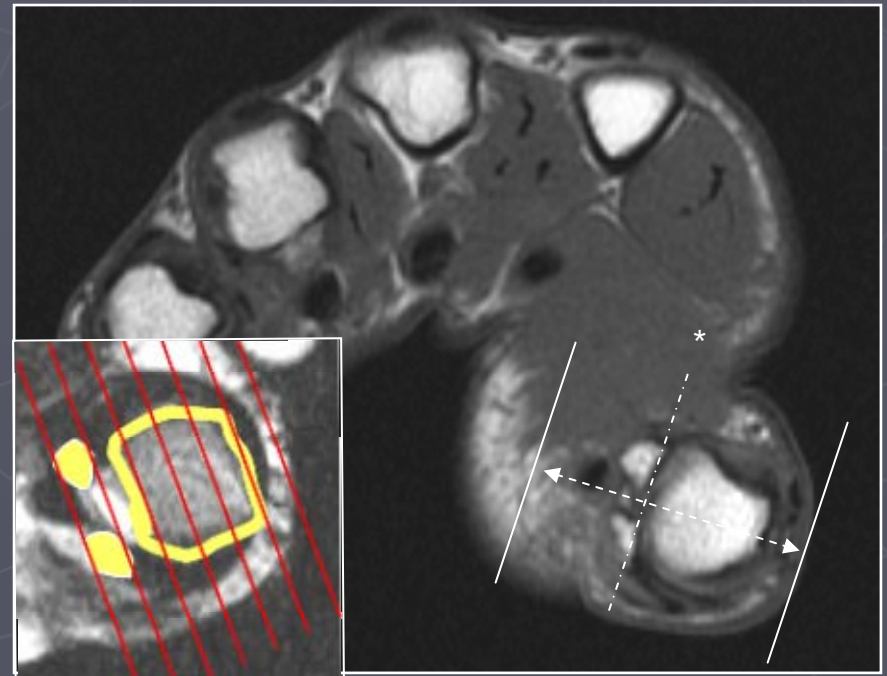
Thumb-Coronal Imaging Plane

Relevant Anatomy



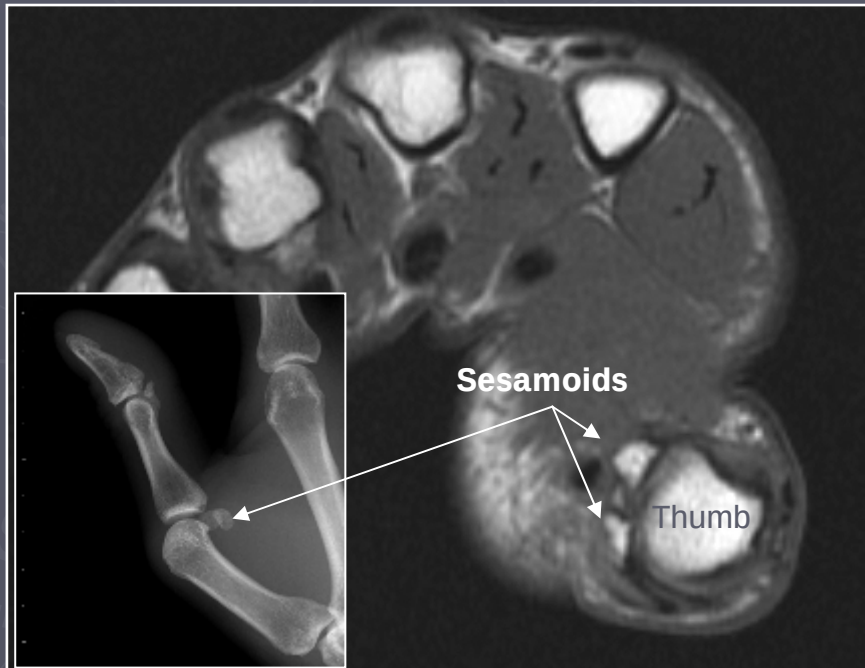
Coronal Imaging Plane

*Prescribe plane with line bisecting sesamoid bones. Scan through entire thumb.



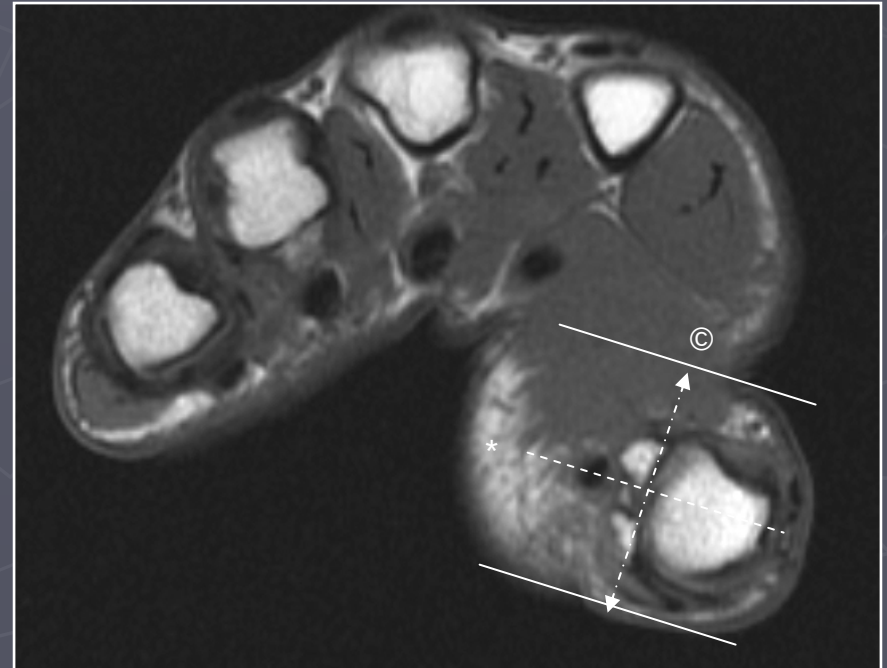
Thumb-Sagittal Imaging Plane

Relevant Anatomy



Sagittal Imaging Plane

*Prescribe plane perpendicular to coronal imaging plane (©). Scan through entire thumb.



MR Finger Exam Selection:

- ▶ Routine Finger

- Indications:

- ▶ Pulley rupture/Flexor or Extensor Tendon Injury

Finger-Routine

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Sag T1 SE Non FatSat		256 x 192	3/0.3	400-800	minimum			16	
Sag T2 FSE FatSat		256 x256	3/0.3	>2000	50-60			8	16
Axial T1 SE Non FatSat		256 x 192	3/0.3	400-800	minimum			16	
Axial T2 FSE FatSat		256 x256	3/0.3	>2000	50-60			8	16
Coronal FSE-STIR		256x192 3	3/0.3	>2000	20-40	150		8	16

Finger-Axial Imaging Plane

Relevant Anatomy

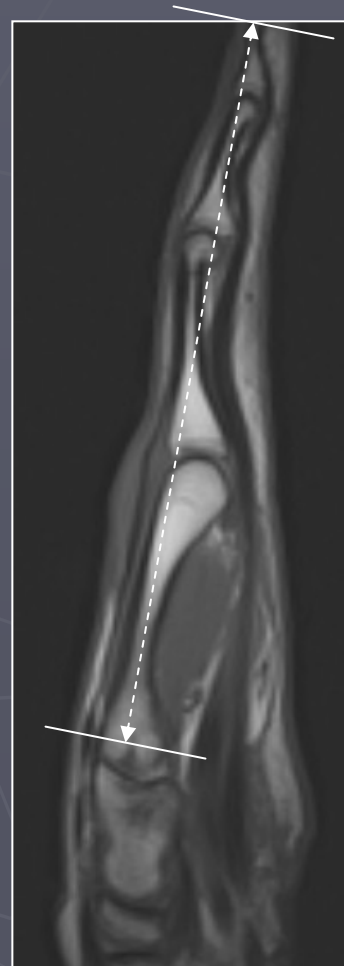


Distal
Phalanx

Mid
Phalanx

Proximal
Phalanx

Metacarpal



Axial Imaging Plane

Prescribe best fit line. Scan from proximal metacarpal through entire finger.

Finger-Coronal Imaging Plane

Relevant Anatomy

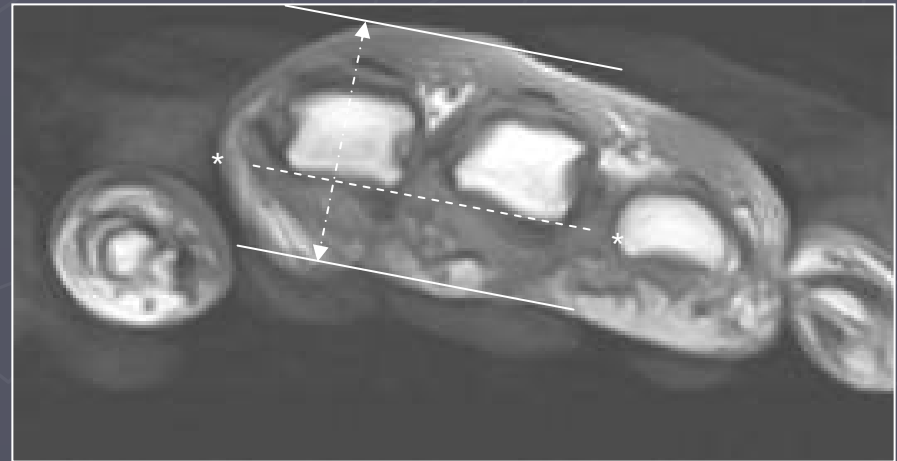
Extensor Tendon

Thumb



Coronal Imaging Plane

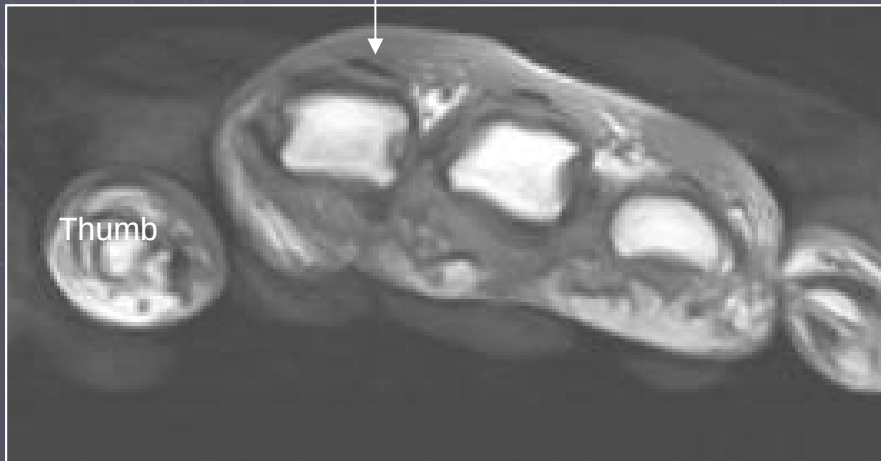
*Prescribe plane parallel to anterior metacarpal head. Scan through adjacent finger for comparison.



Finger-Sagittal Imaging Plane

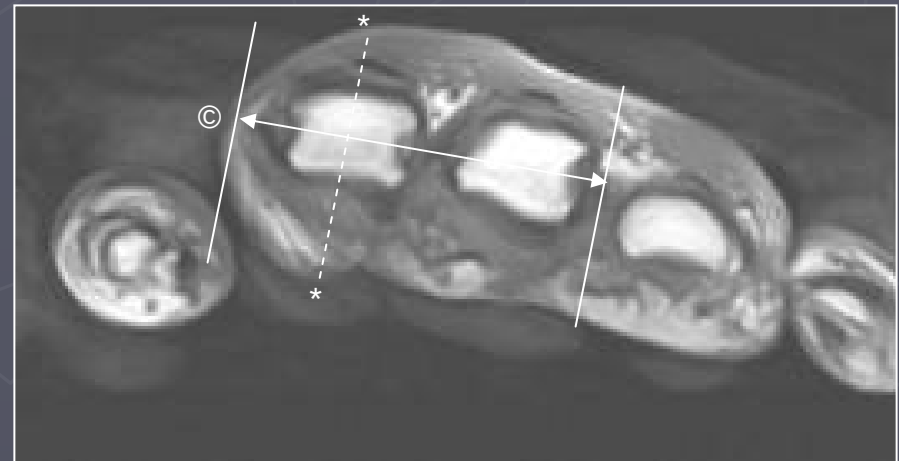
Relevant Anatomy

Extensor Tendon



Sagittal Imaging Plane

*Prescribe plane perpendicular to coronal plane (©). Continue scan through adjacent finger for comparison.



