



Introduction

- Magnetic Resonance Imaging (MRI) creates cross-sectional images of the body in multiple planes. MRI uses a magnetic field and radiofrequency pulses to create diagnostic images.
- MRI takes advantage of the different densities of different tissues within the body. MRI uses radio waves and magnetic fields to distinguish minute differences between these tissues making it the modality of choice for breast imaging on high-risk patients (Pierce & Dubose, 2019, p. 246).

Breast Cancer

- Most common cancer, and the second leading cause of cancer death for women in the U.S.
- “It accounts for about 30% (or 1 in 3) of all new female cancers each year” (American Cancer Society, 2022, para. 1).
- Women with high-lifetime risk of breast cancer are recommended breast MRI and yearly mammogram (American Cancer Society, 2022, para. 7).

Breast MRI

- “Breast MRI is the most sensitive breast imaging modality” (Adrada et al., 2022, slide 4).
- The patient is positioned prone head-first in the breast coil and scanned on a 3T or 1.5T scanner.
- Common sequences are T2-fat saturation, pre-contrast T1, and pre-contrast T1-fat saturation, followed by multiple post-contrast T1-fat saturation sequences.
- Breast MRI uses the Breast Imaging – Reporting and Data System (BI-RADS) to read the images (Gao et al., 2020, pp. 4672-4673).

