Austin Radiological Association

MRI Breast Protocols

1.5T & 3T Protocols

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Breast Protocols

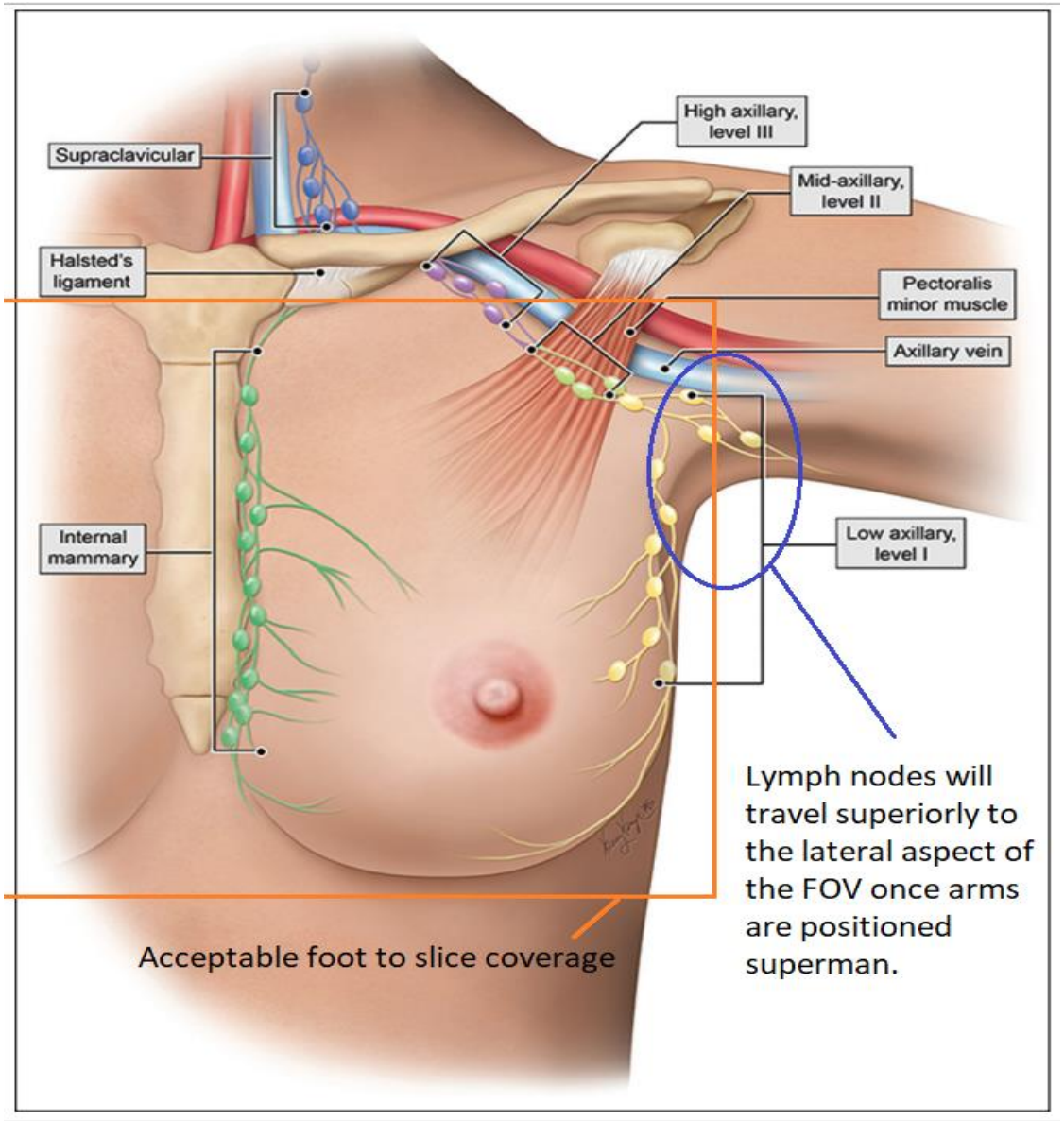
Guidelines

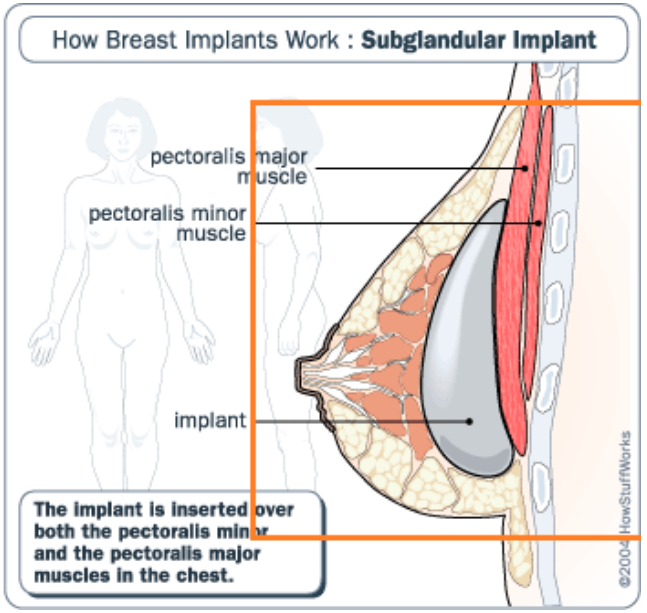
(Updated 9/7/23)

BREAST	
General	• Breast MRI Studies are done on 3T scanners only. At ARA, patients with 3T contraindications can be scanned on the Espree scanner at CP and MPT. • All prior exams will need to be located and scanned into PACS • Delay imaging for 2 weeks in patients with recent iron therapy infusions ○ Excludes patient with new finding or diagnosis, document iron in tech notes • Send breast imaging to PACS with breast facing up.
Technique	• Patient positioning: straighten inframammary skin fold, breast centered to coil, landmark mid-breast / center coil. Skin markers are recommended on any areas of interest, scars or prior procedures. Use the Beekley #186 .75CM flat Orthro-SPOT marker. • Prescription positioning: Anterior to posterior positioning to center box to breasts and to avoid posterior thorax anatomy
Contrast	• X-ray / CT abdomen and pelvis imaging must be performed prior to MR contrast exams. • DatScans must be performed prior to MR contrast exams.