LOWER EXTREMITY



MR Hip Exam Selection: (Unilateral Pathology)

(See MR Bony Pelvis/Thigh for Bilateral/Diffuse MSK Pelvis Pathology)

► Routine Hip

- Indications:
 - Possible Occult fracture/Stress Fracture
 - Hamstring/Rectus Femoris/Gluteus/Iliopsoas Muscle or Tendon Pathology (i.e. tear/strain)
- ****IMPORTANT**** Perform Coronals both hips. Perform Sagittal and Axials of side in question only.**

► Hip Arthrogram

- Indications:
 - Labrum tear/Intra articular body evaluation
- ****IMPORTANT**** Perform Coronal STIR of both hips. Perform all other sequences on only side in question**.
- ****IMPORTANT**** For Femoracetabular Impingement, include Axial Oblique T1 Fat Saturated Images as well.**

Routine Hip

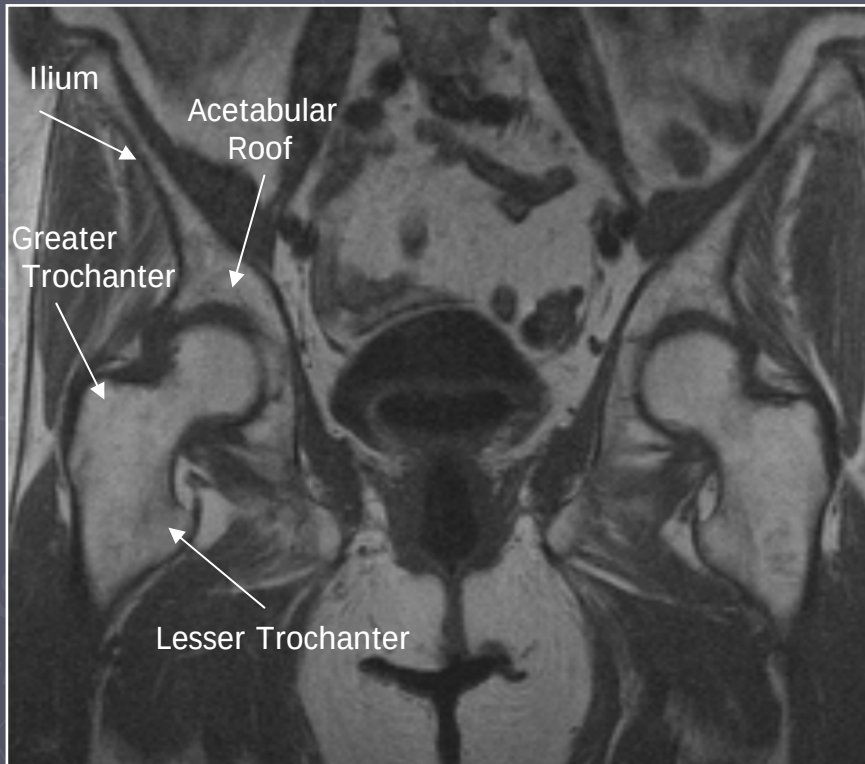
Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Coronal T1 SE Non FatSat (PELVIS)	30-40	245 x 256 1	4/0.5	400-800	Minimum				16
Coronal FSE-STIR (PELVIS)	40	256x192 3	4/0.5	>2000	20-40	150		8	16
Sag T2 FSE FatSat (HIP)	12-14	256 x 256 1	4/0.5	>2000	50-60			8	16
Axial PD FSE Non FatSat (HIP)	14-16	512 x 256 2	4/0.5	3000	15-20			8	16
Axial T2 FSE FatSat (HIP)	14-16	512 x 256 2	4/0.5	>2000	50-60			8	16

MR Arthrogram Hip

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Cor FSE-STIR (Pelvis)	40	256x192 3	4/1	>2000	20-40	150		8	16
Axial T1 SE FatSat (hip)	18	256 x 192	4/1	400-800	minimum				16
Axial T2 FSE FatSat (hip)	18	256 x 256	4/1	>2000	50-60			8	16
Coronal T1 SE FatSat (hip)	20	256 x 192	4/1	400-800	minimum				16
Sag T1 SE FatSat (hip)	20	256 x 192	4/1	400-800	minimum				16
Axial Obl T1 Non fatsat	20	256 x 192	4/1	400-800	minimum				16
SEQUENCE FOR FEMOROACETABULAR IMPINGEMENT ONLY									

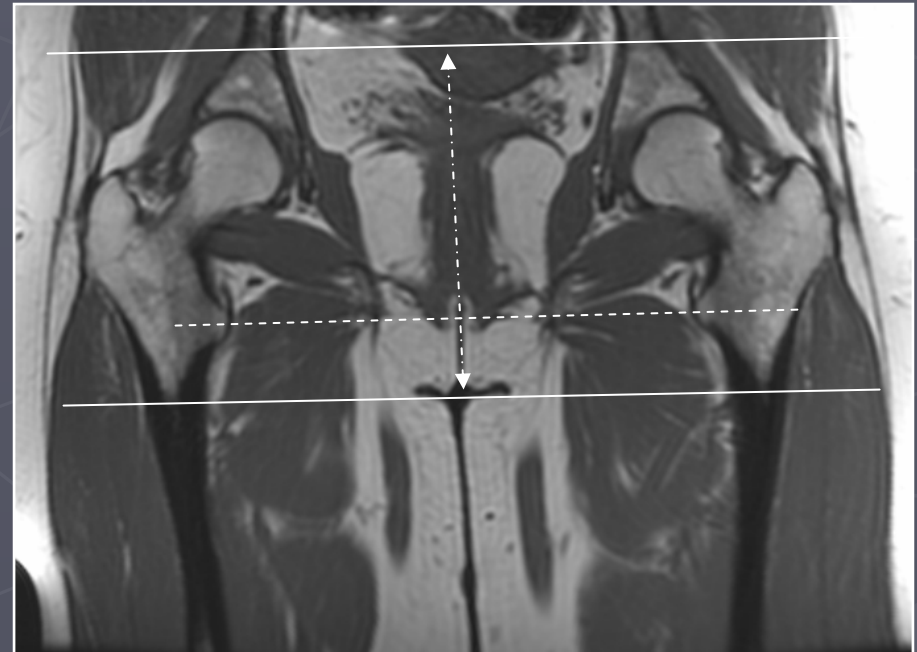
Hip-Axial Imaging Plane

Relevant Anatomy



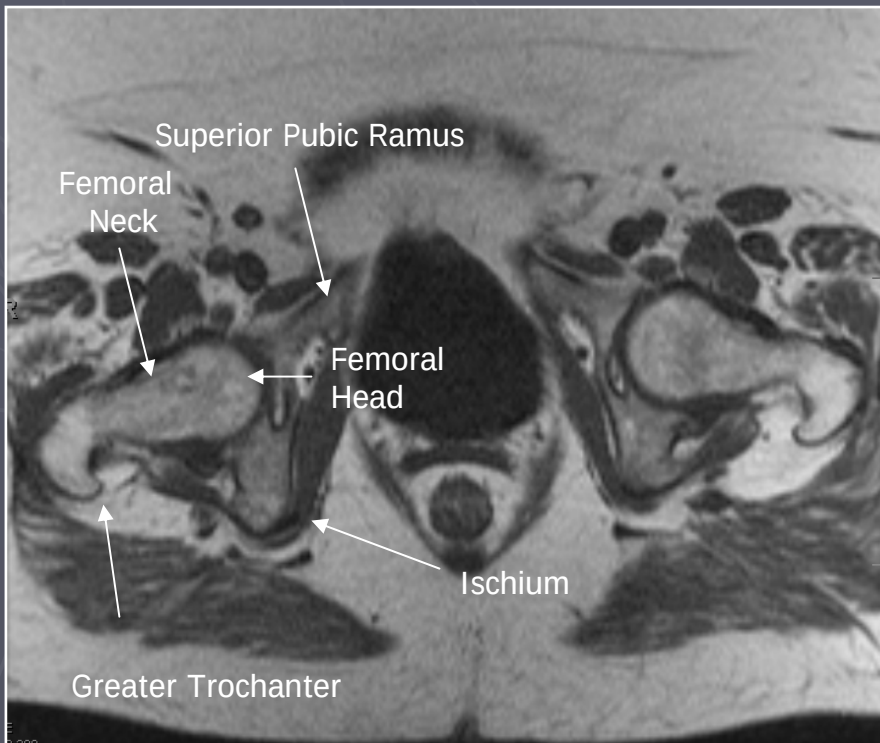
Axial Imaging Plane

Prescribe plane parallel line bisecting lesser trochanters and/or acetabular roofs. Scan from acetabular roof through lesser trochanter.



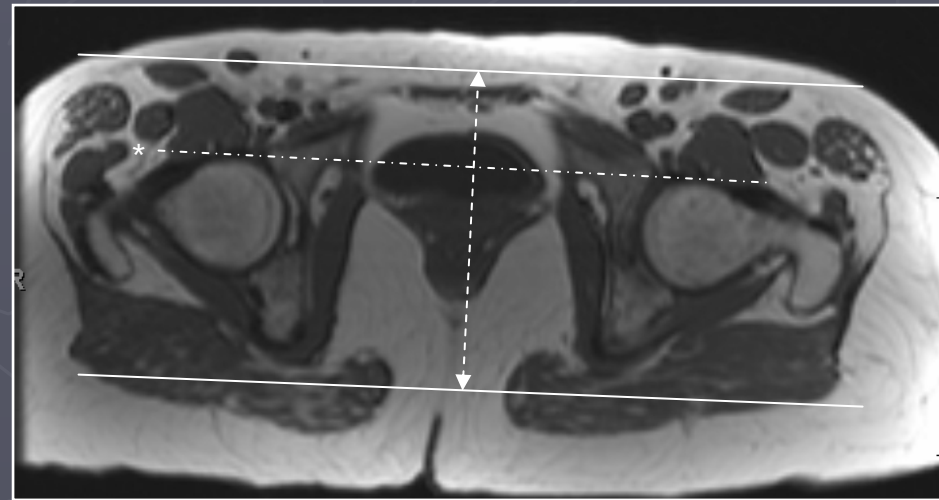
Hip-Coronal Imaging Plane

Relevant Anatomy



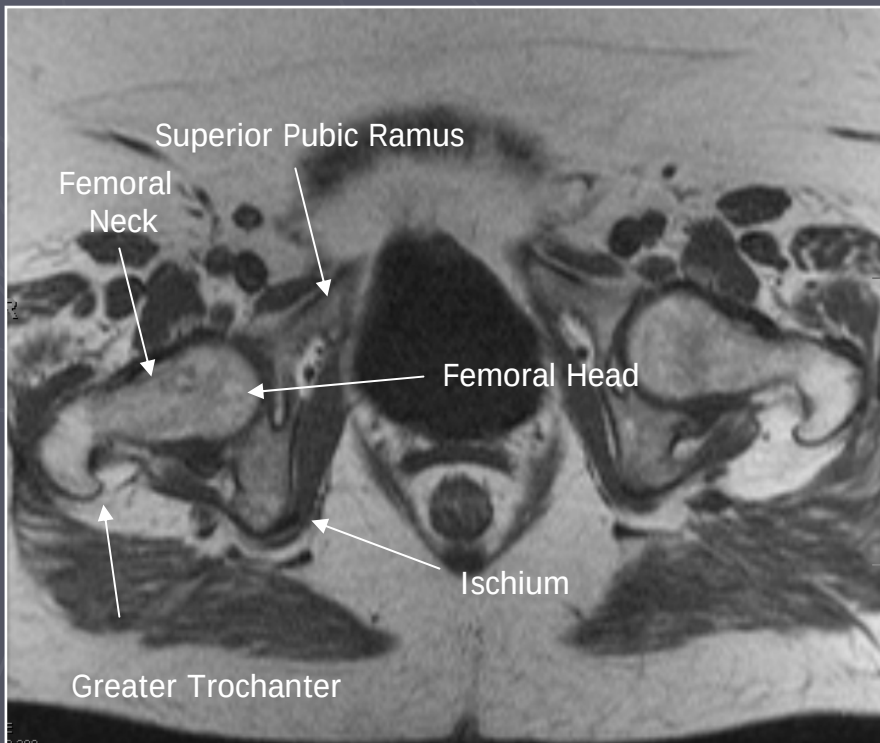
Coronal Imaging Plane

*Prescribe plane parallel femoral heads.
Scan from ischium through pubic symphysis.



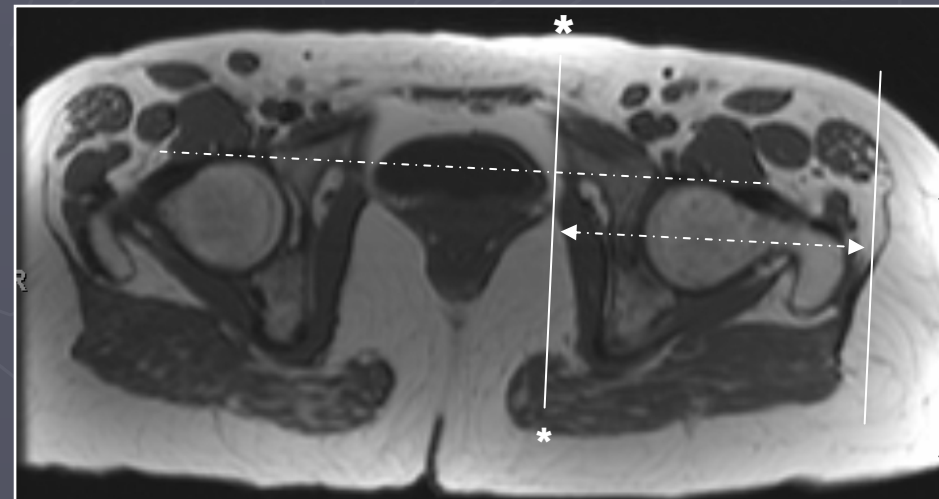
Hip-Sagittal Imaging Plane

Relevant Anatomy



Sagittal Imaging Plane

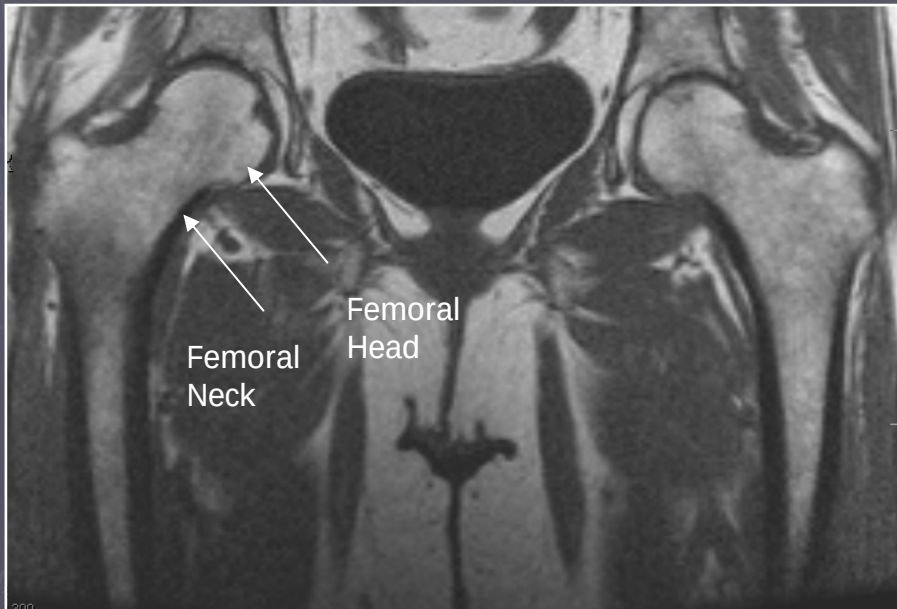
*Prescribe plane perpendicular to coronal plane.
Scan from acetabulum through greater trochanter.