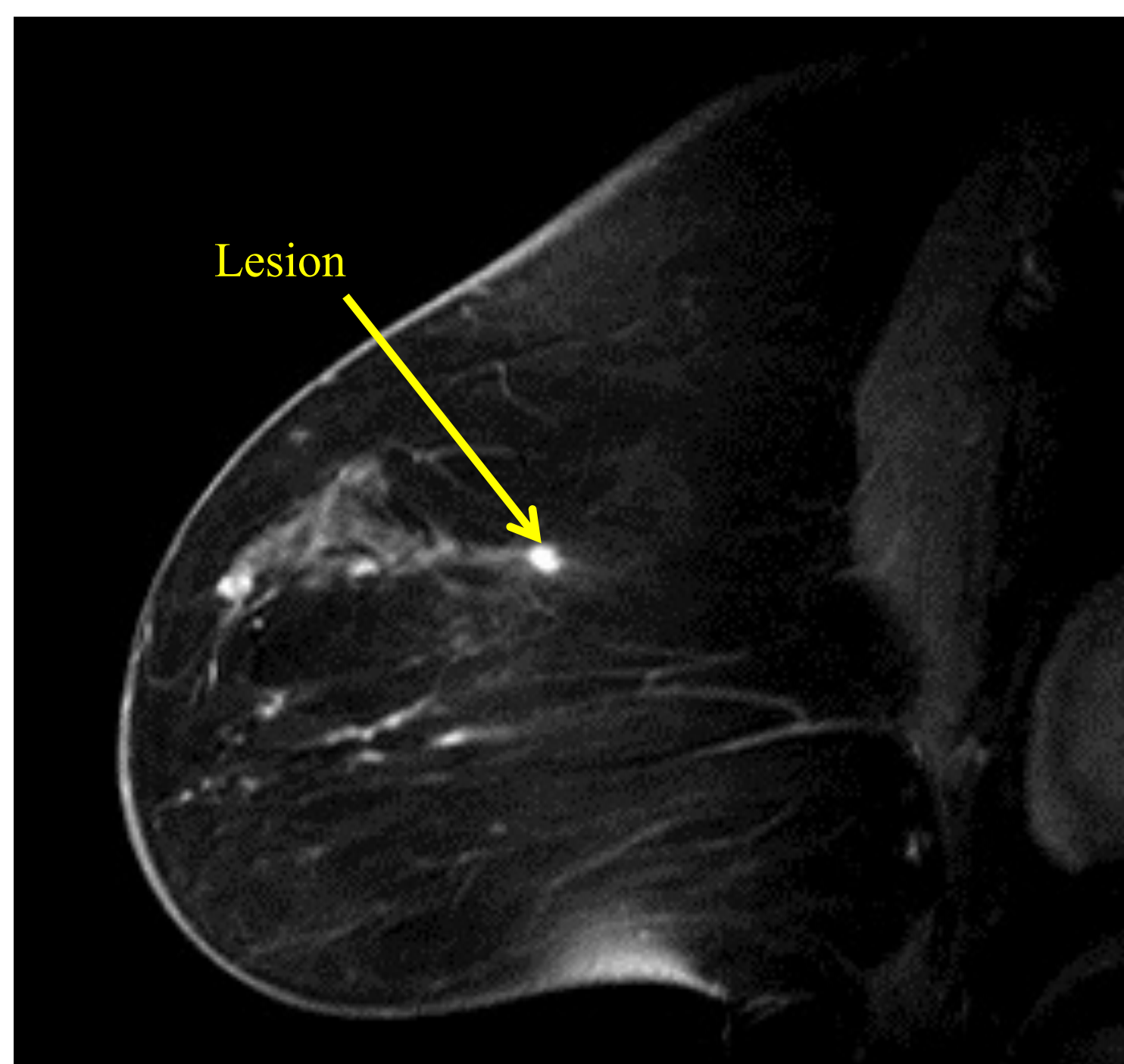


Figure 1. Sagittal T1W (T1-weighted) postcontrast delay (Adrada et al., 2022, slide 19)

Advantages and Disadvantages of MRI-Guided Breast Biopsies

Advantages:

- Best for the detection of clinically suspected lesions that are not seen with mammography or ultrasound (US) and covers more tissue than mammograms (Gillespie et al., 2020, p. 714).
- If a lesion is only detected on breast MRI, then MRI-guided breast biopsy is prompted.
- “...(MRI) may reveal additional breast cancers missed by both mammography and ultrasound screening” (Berg et al., 2012, p. 1394).
- Enhanced detail of the image helps the surgeon decide between breast-conserving surgery (BCS) or mastectomy (Gao et al., 2020, pp. 4672-4673).

Disadvantages:

- “...(60%-80%) of all MRI-guided breast biopsies continue to yield benign findings” (Motanagh et al., 2023, para. 1).
- If patient has a non-conditional pacemakers or breast implants can rupture.
- Target lesion on pre-biopsy not visible during the biopsy. Exam terminated if lesion not detected.

Indications and Contraindications

Indications:

- Suspicious lesion BI-RADS 4-5 seen on breast MRI. Lesion not found on mammography or US (Adrada et al., 2022, slide 6).