SLICE COVERAGE

Appropriate foot to head slice coverage includes from just below the breast tissue to the upper limits of the pectoralis minor muscle.





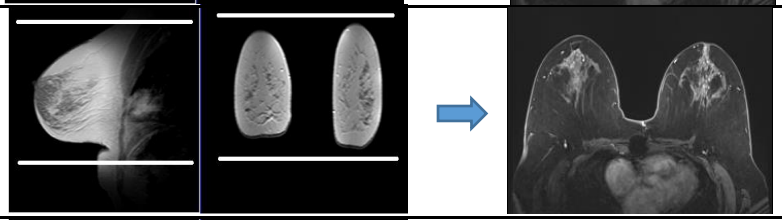
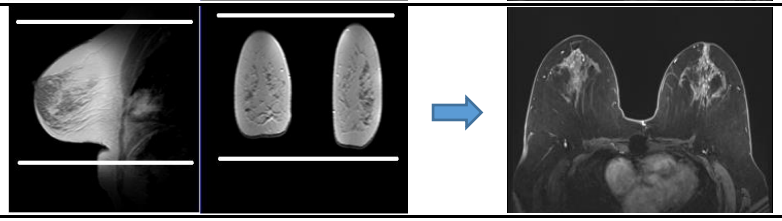
3T

Diagnostic Breast, MRBRBI

(Updated 2/8/24)

Complete MRI Breast worksheet with a very thorough history:

- History of biopsy - state if no biopsy was performed. List details such as date, laterality, type (needle, excision/lumpectomy)
- Supplemental hormones
- LMP status and dates
- Genetic testing, family history of breast or ovarian cancer with age, hysterectomy

SEQUENCE	FOV (mm)	SLICE (mm)	COMMENTS	IMAGES
T1 3D Ax	330, 350, 370, 390 (FOV fit to anatomy)	1 (1.1 mm for increased slice coverage)		
STIR Ax	330, 350, 370, 390 (FOV fit to anatomy)	4 x 0.8 ~43 slices		
T1 FS DIXON Ax Pre + 5 posts *~1.29min/sequence*	330, 350, 370, 390 (FOV fit to anatomy)	1 (1.1 mm for increased slice coverage)		

- Be sure to look through the dynamic images to verify that Dixon swap artifact is not present. Depending on the severity and location of the artifact, other interventions may be warranted.