Axial Oblique Imaging Plane

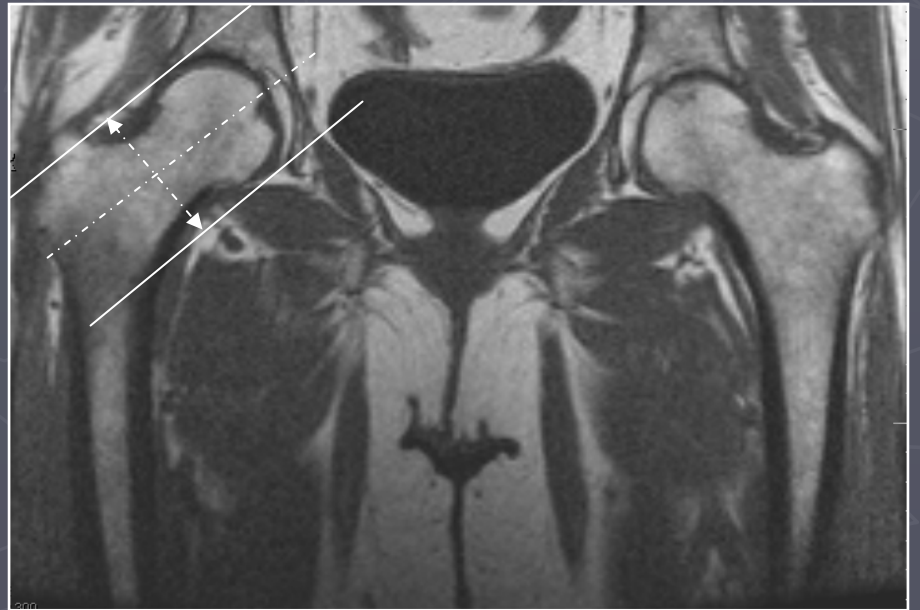
(For Femoracetabular Impingement Patients Only)

Relevant Anatomy



Axial Oblique Plane

Prescribe plane parallel to femoral neck. Scan through entire femoral neck.



MR Bony Pelvis Exam Selection:

- ▶ Osteomyelitis Protocol/Post Gadolinium Pelvis
 - Indications:
 - ▶ Osteomyelitis
 - ****IMPORTANT****
 - ▶ Perform Routine Hip Protocol but perform axial and coronal images to include both right and left sides .
 - ▶ In addition, perform FMPSPGR fat saturated pre and post images following Osteomyelitis protocol (Page).
- ▶ R/O Metastases Protocol (In/Out of Phase)
 - Indications:
 - ▶ Possible Bony Metastases
 - ****IMPORTANT****
 - ▶ Perform Routine Hip Protocol but perform axial and coronal images to include both right and left sides.
 - ▶ In addition, perform In/Out of Phase images in Coronal Plane
- ▶ Sacroiliitis Protocol
 - Indications:
 - ▶ Possible Sacroiliitis (Septic/Rheumatoid or Rheumatoid Variant Arthritis)
 - ****IMPORTANT****
 - ▶ Perform Routine Hip Protocol but do sagittal T2 FSE Fat Saturated images on both sides (NOT JUST ONE)

Bony Pelvis-Osteomyelitis/AVN

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
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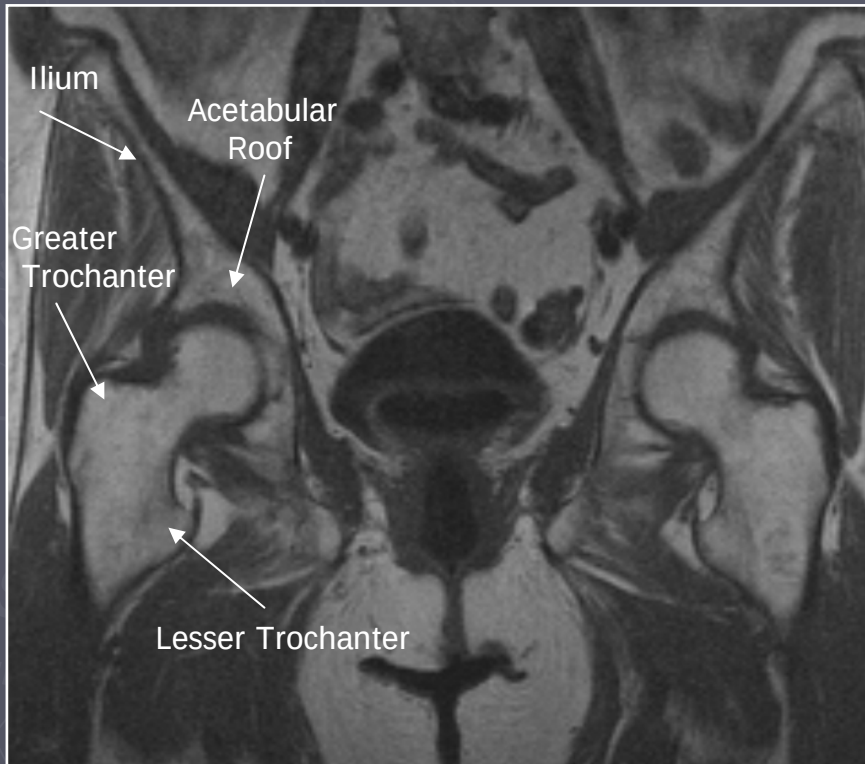
Coronal T1 Non FatSat	30-45	256 x 192	4/1	400-800	minimal				16
Coronal FSE-STIR	30-45	256x192 3	4/1	>2000	20-40	150		8	16
Axial T1 Non FatSat	30-45	256 x 192	4/1	400-800	minimal				16
Axial T2 FSE FatSat	30-45	256 x 256	4/1	>2000	50-60			8	16
Sag T2 FSE FatSat	20	256 x 256	4/1	>2000	50-60			8	16
Axial/Cor FMPSPGR FatSat (Pre 1 Plane, Post 3 Planes)	12	256 x 192	3/.5	50	5		30-40	8	16

Bony Pelvis-R/O Mets

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Coronal T1 SE Non FatSat	30-45	256 x 192	4/1	400-800	minimal				16
Coronal FSE-STIR	30-45	256x192 3	4/1	>2000	20-40	150		8	16
Axial T1 SE Non FatSat	30-45	256 x 192	4/1	400-800	minimal				16
Axial T2 FSE FatSat	30-45	256 x 256	4/1	>2000	50-60			8	16
Sag T2 FSE FatSat	20	256 x 256	4/1	>2000	50-60			8	16
Coronal In/Out of Phase	30-45	256 x XX			2/4				16

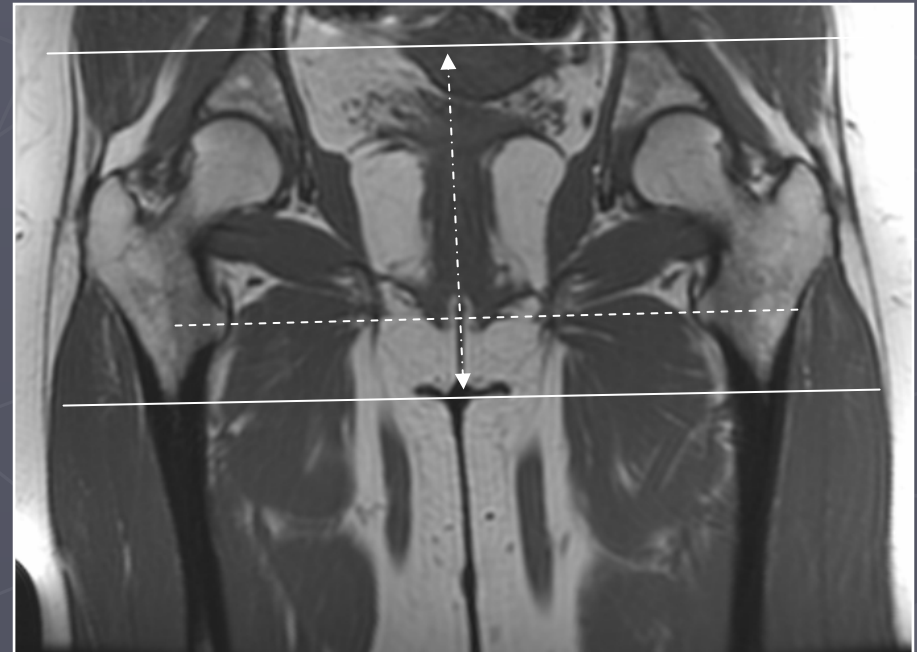
Bony Pelvis-Axial Imaging Plane

Relevant Anatomy



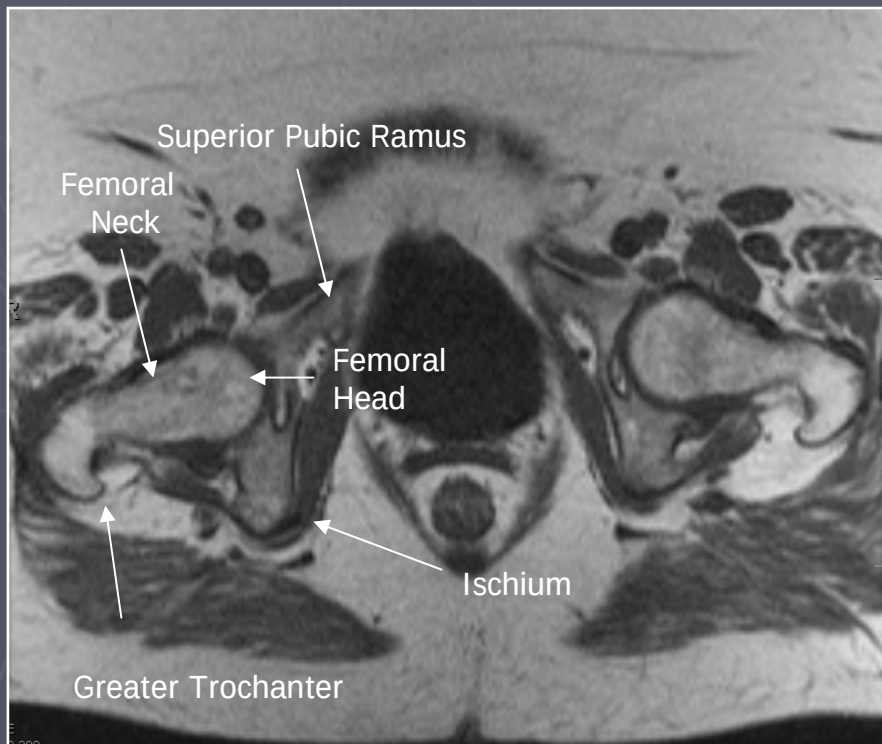
Axial Imaging Plane

Prescribe plane parallel line bisecting lesser trochanters and/or acetabular roofs. Scan from acetabular roof through lesser trochanter.



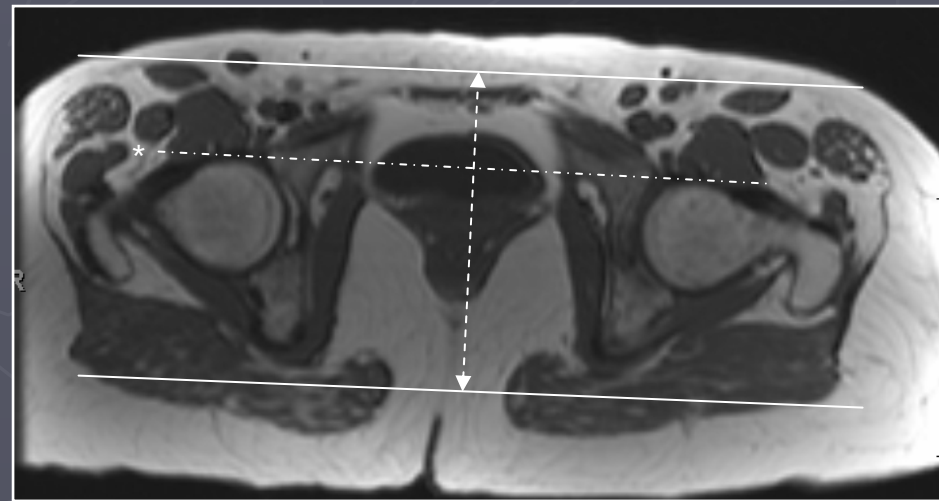
Bony Pelvis-Coronal Imaging Plane

Relevant Anatomy



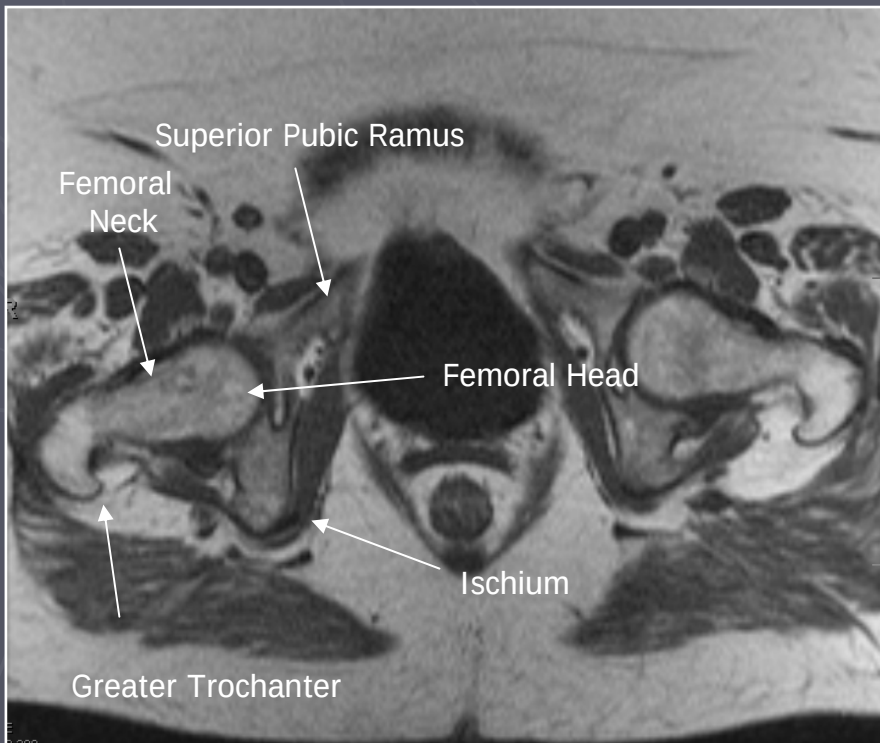
Coronal Imaging Plane

*Prescribe plane parallel femoral heads.
Scan from ischium through pubic symphysis.