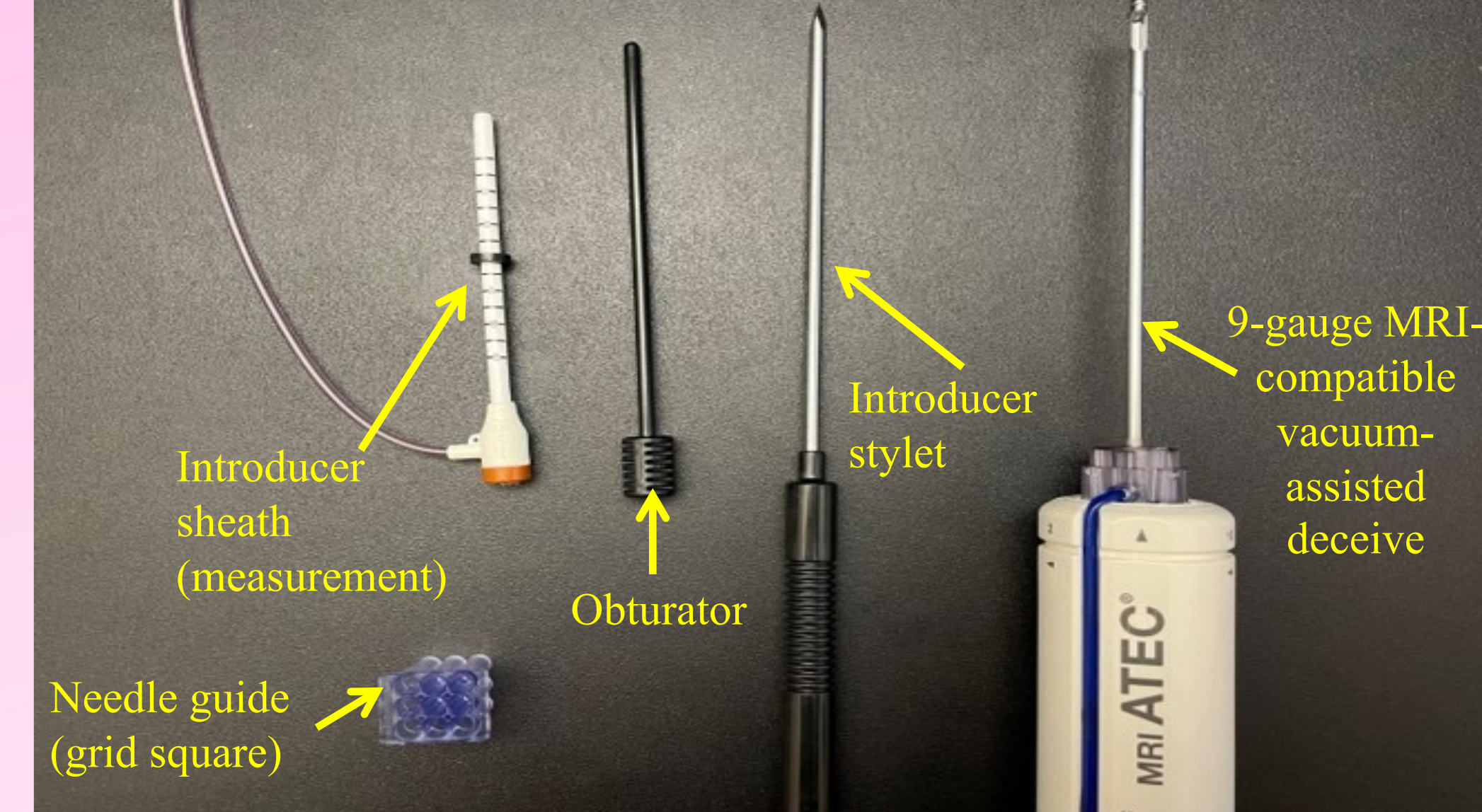
Contraindications:

- Includes MRI non-conditional metallic/magnetic devices. pacemakers, aneurysm clips. renal failure claustrophobia, contrast allergy (Berg et al., 2012, p. 1396).
- Target lesion not reidentified on prebiopsy, lesion too close to the skin, chest wall, or nipple (Adrada et al., 2022, slide 6).

Equipment for the Biopsy

- Includes a breast coil, breast compression device, grid, and a fiducial marker for localization of the outer portion of the breast.
- Sterile tray includes lidocaine, two syringes with lidocaine and epinephrine, scalpel, needle guide, introducer sheath, obturator, introducer stylet, vacuum-assisted breast biopsy (VABB), metallic clip (Adrada et al., 2022, slides 9-10).

Figure 2. Biopsy supplies for MRI guided biopsy (Adrada et al., 2022, slide 10)



MRI-Guided Biopsy Procedure

- IV started, affected breast cleaned, patient lies prone with breast in the breast coil. Affected breast compressed with sterile grid and fiducial marker inserted into grid near lesion. Localizer images taken to identify location of the lesion.
- A sagittal T1-weighted fat-saturated image taken to relocate lesion. Once located, contrast is injected. Axial T1 fat-saturated image taken for target placement, depth, and needle position. Biopsy performed once radiologist or computer-dedicated biopsy software locate lesion (Bick et al., 2020, p. 6).
- Location of needle guide and space in needle grid confirmed by radiologist. Lidocaine with epinephrine injected into breast. Introducer stylet and sheath inserted through the needle guide. Stylet is removed and replaced with obturator. Image confirms placement (Adrada et al., 2022, slides 11-17).