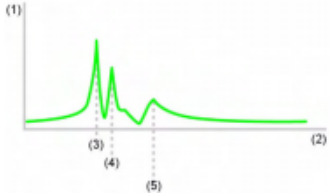
POST PROCESSING

- Rename dynamic sequences: T1, STIR, PRE, POST 1, POST 2, POST 3, POST 4, & POST 5.
- Time MIP, Sag MPR 3x0 mm from Post 2 series.
- Send to CAD: T1, STIR, PRE, POST 1, POST 2, POST 3, POST 4, POST 5, do not send repeats.
- Send to PACS: Localizer, T1 STIR, PRE/POST 1-5, SUBs, repeats, Time MIP, and Sag MPR.
- MI: scan 100% completed MRI Breast worksheet under Radiologists Paperwork.

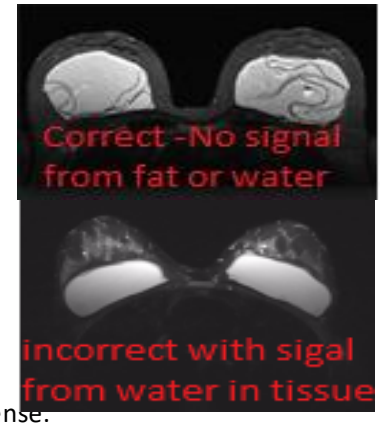
Silicone Implant, MRBRBIIMP

(Updated 10/10/22)

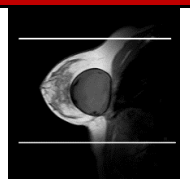
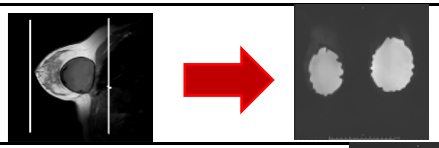
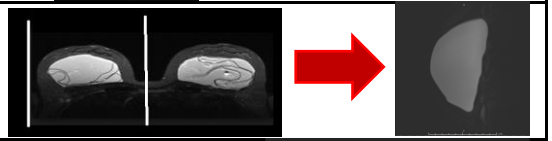
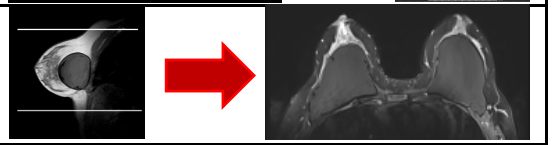
- Only performed this study on patients with silicone implants. If a patient has saline implants, explain to the ordering physician that the implant rupture protocol is for silicone implants only. If the ordering doctor is trying to rule out an effusion and the patient has saline implants, then a diagnostic breast contrast exam needs to be performed.
- Always to be scanned as individual / free standing exam
- TIRM Images should show bright silicone and dark and or no signal from rest of soft tissues. See example:
- If Silicone is dark, the wrong peak was suppressed. Manual adjustment to change the resonance frequency is required.



(1) Amplitude
(2) Frequency
(3) Silicone
(4) Fat
(5) Water



- Stir with water saturation: the fat signal is suppressed by an additional inversion pulse, the water saturation pulse (centered On the water peak) suppresses the signal from the breast and blood vessels. In the result image, silicone is displayed hyperintense.
- Center the frequency on the fat peak by clicking on the fat peak. The new transmit frequency is copied to the frequency (temp) field. Add 220 Hz to the 1.5T and 440 Hz to 3T (the last 3 numbers of the transmit frequency). Start measurement with APPLY and CONTINUE.

SEQUENCE	FOV (mm)	SLICE (mm)	COMMENTS	IMAGES
Implant type scan (Siemens)	~330 (FOV fit to anatomy)	6 x 12	• Not a diagnostic scan • Implant: Bright = saline Dark = silicone	
TIRM WS Ax	~330 (FOV fit to anatomy)	4 x 0.8	Breast tissue & fluid is suppressed; silicon is bright	
TIRM WS Cor	~330 (FOV fit to anatomy)	4 x 0.8	Breast tissue & fluid is suppressed; silicon is bright	
TIRM WS Sag RT TIRM WS Sag LT	~200 (FOV fit to anatomy)	4 x 1	• Breast tissue & fluid is suppressed; silicon is bright • Only perform sagittal if implant is present	
T2 TSE FS DIXON Ax	~330 (FOV fit to anatomy)	4 x 0.8	Silicon & surrounding breast tissue is suppressed; fluid is bright	