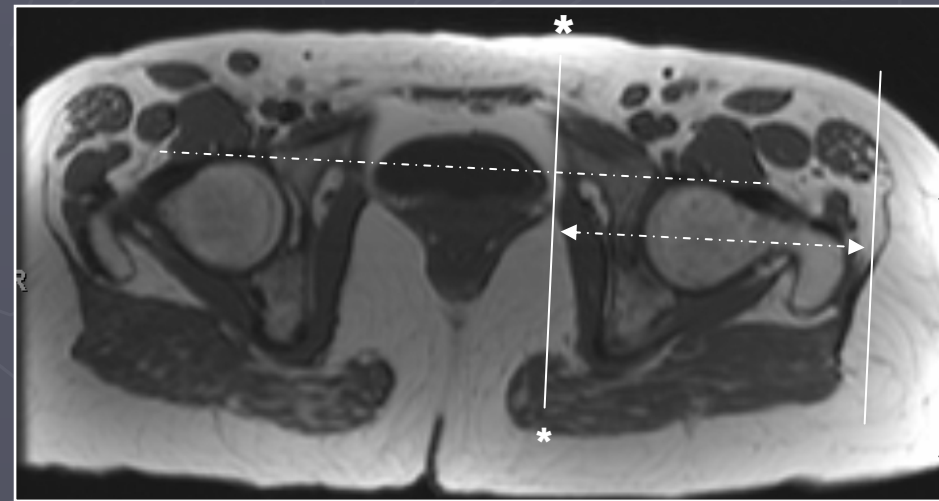
Bony Pelvis-Sagittal Imaging Plane

Relevant Anatomy



Sagittal Imaging Plane

*Prescribe plane perpendicular to coronal plane.
Scan from acetabulum through greater trochanter.



MR Thigh Exam Selection:

► Routine Thigh

- Indications:

- Polymyositis/Diabetic Myonecrosis/Dermatomyositis

► Special Instructions:

- Follow Hip Imaging Planes, but scan both hips in both axial and coronal planes from acetabulum to knee.
- Coil: Body or Torso Coil
- Obtain both sides for comparison

Thigh-Routine

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
------	-----	----------------	-------	----	----	----	------	-----	----

Coronal T1 SE Non FatSat	40	256 x 192	4/1	400-800	minimal				16
Coronal FSE STIR	40	256x192 3	4/1	>2000	20-40	150		8	16
Axial SE T1 Non FatSat	26	256 x 192	4/1	400-800	minimal				16
Axial FSE STIR	26	256x192 3	4/1	>2000	20-40	150		8	16

Athletic Pubalgia Exam Selection

▶ Athletic Pubalgia Exam Selection:

- Indications:

- ▶ Suspected Rectus Abdominus, Adductor strain, osteitis pubis “sports hernia”

- Pointers:

- ▶ Center on Symphysis Pubis
- ▶ Coil: Phase Array Pelvic Coil (same coil used for gyn pathology)
- ▶ Have patient empty bladder prior to scan

Athletic Pubalgia

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
------	-----	----------------	-------	----	----	----	------	-----	----

Coronal FSE-STIR	24	256x192 3	4/1	>2000	20-40	150		8	16
Coronal T1 SE	24	256x192 2	4/1	400-800	minimum				16
Sag T2 FSE Fat Sat	20-24	256x192 2	4/1	>2000	50-60			8	16
Axial T2 FSE Fat Sat	20	256x192 2	4/1	>2000	50-60			8	16
Axial Obl PD FSE Nonfatsat	20	256x256 2	4/1	3000(max)	25			8	16
Axial Obl T2 FSE Fat Sat	20	256x192 2	4/1	>2000	50-60			8	16

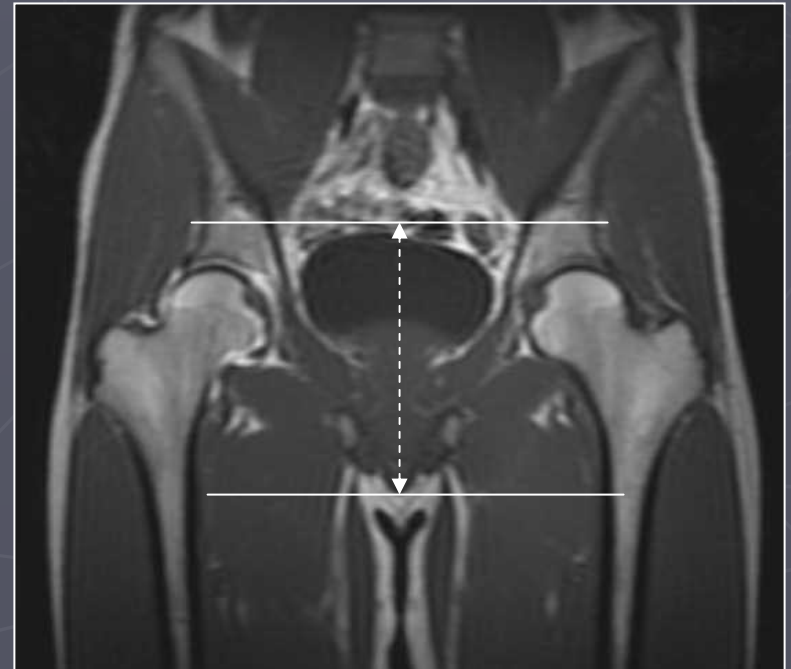
Axial Imaging Plane

Relevant Anatomy



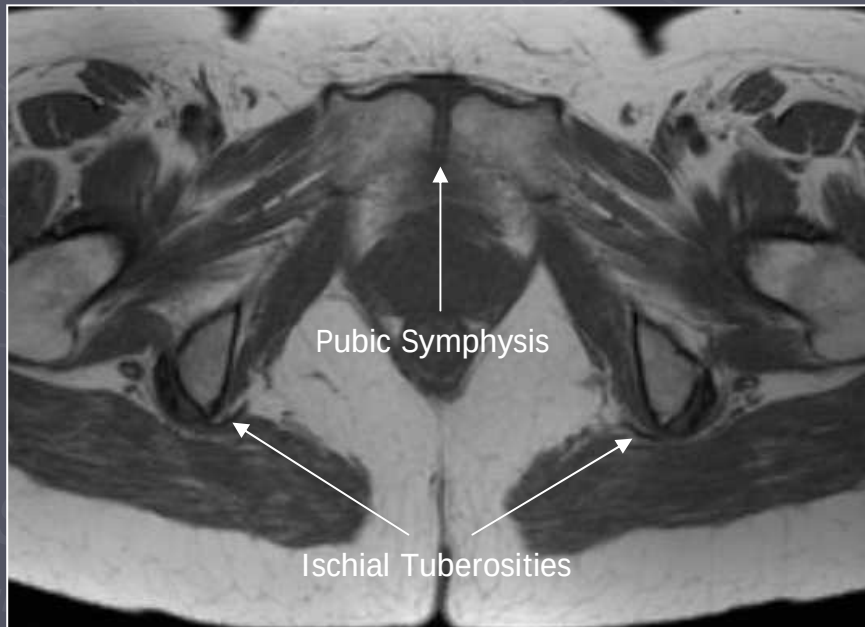
Axial Imaging Plane

Center on pubic symphysis pubis.
Scan from superior acetabulum
through symphysis pubis.



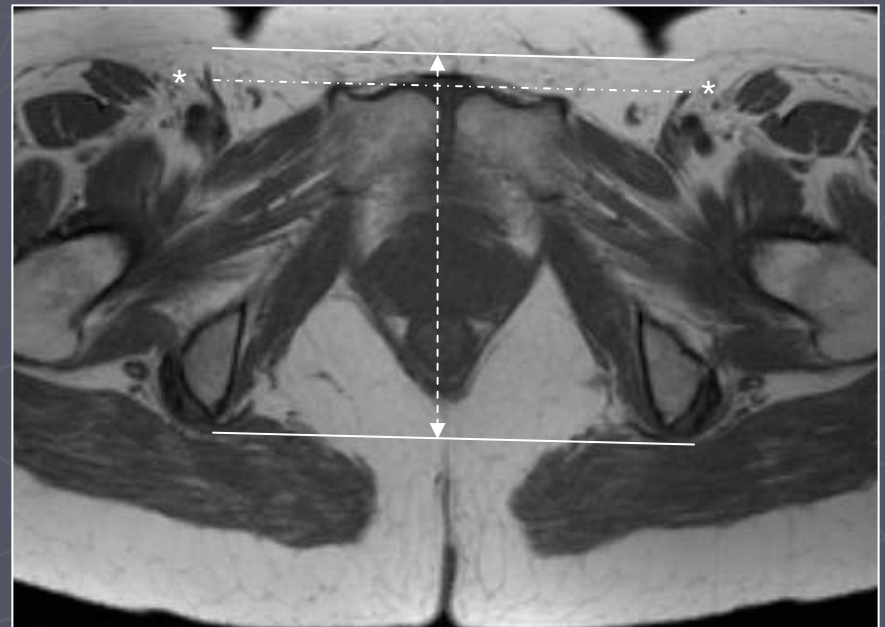
Coronal Imaging Plane

Relevant Anatomy



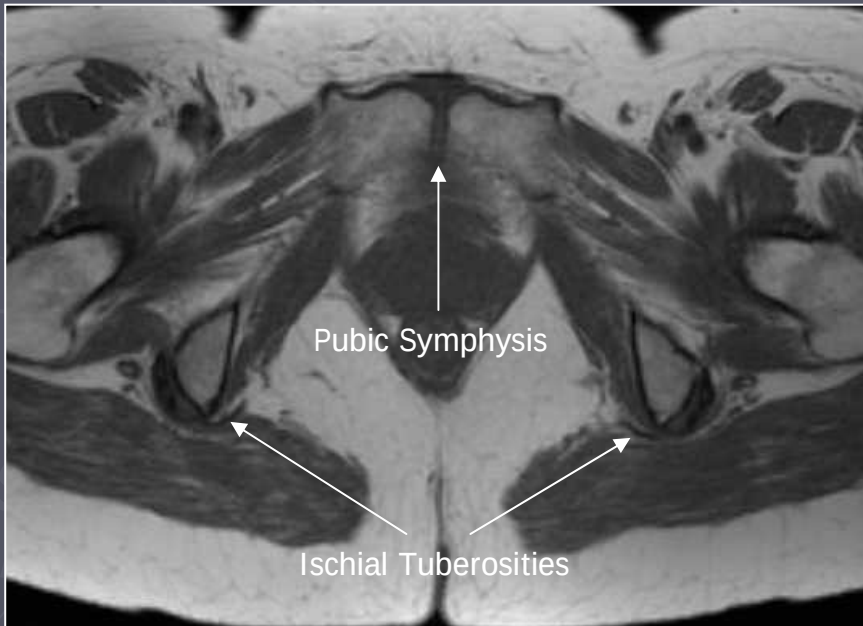
Coronal Imaging Plane

Prescribe plane with line parallel to symphysis pubis. Scan through ischial tuberosities



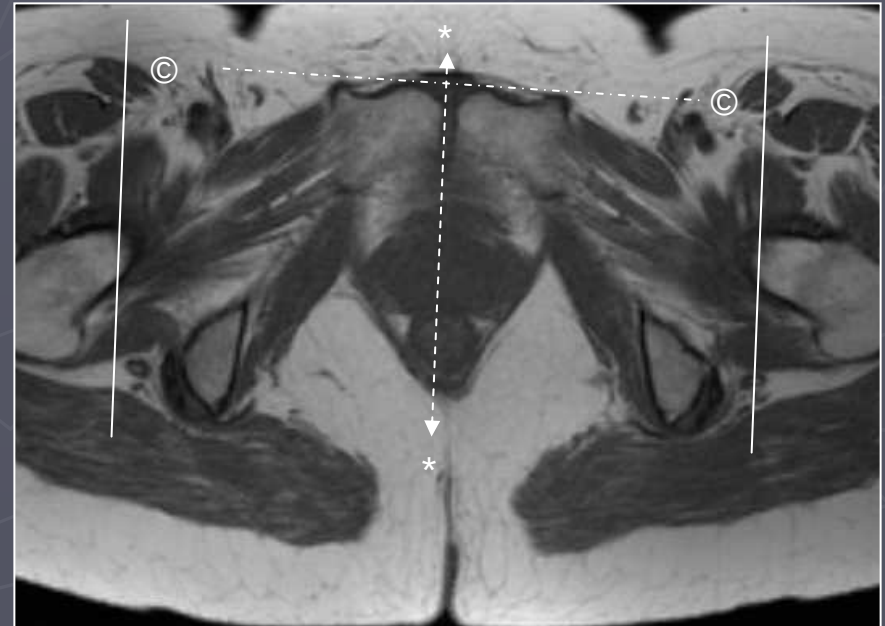
Sagittal Imaging Plane

Relevant Anatomy



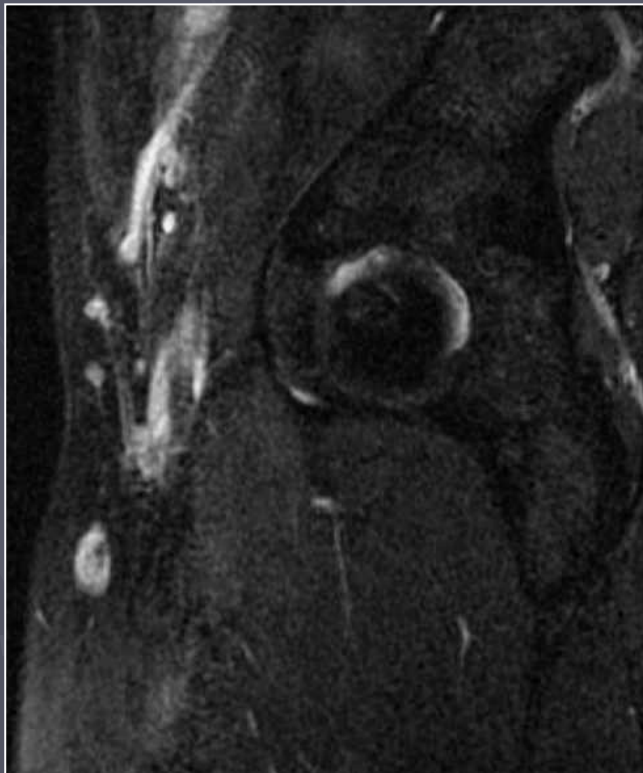
Sagittal Imaging Plane

Prescribe plane perpendicular to coronal plane (©). Scan from right through left ischial tuberosities.



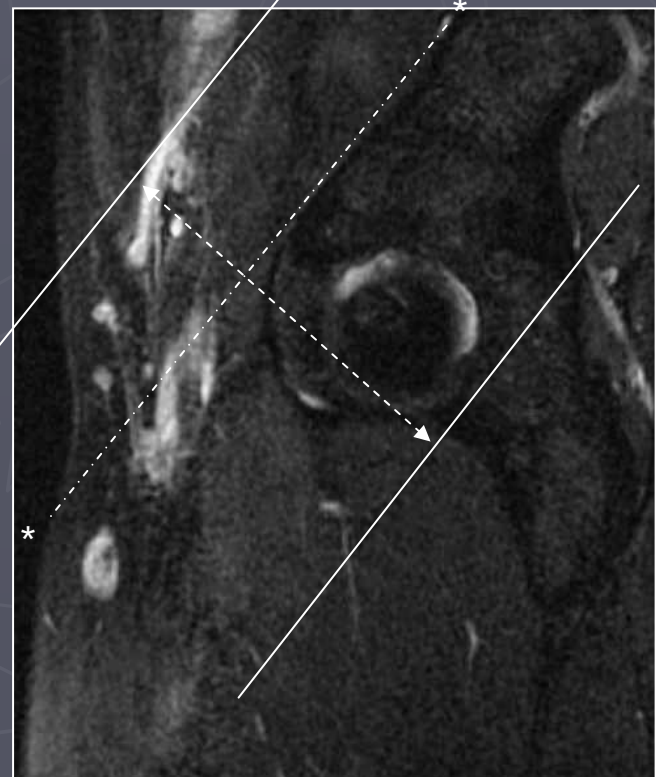
Axial Oblique Imaging Plane

Relevant Anatomy



Axial Oblique Imaging Plane

Prescribe plane to line paralleling anterior ilio-pubic cortex. Be sure to scan through



MR Knee Exam Selection:

► Routine Knee

- Indications:
 - Meniscal Tear/Medial or Lateral Ligament Tear/ACL/PCL
- IMPORTANT: If FSE PD is used Proton Density Images should have Echo Train of 4 and TE ~ 30.

► Direct Arthrogram

- Indications:
 - Meniscal Re-tear
 - Intra articular Body

► Indirect Arthrogram Knee

- Indications
 - Post Operative Intra-articular Surgery
- IMPORTANT: Inject and have patient exercise knee. Wait 20 minutes post injection to scan. Start Scan with Sagittal and Coronal T2 sequences before doing T1 sequences.

Knee-Routine

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Sag PD FSE Nonfatsat	14-16	512 x 256 2	4/0.5	3000	25			4	16
Sag T2 FSE FatSat	14-16	256 x 256 2	4/0.5	>2000	50-60			8	16
Cor T1 SE Non FatSat	16-18	256 x 192 1	3/0.5	400-800	Minimal				16
Coronal T2 FSE Fat Sat	16-18	256 x 256 2	3/0.5	>2000	50-60			8	16
Axial T2 FSE FatSat	14-16	256 x 256 2	3/0.5	>2000	50-60			8	16

MR Arthrogram Knee

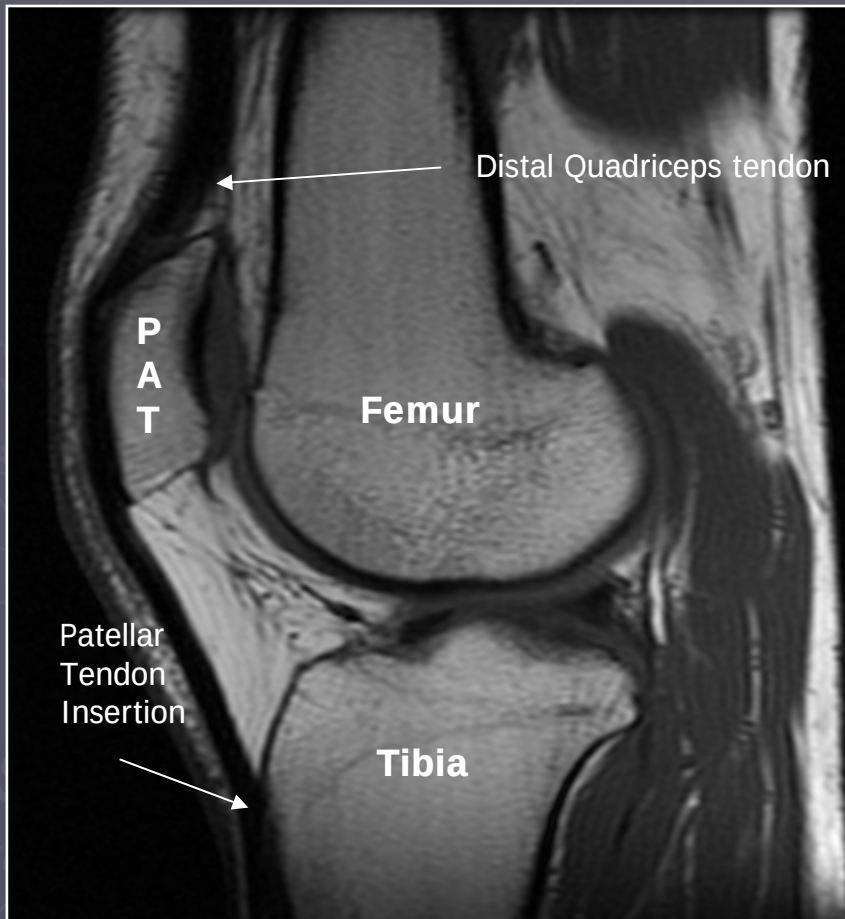
Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Sag T1 Se FatSat	14-16	256 x 192	4/1	400-800	Minimal				16
Sag T2 FSE FatSat	14-16	256 x 256	4/1	>2000	50-60			8	16
Coronal T2 FSE FatSat	16-18	256 x 256 2	4/1	>2000	50-60			8	16
Coronal T1 SE Non FatSat	16-18	256 x 192 1	4/1	400-800	Minimal				16
Axial T1 SE FatSat	14-16	256 x 192	4/1	400-800	Minimal				16

Knee-Indirect Arthrogram

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Sag T1 SE FatSat	14	256 x 192	4/1	400-800	minimal				16
Sag T2 FSE FatSat	14-16	256 x 192	4/1	>2000	50-60			8	16
Cor T1 SE Non FatSat	12	256 x 192	4/1	400-800	Minimal				16
Cor T2 FSE FatSat	14-16	256 x 256	4/1	>2000	50-60			8	16
Axial T1 SE FatSat	12	256 x 256	4/1	400-800	Minimal				16