Send to PACS: Implant Type Scan, IR WS AX, Cor & RT/LT, T2 FS DIXON_W only, do not send non-FS image

Abbreviated Screening <20% Risk, MRBRBIAS

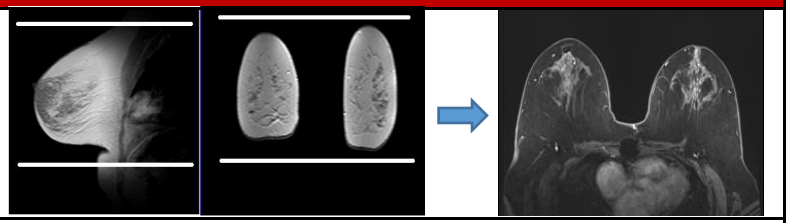
(Updated 11/10/22)

- Abbreviated Breast MRI is a screening exam meant for asymptomatic women without a family history of breast cancer. If PT has any of the following, a routine diagnostic protocol should be performed.
    - Personal history of breast cancer
    - Currently symptoms
    - Lifetime risk of 20% or greater
    - First degree relative (parent, sibling, or child) tested positive for the BRCA1 or BRCA2 gene mutation
    - First degree relative with history of breast cancer
    - First degree relative with history of Li-Fraumeni, Cowden's, or Bannaya-Riley_Ruvalcaba syndromes

Complete MRI Breast worksheet with a very thorough history:

- History of biopsy - state if no biopsy was performed. List details such as date, laterality, type (needle, excision/lumpectomy)
- Supplemental hormones
- LMP status and dates

Genetic testing, family history of breast or ovarian cancer with age, hysterectomy

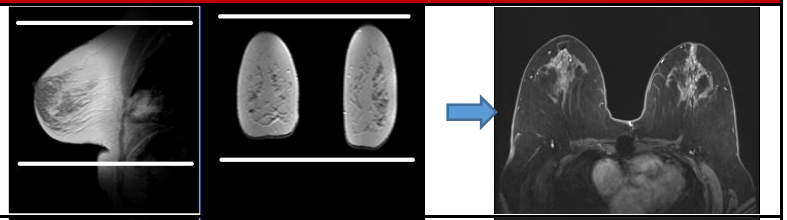
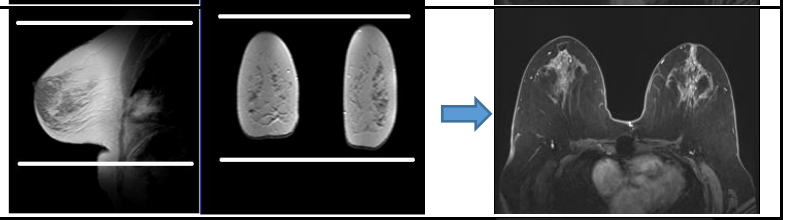
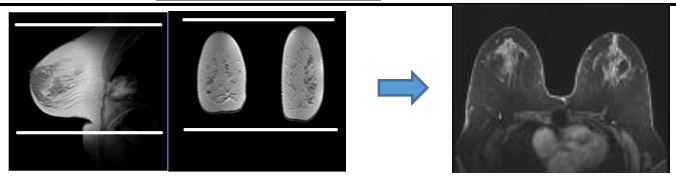
SEQUENCE	FOV (mm)	SLICE (mm)	COMMENTS	IMAGES
T1 fl3d_tra_Dixon *(2 consecutive measurements at ~1.2 9min each, with 20 sec delay after 1st measurement for contrast injection*	330, 350, 370, 390 (FOV fit to anatomy)	1 (1.1 mm for increased slice coverage)		

- Sag MPR 3x0mm and Axial MIPs from Pre and Post Dixon

1.5T (CP, MPT only)
Diagnostic Breast, MRBRBI

(Updated 2/8/24)

Complete MRI Breast worksheet with a very thorough history:
- History of biopsy- state if no biopsy was performed. List details such as date, laterality, type (needle, excision/lumpectomy)
- Supplemental hormones
- LMP status and dates
- Genetic testing, family history of breast or ovarian cancer with age, hysterectomy

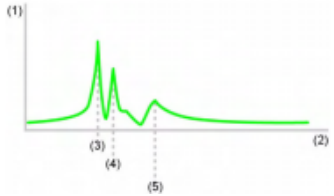
SEQUENCE	FOV (mm)	SLICE (mm)	COMMENTS	IMAGES
T1 3D Ax	~330 (FOV fit to anatomy)	2 (2.1 mm for increased slice coverage)		
STIR Ax	~330 (FOV fit to anatomy)	4 x 0.8 ~43 slices		
T1 Ax dynamic DIXON (FS) *6 consecutive measurements at ~1.29min each, with 20sec delay after 1st measurement for contrast injection, total ~9.18min*	~330 (FOV fit to anatomy)	1.8 ~112 slices	Each phase should be around 1:16 min	
hires 3d	~330 (FOV fit to anatomy)	1.0 ~192 slices		

POST PROCESSING
- Rename dynamic sequences: T1, STIR, PRE, POST 1, POST 2, POST 3, POST 4, & POST 5.
- Create Sag MPR 3x0 mm from Post 2 series.
- Send to CAD: T1, STIR, PRE, POST 1, POST 2, POST 3, POST 4, POST 5, do not send repeats.
- Send to PACS: Localizer, T1 STIR, PRE/POST 1-5, SUBs, repeats, Time MIP, and Sag MPR.
  - Rename the t1 axial dynamic_SUB_MIP_TRA to TIME MIP
- MI: scan 100% completed MRI Breast worksheet under Radiologists Paperwork.

Silicone Implant, MRBRBIIMP

(Updated 10/10/22)

- Always to be scanned as individual / free standing exam
- TIRM Images should show bright silicone and dark and or no signal from rest of soft tissues. See example:
- If Silicone is dark, the wrong peak was suppressed. Manual adjustment to change the resonance frequency is required.



(1) Amplitude
(2) Frequency
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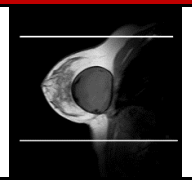
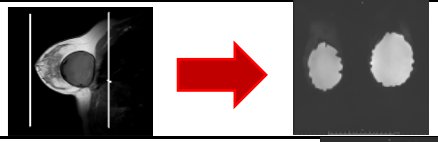
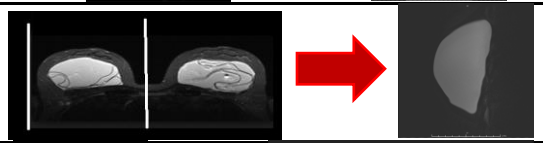
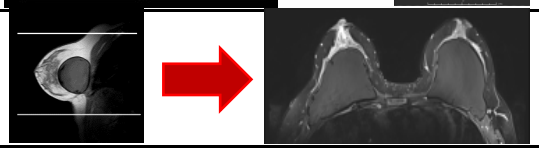
- Stir with water saturation: the fat signal is suppressed by an additional inversion pulse, the water saturation pulse (centered On the water peak) suppresses the signal from the breast and blood vessels. In the result image, silicone is displayed bright.
- Center the frequency on the fat peak by clicking on the fat peak. The new transmit frequency is copied to the frequency (temp) field. Add 220 Hz to the 1.5T and 440 Hz to 3T (the last 3 numbers of the transmit frequency). Start measurement with APPLY and CONTINUE.

SEQUENCE	FOV (mm)	SLICE (mm)	COMMENTS	IMAGES
TIRM WS Ax	~340 (FOV fit to anatomy)	4 x 0.8	Breast tissue & fluid is suppressed; silicon is bright	
TIRM WS Cor	~340 (FOV fit to anatomy)	4 x 0.8	Breast tissue & fluid is suppressed; silicon is bright	
TIRM WS Sag RT TIRM WS Sag LT	~340 (FOV fit to anatomy)	4 x 1	• Breast tissue & fluid is suppressed; silicon is bright • Only perform sagittal if implant is present	
T2 TSE FS DIXON Ax	~330 (FOV fit to anatomy)	4 x 0.8	Silicon & surrounding breast tissue is suppressed; fluid is bright	

Send to PACS: Implant Type Scan, IR WS AX, Cor & RT/LT, T2 FS DIXON_W only, do not send non-FS image

Biopsy Procedure Guidelines for ARA MRI Technologist

1. Desktop preparation
2. Room setup for single breast, single area of interest biopsy (most common exam performed)
3. Room setup for single breast, multiple area of interest (second most common)
4. Room setup for bilateral breast, bilateral area(s) of interest (third and least common)
5. Patient positioning
6. Protocol
7. Acquisition of images
8. Biopsy intervention
9. Technologist duties during the biopsy intervention
10. Post procedure equipment care
11. Post examination image delivery and case conclusion
12. Cancelled biopsy processing
13. CADStream navigation