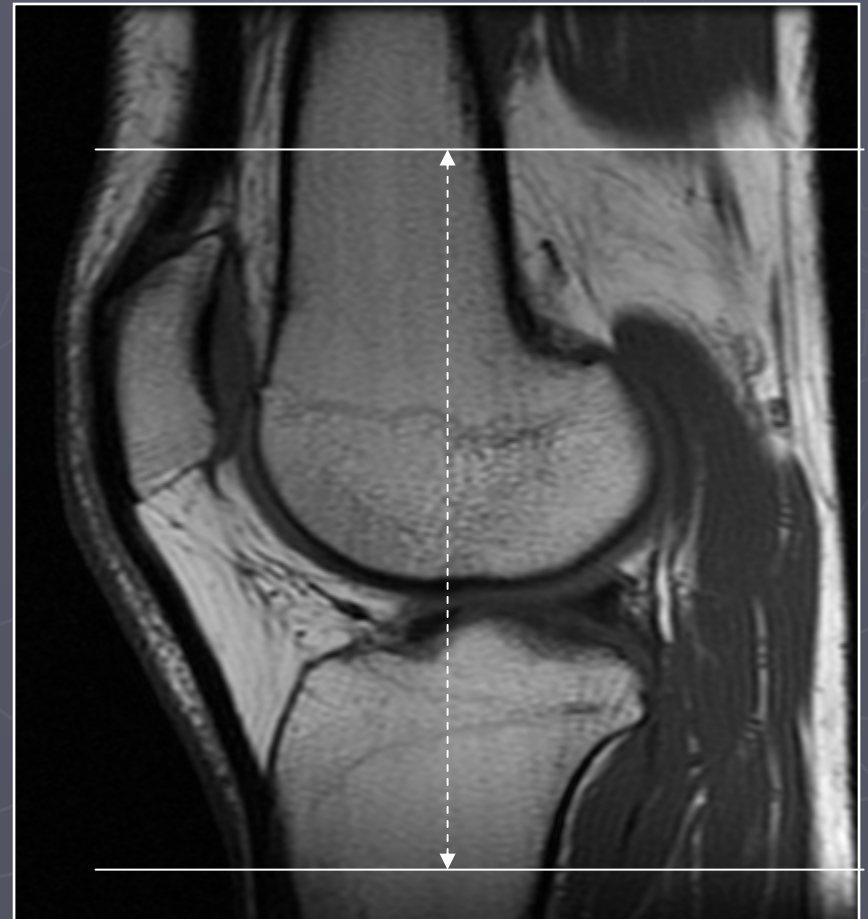
Knee-Axial Imaging Plane

Relevant Anatomy



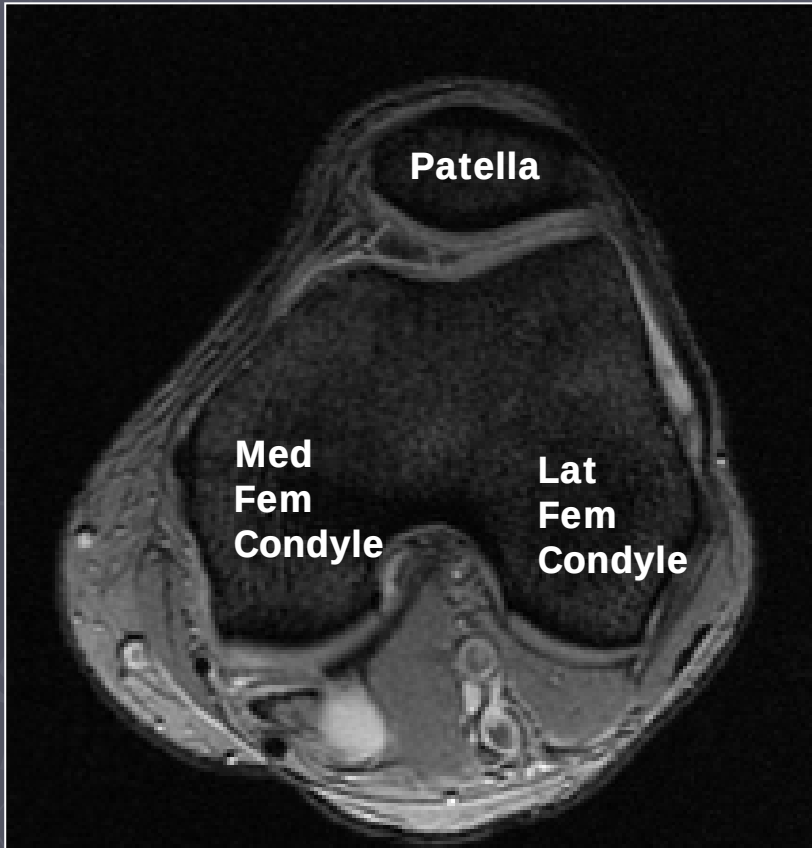
Axial Imaging Plane

Image from distal quad tendon
through patellar tendon insertion



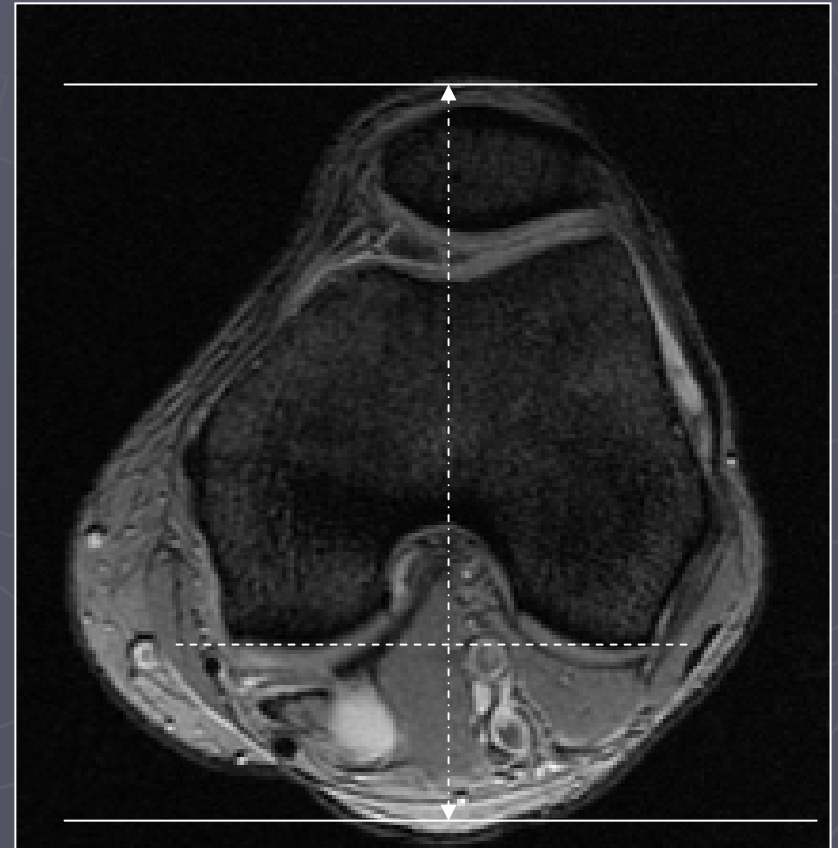
Knee-Coronal Imaging

Relevant Anatomy



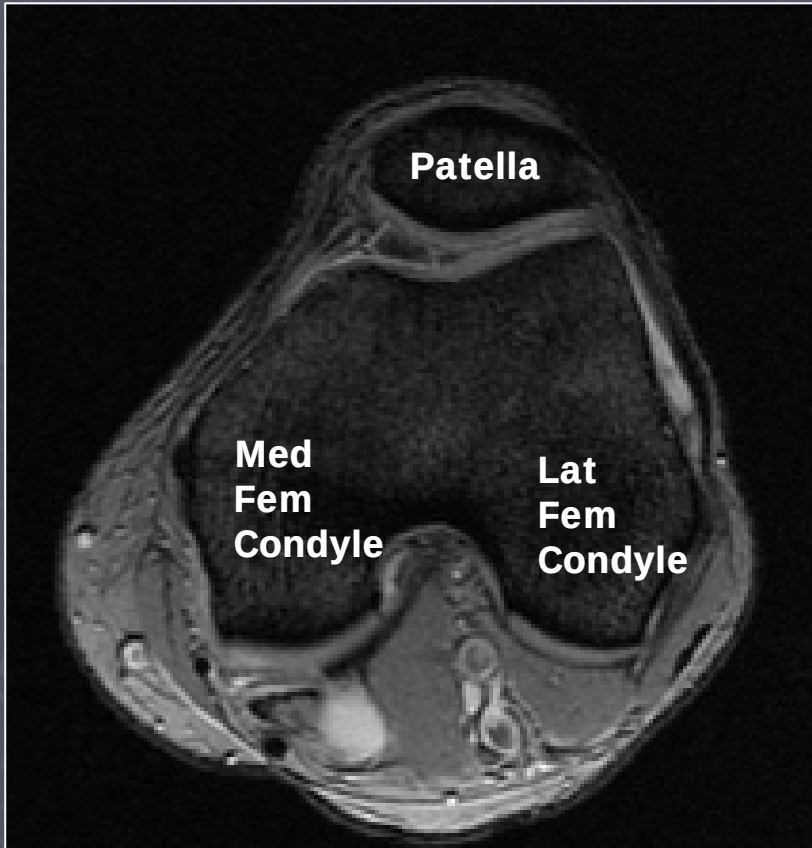
Coronal Imaging Plane

Prescribe plane with line parallel to femoral condyles. Image entire knee.



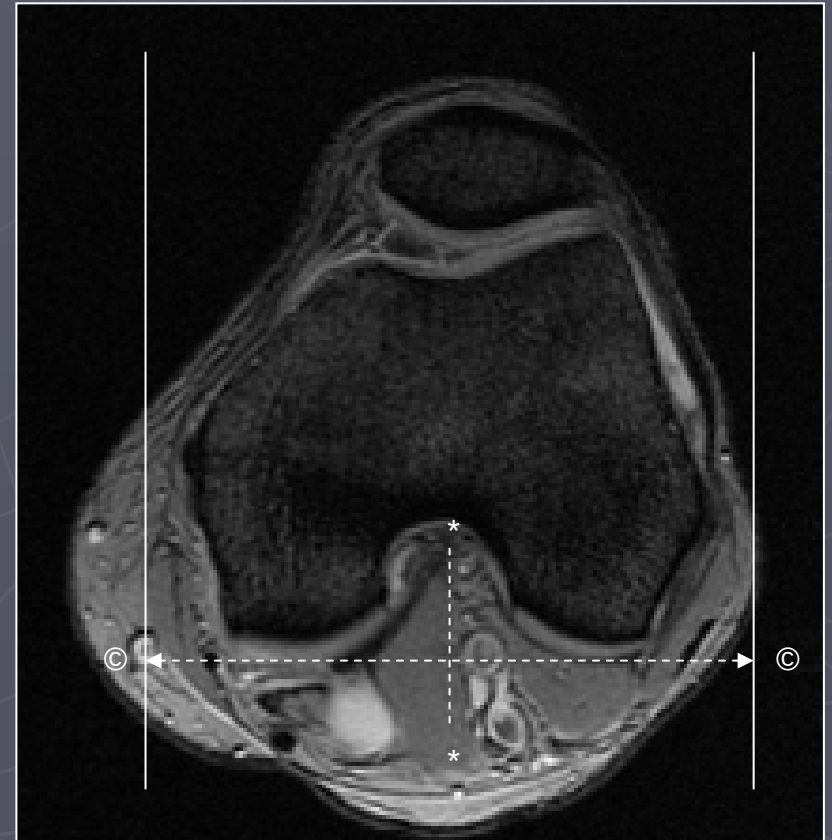
Knee-Sagittal Imaging Plane

Relevant Anatomy



Sagittal Imaging Plane

*Prescribe plane perpendicular to coronal plane (©).
Scan from the medial to the lateral femoral condyle.



MR Lower Extremity/Shin Exam Selection:

► Indication:

- Shin Splints, Stress Fracture (Medial Tibial Stress Syndrome)

► Important:

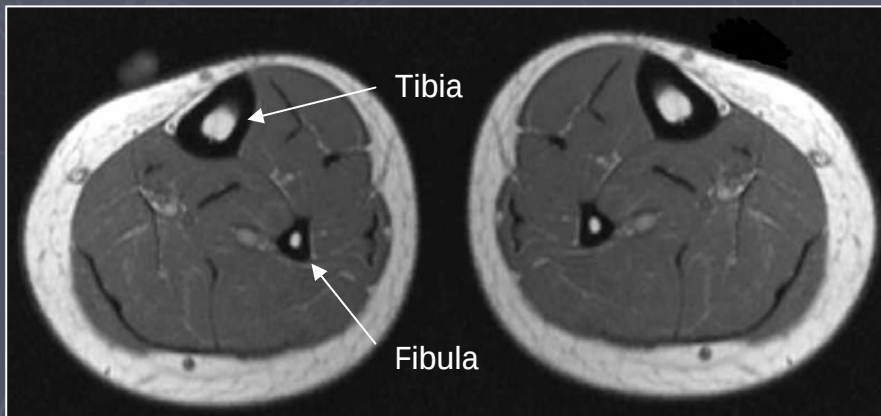
- Coronal Images should include both sides
- Axials and Sagittals should include side in question only

Lower Extremity/Shin Area

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Coronal T1 SE Non FatSat (B/L)	35-40	256 x 192	4/1	400-800	minimal				16
Coronal FSE-STIR (B/L)	35-40	256x192 3	4/1	>2000	20-40	150		8	16
Sag T1 SE Non FatSat (Unilateral)	35-40	256 x 192	4/1	400-800	minimal				16
Sag T2 FSE FatSat (Unilateral)	35-40	256 x 256	4/1	>2000	50-60			8	16
Axial T2 FSE FatSat (Unilateral)	16-20	256 x 256	5/1	>2000	50-60			8	16

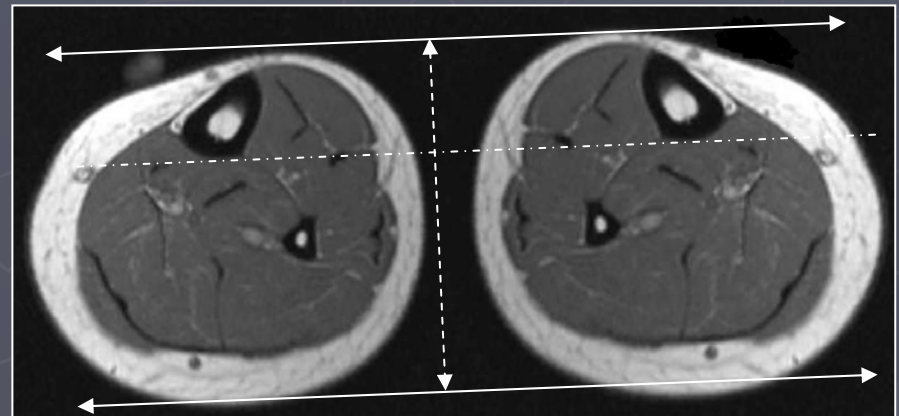
Shin-Coronal Imaging Plane

Relevant Anatomy



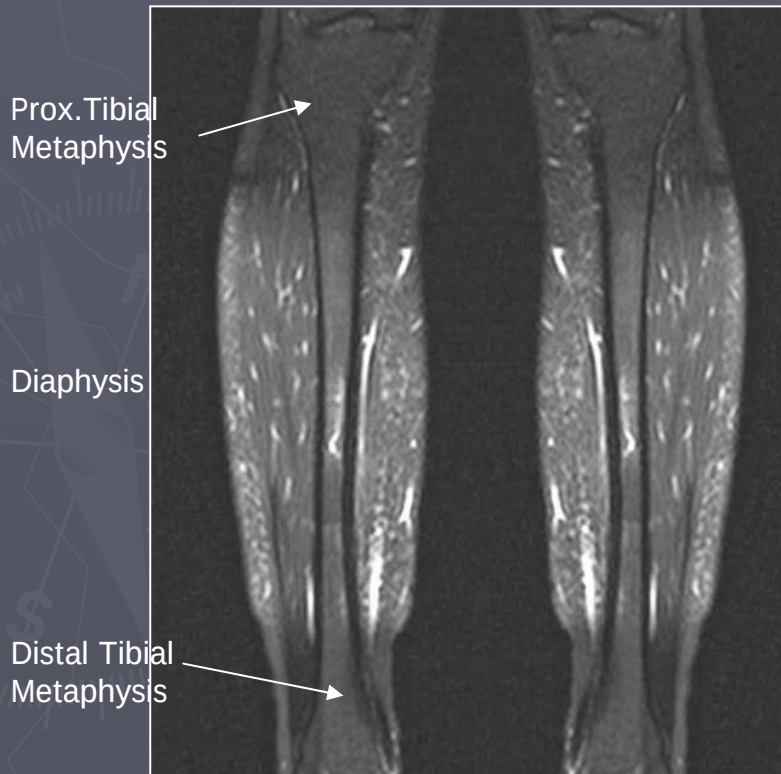
Coronal Imaging Plane

Prescribe plane with line through either the anterior or posterior tibial cortex. Scan both sides from proximal tibial metaphysis to distal tibial metaphysis.



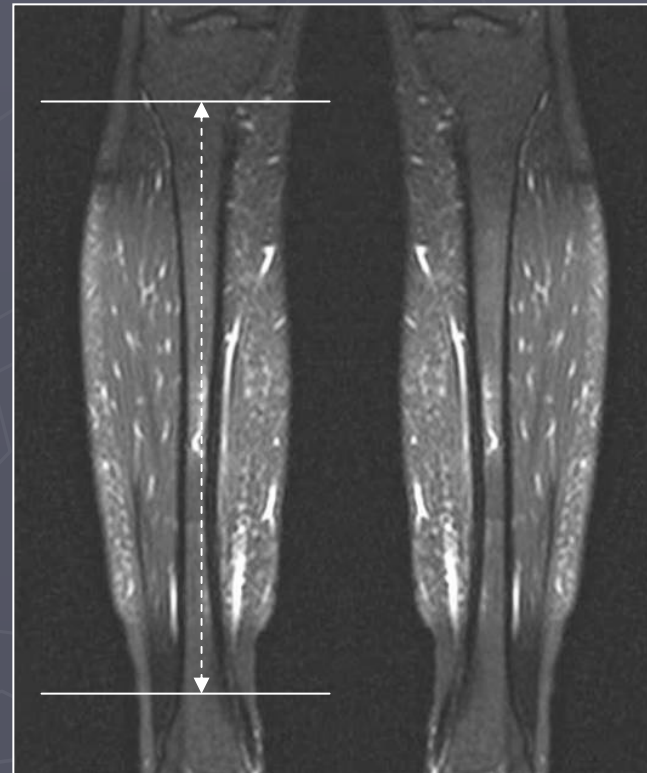
Shin-Axial Imaging Planes

Relevant Anatomy



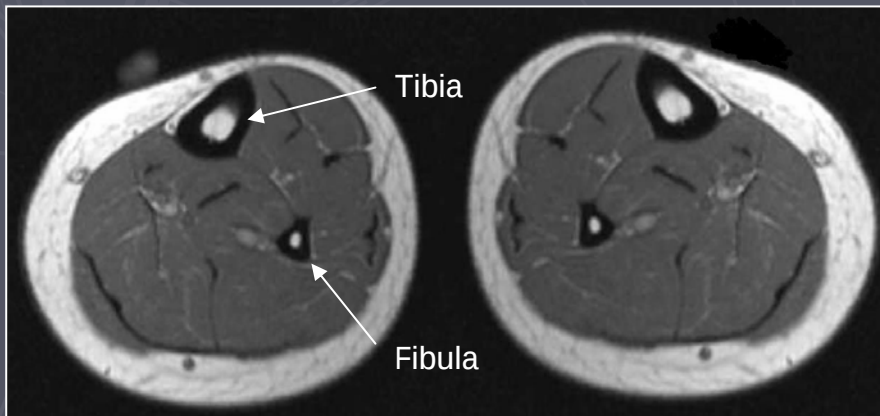
Axial Imaging Plane

Prescribe plane through mid tibia.
Scan from proximal tibial metaphysis
through distal tibial metaphysis.