1. Desktop preparation

- Ensure ability to access breast CADStream through the CITRIX receiver. Username and password required. **See number 13 "CADStream Navigation" for details.**
- Confirm printer setup. Assign the nearest printer as a default for your Windows log in.
- Open **CADStream** and set the viewing **filter** to the "today" option.
- Open the patient's most recent breast MRI in SYNAPSE/ARA PACS and have the following images visible for the radiologist: **POST 2, POST 2 SUB, SAG MPR, and BOOKMARKS**.
- Identify the area of interest from the breast MRI report and bookmarks. Consult with Radiologist if unclear.

2. Room setup for single breast, single area of interest biopsy (most common exam performed)

- Place the breast coil on the MRI table.
- Remove the right, center, and left coils from the support frame. Keep the **center** coil connected for bilateral exams.
- Place a Chux absorbent pad over the base of the coil to protect from blood and debris during the procedure.
- Connect the biopsy specific coils, grid, and compression plate according to side of interest and approach (lateral vs. Medial). Block the center coil connection with the biopsy plug and snap the bilateral biopsy specific coils to the back of the grid and compression plate holders.
- Block the opposite breast space with the provided cover.
- Pad the breast coil frame as much as possible for patient comfort. The patient must be able to tolerate the position without the option of adjusting their body for the entire duration of the exam.
- Load the injector according to contrast guidelines.
- Provide stool for radiologist to sit on during the procedure.
- Have safety goggles accessible for the radiologist to use and for cleanup after the exam.
- Ensure that the paramedic staff are ready with radiologist sterile cart and SUROS biopsy machine.

3. Room setup for single breast, multiple area of interest (second most common)

- This set up is identical to the single breast, single area of interest.
- During positioning, ensure placement of the fiducial away from **both** areas of interest.
- One fiducial will be used as reference for both areas.
- In this case, the radiologist will produce **two** CADStream printouts, **one for each target**.

4. Room setup for bilateral breast, bilateral area(s) of interest (third and least common)

- This procedure requires the use of **two grids and two fiducials**.
- When preparing the coil, remove the right and left routine breast coils but **keep the center coil plugged in**.
- Tape foam padding to each side of the center coil to level the concave surface.
- During positioning, apply compression by moving the grids medially against each breast and place one fiducial in each grid away from the area(s) of interest.
- At the console, **select the "bilateral" protocol. This selection provides a large FOV image for visualization of both breasts.**
- In this case the radiologist will produce **multiple** CADStream printouts, **one for each individual lesion(s) for each breast**.

5. Patient positioning

- After the radiologist consultation, the patient will be delivered to the MRI suite by the assisting paramedic.
- Perform a "time out" to confirm patient & procedure
- Have the patient open the gown and remove the arm (side of interest) out of the sleeve.
- Assist the patient into a prone position with the breast of interest between the grid and compression plate device. The opposite breast will be supported away by the covered surface.
- For **bilateral exams**, each breast will rest between a laterally positioned grid and the right or left surface of the routine center breast coil.
- The patient's arms will be placed above the patient's head as usual for a routine breast MRI.
- Have the patient adjust their body position and manipulate the breast until the area of interest is centered as best as possible within the grid.
- Once desired positioning has been achieved, apply compression so that the skin is firm enough to prevent tissue displacement while being punctured.
- Place the fiducial in a grid box away from the area of interest. The fiducial must be in full contact with the skin for proper depth calculation by CADStream.
- Re-assure the patient and stress the importance of not moving at any time during the procedure until specifically instructed to do so.
- Place the patient in the scanner.
- Connect the contrast to the patients I.V line.

6. Protocol

- Whether scanning a unilateral study (FOV of 200) or bilateral study (FOV 360) the sequences are as follows:
- T1 fl3d axial dynaViews pre.
- Inject contrast and **wait 15 sec before starting post contrast** images.
- T1 fl3d axial dynaViews post 1.
- T1 fl3d axial dynaViews post 2.
- T1 fl3d axial dynaViews post 3.
- T1 fl3d sagittal dynaViews post (the bilateral protocol will have option for RT and LT sag) Ensure good visualization of the grid and fiducial.