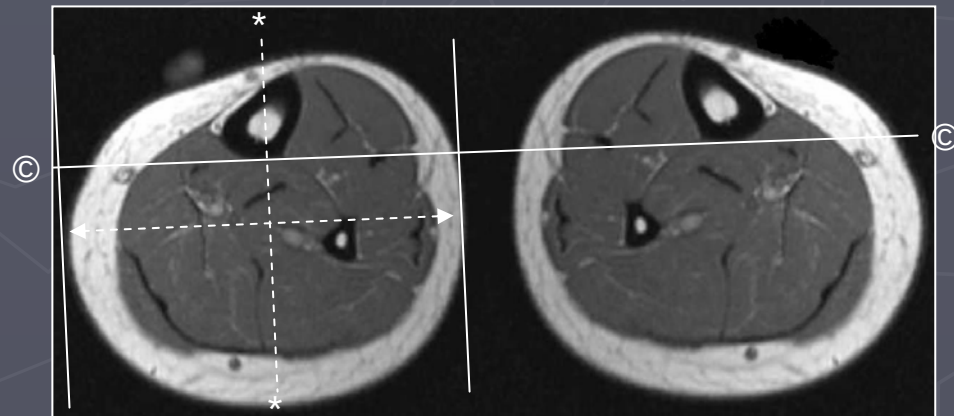
Shin-Sagittal Imaging Plane

Relevant Anatomy



Sagittal Imaging Plane

*Prescribe plane perpendicular to coronal imaging plane (©). Scan through affected side from proximal tibial metaphysis through distal tibial metaphysis.



MR Ankle Exam Selection:

▶ Routine Ankle

- Ligament Sprain/Tendon pathology/Tarsal Tunnel/Sinus Tarsi/Occult fracture

▶ Ankle Arthrogram

- Indications:
 - ▶ Intra-articular Body, OCD

▶ AVN/Osteomyelitis Protocol/Post Gadolinium Ankle

- Indications:
 - ▶ Osteomyelitis/AVN
- ****IMPORTANT****
 - ▶ Perform FMPSPGR fat saturated pre and post images following Osteomyelitis/AVN protocol (Page).

Ankle-Routine

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
------	-----	----------------	-------	----	----	----	------	-----	----

Sag T1 SE Non FatSat	16-18	256 x 192 1	4/1	400-800	Minimal				16
Sag FSE-STIR	16-18	256x192 3	4/1	>2000	20-40	150		8	16
Short Axis PD FSE Non FatSat	14-16	512 x 256 2	4/1	3000	40			8	16
Short Axis T2 FSE FatSat	14-16	256 x 256 2	4/1	>2000	50-60			8	16
Long Axis T2 FSE FatSat	14-16	256 x 256 3	3/1	>2000	40-50			8	16

MR Arthrogram Ankle

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Sag T1 SE FatSat	16	256 x 192 2	4/1	400-800	minimal				16
Sag FSE-STIR	18	256x192 3	4/1	>2000	20-40	150		8	16
Short Axis T1 SE Non FatSat	14	256 x 256 2	4/1	800	min				16
Short Axis PD FSE Non FatSat	14-16	512 x 256 2	4/1	3000	40			8	16
Long Axis T1 SE FatSat	12	256 x 192 2	3/1	400-800	minimal				16
Long Axis T2 FSE FatSat	12	256 x 256 3	3/1	>2000	40-50			8	16

Ankle-AVN/Osteomyelitis

Seq. FOV Matrix/
Nex Slice TR TE TI Flip ETL BW

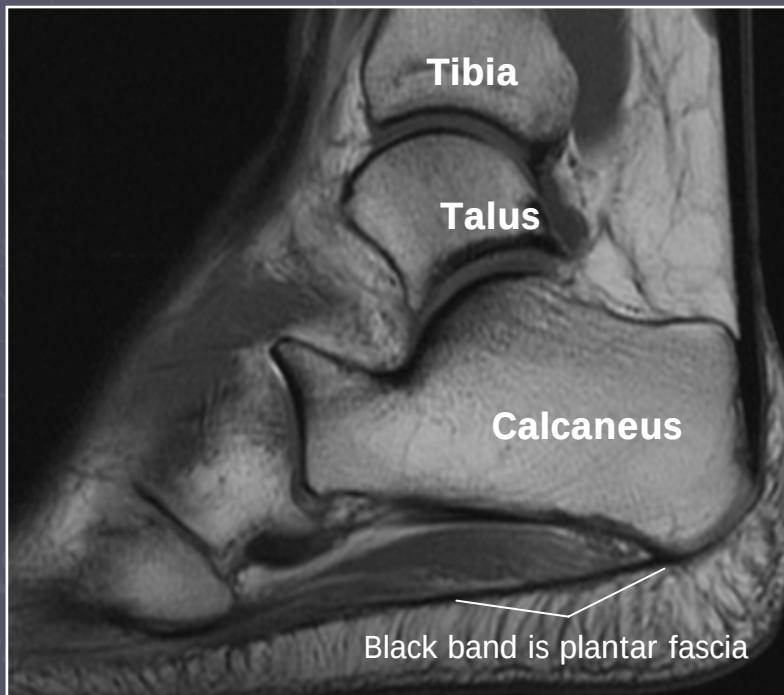
Sag T1 SE Non FatSat	16-18	256 x 192 1	4/1	400-800	Minimal				16
Sag FSE-STIR	16-18	256x192 3	4/1	>2000	20-40	150		8	16
Short Axis PD FSE Non FatSat	14-16	512 x 256 2	4/1	3000	40			8	16
Short Axis T2 FSE FatSat	14-16	256 x 256 2	4/1	>2000	50-60			8	16
Long Axis T2 FSE FatSat	14-16	256 x 256 3	3/1	>2000	40-50			8	16

Ankle-AVN/Osteomyelitis

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Sag T1 SE Non FatSat	16-18	256 x 192 1	4/1	400-800	Minimal				16
Sag FSE-STIR	16-18	256x192 3	4/1	>2000	20-40	150		8	16
Short Axis PD FSE Non FatSat	14-16	512 x 256 2	4/1	3000	40			8	16
Short Axis T2 FSE FatSat	14-16	256 x 256 2	4/1	>2000	50-60			8	16
Long Axis T2 FSE FatSat	14-16	256 x 256 3	3/1	>2000	40-50			8	16
Axial/Cor FMPSPGR FatSat (Pre 1 Plane, Post 3 Planes)	14-16	256 x 192	3/.5	50	5		30-40	8	16

Ankle-Axial Imaging Plane

Relevant Anatomy



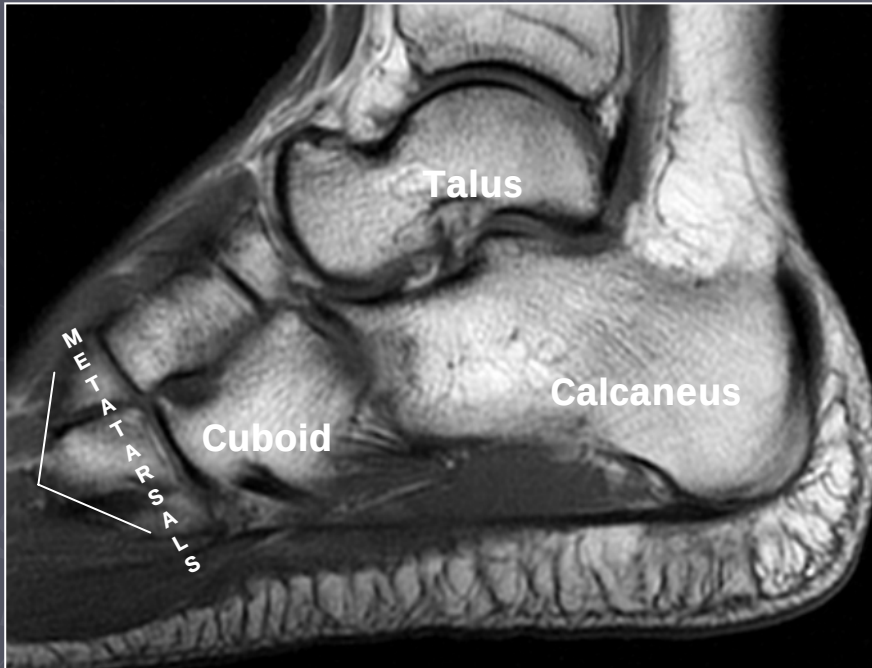
Axial Imaging Plane

Prescribe plane parallel to axis of calcaneus.
Scan ankle from distal tibia through subcutaneous soft tissues (include plantar fascia).



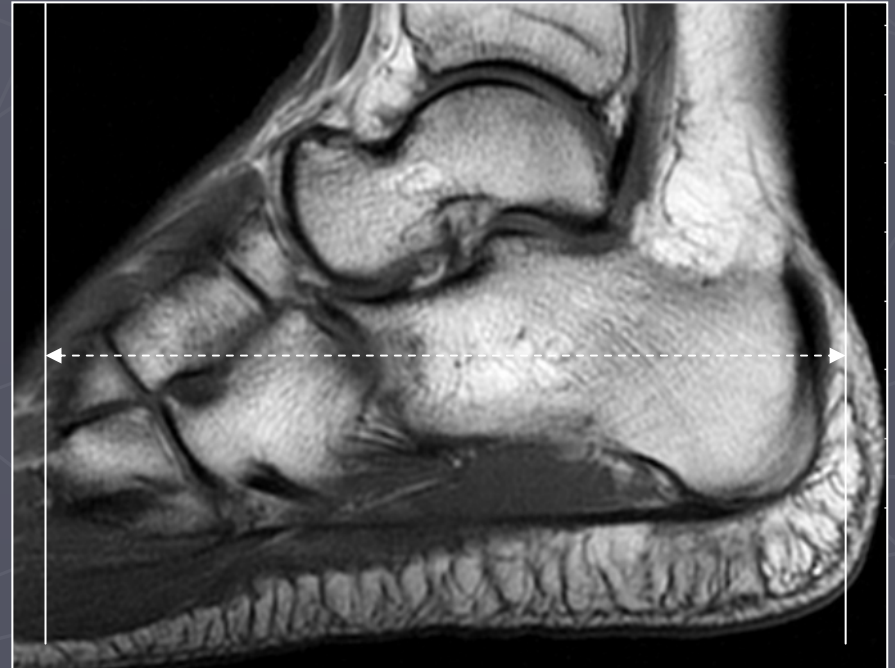
Ankle-Coronal Imaging Plane

Relevant Anatomy



Coronal Imaging Plane

Prescribe plane perpendicular to axial imaging plane. Scan ankle from calcaneus through metatarsal bases.



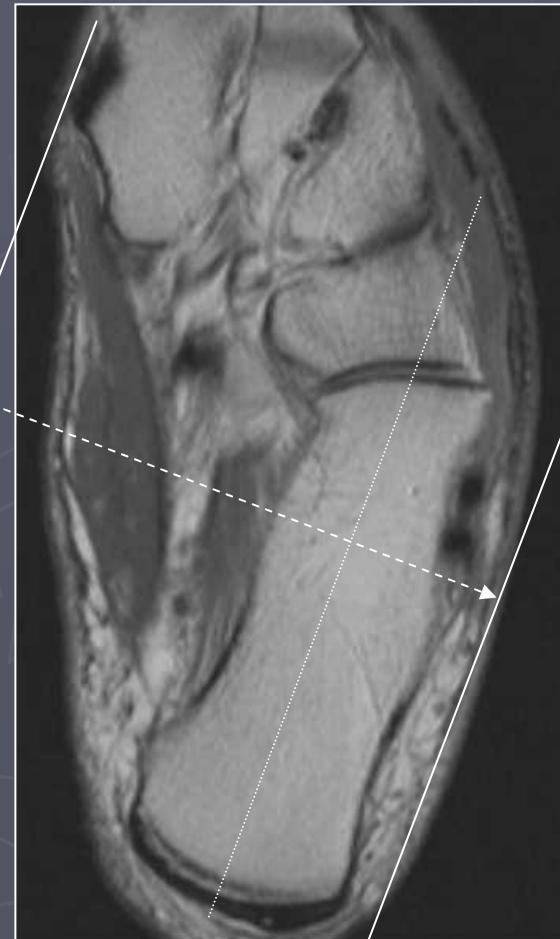
Ankle-Sagittal Imaging Plane

Relevant Anatomy



Sagittal Imaging Plane

Prescribe plane with line bisecting calcaneus. Scan through entire foot.



MR Foot Exam Selection:

► Routine Foot

- Indications:

- Plantar Plate Injury, R/O fracture, Sesamoid Pathology, Traumatic Lisfranc Injury (non diabetic)

► Osteomyelitis Protocol

- Indications:

- Osteomyelitis

- ****IMPORTANT****

- Perform FMPSPGR fat saturated pre and post images following Osteomyelitis/AVN protocol (Page).