7. Acquisition of images

- Scan the pre contrast sequence.
- Show the pre contrast sequence to the radiologist.
- Upon approval by the radiologist, contrast the patient.
- *Administer the contrast bolus and wait 15 seconds before staring the scan*
- Link the pre and post contrast images in the exam viewer to allow for simultaneous paging up and down. This will allow the radiologist to directly compare the two sets as they look for the area of interest.
- After the lesion has been detected, send the pre and 1 set of post contrast **axial images** (best enhancement of lesion) to CADStream. **This step is the same for both single and bilateral protocols**. The bilateral protocol (large FOV) will allow the radiologist to target as many lesions as required for each breast. **See number 13 "CADStream navigation" for details**.
- The radiologist will produce a target area in CADStream and send the image to your default printer.
- Record/remember the slice number location of the lesion. This area will be examined and compared several times after each intervention by the radiologist.
- Obtain CADStream print out and tape it to the breast coil frame in a visible area but away from the radiologist workspace/sterile field.

8. Biopsy intervention

- The radiologist will clean and anesthetize the patient's skin at the area of interest.
- An incision is then made with a scalpel and a guide block is placed in the grid.
- The breast is punctured with a sharp introducer and a trocar cannula is positioned followed by an obturator marking device.
- A new set of images is obtained to confirm that the marking device is in line with the proposed target.
- Once placement is verified, a tissue sample is obtained by removing the obturator and placing a tissue excision device connected to the SUROS biopsy system.
- Once the sample is obtained, the excision device is removed, and the obturator marker is placed back in the cannula.
- A new set of images is then obtained to confirm the biopsy cavity.
- Once satisfied with the sample, the obturator marker is removed, and a titanium clip is inserted inside the breast to mark the area.
- The grid compression is released, and manual compression is applied to the breast while assisting the patient off the table.
- The patient is then walked back to recovery room and assisted into a flat, supine position.

9. Technologist duties during the biopsy intervention

- Verify that the grid coil and fiducial are not interfering with access to the biopsy site. Occasionally it is necessary to remove the fiducial to reposition the coil away from the area of interest. If indicated, remove the fiducial, and have the radiologist mark the skin with the provided **sterile surgical skin marker** on his/her tray**.**
- Firmly support the patient's back during injections to prevent involuntary movement.
- Assist the paramedic in moving cables, biopsy machine pedal, and radiologist stool out of the way of traffic.
- Communicate with the patient frequently to ensure relative comfort and address any questions.

10. Post procedure equipment care

- Upon completion of the exam, careful breakdown and a detailed cleanup of the breast coil and table is to follow. Before any cleanup begins, **RECOVER THE FIDUCIAL(S**) and place it/them in a safe place. Note that some fiducials and the biopsy guide look very similar. Sanitized all foam pads with the **purple color** cap Sani-Cloth wipes and the frame and all hard surfaces with the **gray color** cap Sani-Cloth wipes. Ensure proper handling of all sharps and blood contaminated items.
- **Note on biopsy grids**. The biopsy grid is a single use device. Occasionally the grids order is delayed. Always verify that we have grids in stock before disposing of the one used during the procedure.

11. Post examination image delivery and case conclusion

- Send the pre contrast T1 fl3d axial dynaViews and all (including sagittal) post contrast images to SYNAPSE/ARA PACS.
- Verify with the paramedic that all notes are in and complete the exam in M.I. as usual.
- Tech Notes: Include which clip(s) was placement. Unlike the routine breast exam, the LMP, hormones, family HX, genetic testing/BRCA, and skin markers information is not necessary for this exam.

12. Cancelled biopsy processing

- There are instances when a biopsy exam is started but cancelled by the radiologist during the procedure. Most common reasons include Inability to access the lesion, breast implant to close to area of interest, lesion not enhancing, etc. When this occurs, send images to SYNAPSE/ARA PACS as stated above.
- Change exam code to "Cancelled biopsy report-non billable" and complete the exam in M.I. with the pertinent information. These steps will allow the radiologist to produce a non-billable report regarding the case.