► Soft Tissue Mass Protocol

- Indications:

- Soft Tissue Mass/Morton's Neuroma/Plantar Plate Injury

Foot-Routine

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
------	-----	----------------	-------	----	----	----	------	-----	----

Coronal T1 Non FatSat	12	256 x 256 1	3/0.5	400-800	minimal				16
Coronal T2 FSE FatSat	12	256 x 192 2	3/0.5	>2000	50-60			8	16
Sag FSE-STIR	12-14	256x192 3	3/0.5	>2000	20-40	150		8	16
Sag T1 Non FatSat	12-14	256 x 256 1	3/0.5	400-800	minimal				16
Axial T2 FSE Non FatSat	12-14	256 x 256 2	3/0.5	>2000	80-90			8	16

Foot-Osteomyelitis

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
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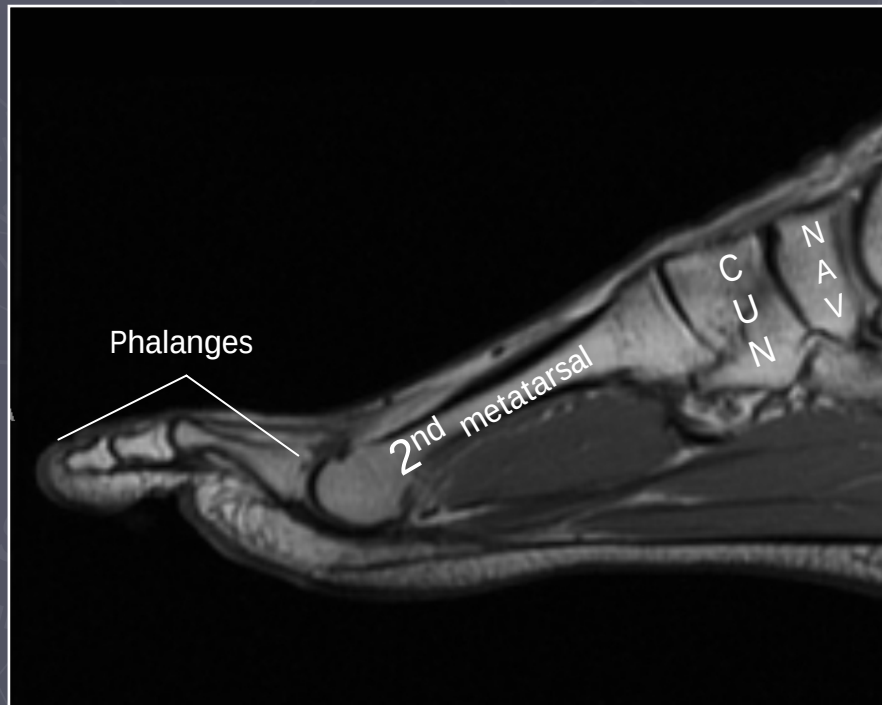
Long Axis T1 Non FatSat	12	256 x 256 1	3/0.5	400-800	minimal				16
Long Axis T2 FSE FatSat	12	256 x 192 2	3/0.5	>2000	50-60			8	16
Sag FSE-STIR	12-14	256x192 3	3/0.5	>2000	20-40	150		8	16
Sag T1 Non FatSat	12-14	256 x 256 1	3/0.5	400-800	minimal				16
Short Axis T2 FSE Non FatSat	12-14	256 x 256 2	3/0.5	>2000	80-90			8	16
Short/Long FMPSPGR FatSat (Pre 1 Plane, Post 3 Planes)	12-14	256 x 192	3/.5	50	5		30-40	8	16

Foot-Mass/Mortons/Plantar Plate

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
Coronal T1 Non FatSat	12	256 x 256 1	3/0.5	400-800	minimal				16
Coronal T2 FSE FatSat	12	256 x 192 2	3/0.5	>2000	50-60			8	16
Sag FSE-STIR	12-14	256x192 3	3/0.5	>2000	20-40	150		8	16
Sag T1 Non FatSat	12-14	256 x 256 1	3/0.5	400-800	minimal				16
Axial T2 FSE Non FatSat	12-14	256 x 256 2	3/0.5	>2000	80-90			8	16
T1 FatSat Pre 1 plane, Post All 3 Planes	12-14	256x192 2	4 / 1	400-800	minimum				16

Foot-Short Axis Imaging Plane

Relevant Anatomy



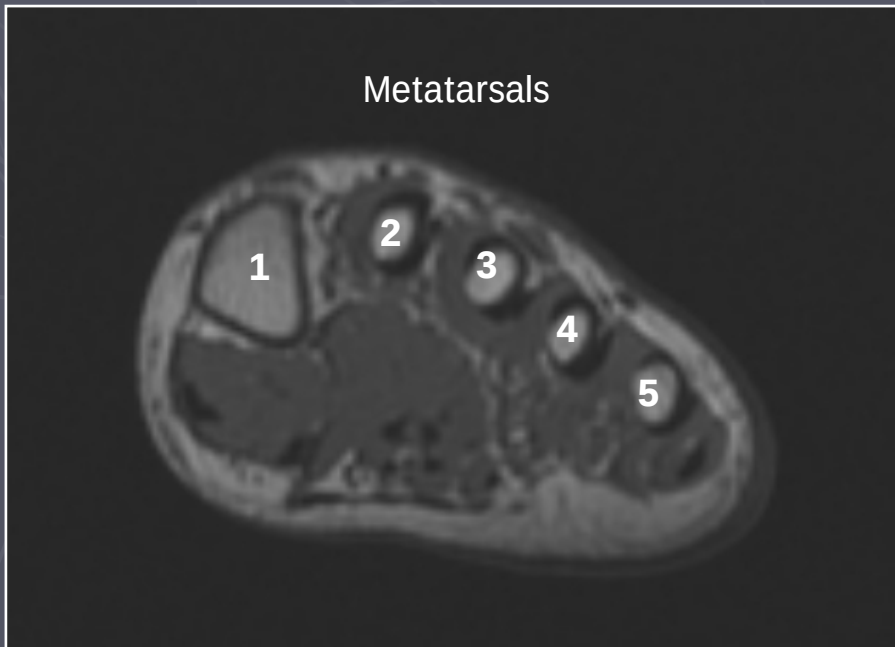
Short Axis Imaging Plane

Prescribe plane parallel to 2nd metatarsal. Scan foot from navicular through phalanges.



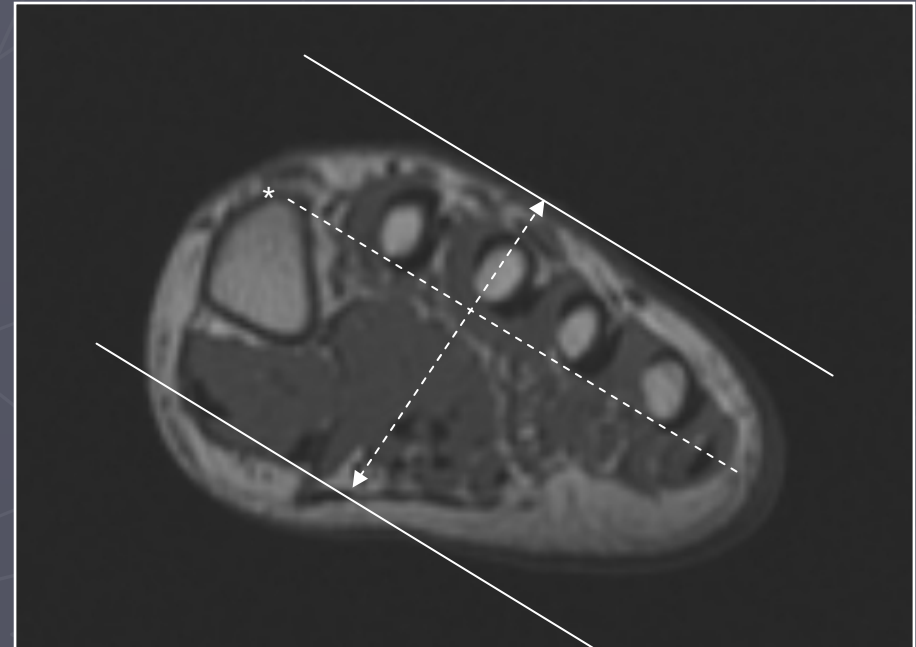
Foot-Long Axis Imaging Plane

Relevant Anatomy



Long Axis Plane

*Prescribe plane parallel to 2-5 metatarsal shafts. Scan through entire foot.



Foot-Sagittal Imaging Plane

Relevant Anatomy



Sagittal Imaging Plane

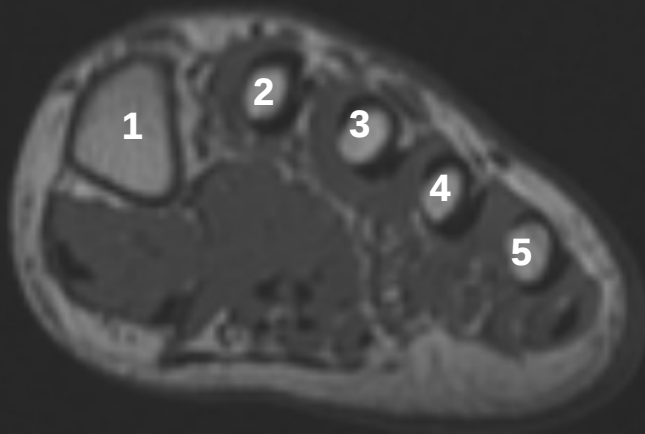
Prescribe plane through 2nd metatarsal.
Scan through entire foot.



Foot-Sagittal Imaging Plane

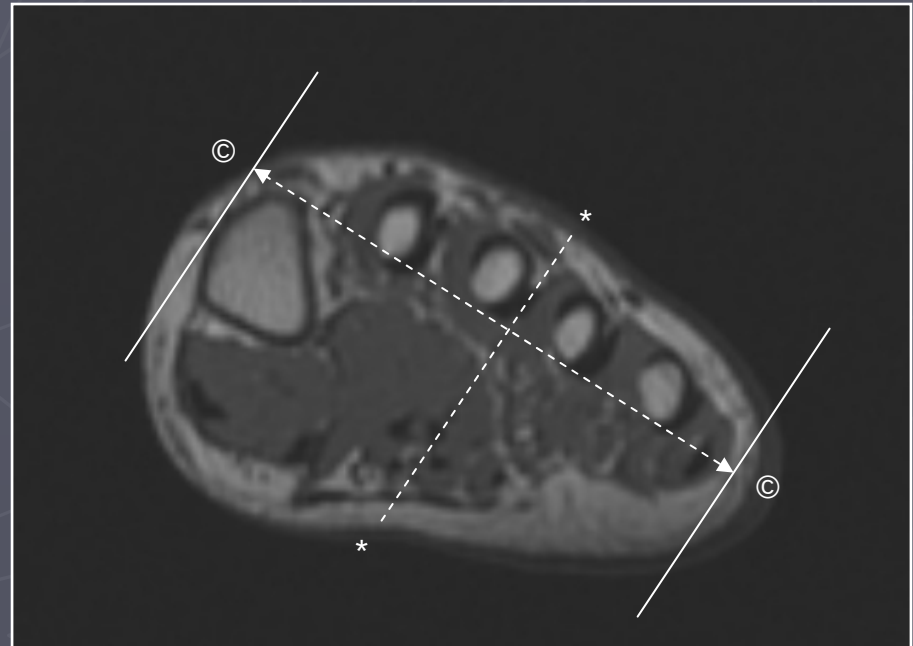
Relevant Anatomy

Metatarsals



Sagittal Plane

*Prescribe plane perpendicular to coronal Plane (©). Scan through entire foot.



Special Cases

- ▶ Soft Tissue Mass
- ▶ Dynamic Imaging (Osteomyelitis and AVN)
- ▶ Metal Hardware

MR Soft Tissue Mass

- ▶ Place Vitamin E tablet on skin lightly
- ▶ Perform routine imaging of the body part imaged PLUS Pre-contrast T1 fat saturated images in 1 plane (whichever plane mass best seen) and Post-gadolinium T1 fat saturated images in all three planes.

Example: Soft Tissue Mass Imaging Perform Routine Imaging for Body Part Plus:

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
T1 FatSat Pre (1 Plane)		256x192 2	4 / 1	400-800	minimum				16
T1 FatSat Post (All 3 Planes)		256x192 2	4 / 1	400-800	minimum				16

Dynamic Enhanced Imaging

► Indications:

- Avascular Necrosis
- Osteomyelitis

► Perform routine imaging of the body part imaged PLUS Pre-contrast FMPSPGR fat saturated images in 1 plane (whichever plane mass best seen) and Post-gadolinium Dynamic Enhanced FMPSPGR fat saturated images in all three planes.

► Directions:

- Obtain Pre-Contrast FMPSPGR (best plane)
- Hook up long tubing and inject, followed by saline bolus
- Obtain Post-Contrast FMPSPGR (best plane) for 4 runs
- Obtain Post-Contrast FMPSPGR in other two planes

AVN/Osteomyelitis Protocol

Perform Routine Imaging for Body Part Plus:

Seq.	FOV	Matrix/ Nex	Slice	TR	TE	TI	Flip	ETL	BW
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FMPSPGR FatSat Pre (1 Plane)		256 x 192	3/.5	50	5		30-40	8	16
DYNAMIC FMPSPGR FatSat Post (All 3 Planes)		256 x 192	3/.5	50	5		30-40	8	16

Metal Hardware Imaging

- ▶ Suggestions to decrease artifact
 - Decrease Bandwidth
 - Swap Phase and Frequency
 - Lower TE
 - STIR instead of T2 FSE images
 - DO NOT remove fat sat unless discussed with performing radiologist