13. CADStream navigation

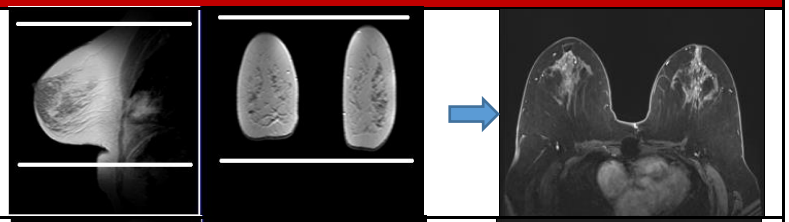
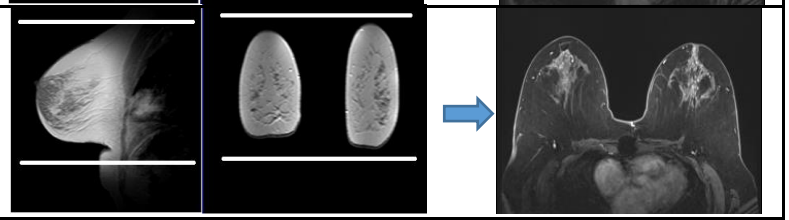
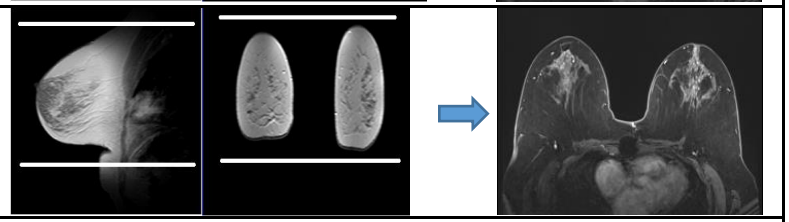
- Launch the CADStream application from the Citrix receiver: **Windows Start>Citrix Receiver>CADStream via Citrix 64.**
- Use one of these for **I.D and Password** depending on ARA site: **cpmr, mptmr, kylemr.**
- Run the application. **Accept > Run.** The study list will appear.
- Change the filter option to "today" to display the most recent exams only.
- Once the pre and post contrast images have been sent to CADStream, the patient's name will appear at the top of the list with a lock sign next to it. Wait for the lock to disappear and **single** click on the name. The **SureLoc** screen will appear displaying four images.
- The radiologist will click on the "**New SureLoc**" tab.
- Instructions will appear to **click on the target point**; this is the lesion.
- The radiologist will mark the lesion on the image.
- The instructions will prompt the radiologist to **click on the reference point.** This is the **center/brightest** image of the fiducial.
- The radiologist will mark the fiducial. The biopsy localizer image will appear.
- Print this image: **Print > select printer > ok.**
- Tape this image to the breast coil frame for the radiologist to visualize during the procedure.
- **Note: These steps can be repeated as many times as needed for multiple lesions on a single breast or bilateral studies. Each lesion will have its own printout.**

- When finalizing the case, close CADStream and select **no** if prompted to “mark as reviewed”.

1.5T– Hospital Protocol for those with separate CAD system (NOT FOR ARA USE)

(Updated 1/20/22)

- Pre-menopausal: exam should be scheduled within 7-14 days of the onset of their menstrual cycle. Only with radiologist's approval or a new diagnosis of breast cancer may this rule be overlooked.
- Recommend delay imaging for 4 – 6 weeks in patient with recent COVID-19 vaccine. Patient's may opt out and proceed with exam
- Do not change sequence parameters, other than # of slices if necessary. If the slice number is changed, alter phase & slice oversampling to keep consistent sequence time.
- Patient needs to fill out a Breast MRI worksheet with a very thorough history:
  - History of biopsy- state if no biopsy was performed. List details such as date, laterality, type (needle, excision/lumpectomy)
  - Supplemental hormones
  - LMP status and dates
  - Genetic testing, family history of breast or ovarian cancer with age, hysterectomy

SEQUENCE	FOV (mm)	SLICE (mm)	COMMENTS	IMAGES
T1 3D Axial	~330 (FOV fit to anatomy)	2		
STIR Axial	~330 (FOV fit to anatomy)	4 x 0.8 ~43 slices		
T1 FS 3D Axial Pre *Contrast 3ml/sec* T1 FS 3D Axial Posts (post four measurements)	~330 (FOV fit to anatomy)			
T1 FS hires 3D Axial post	~330 (FOV fit to anatomy)			
hires 3D				
T1 FS Sag post *include if not sending to CADStream				

POST PROCESSING

- Subtract the T1 FS 3D Axial pre from each post
- T1 FS Axial 2 min delay: SAG MPR (3x1)
- T1 FS Axial 2 min delay: LATERAL MIP (12 images, approx. 15 degrees between, left to right)
- Preferred centering. Center breast in FOV, do not include whole chest.