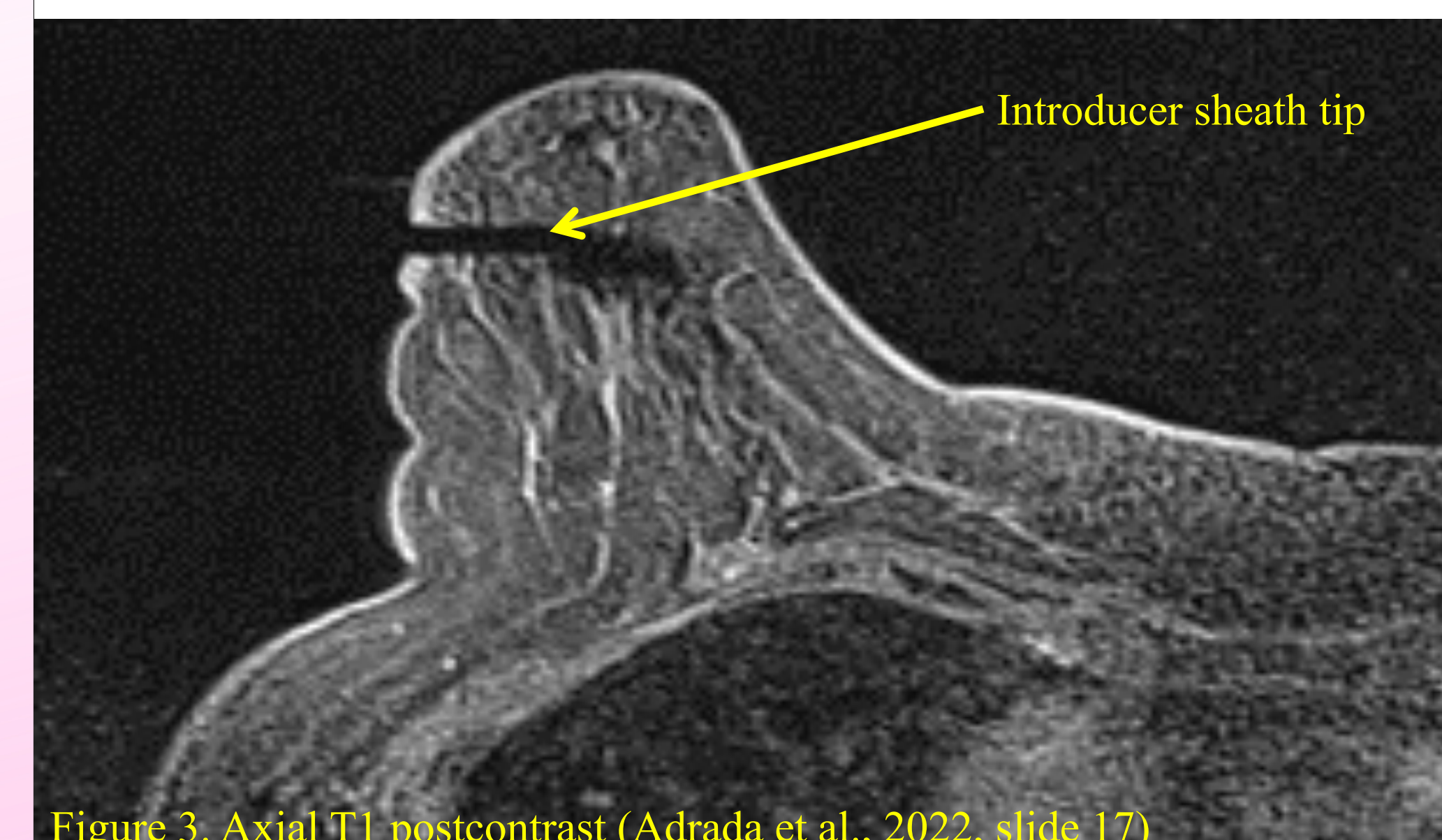


Figure 3. Axial T1 postcontrast (Adrada et al., 2022, slide 17)

- The VABB is inserted through the introducer and samples taken clockwise around lesion by the radiologist. VABB is removed, metallic clip placed at site of biopsy. Final image to confirm clip placement.
- A post-procedure mammogram is completed to confirm the placement of the clip (Adrada et al., 2022, slides 11-17).

Advancements in MRI-Guided Biopsy

- Image-guided automated robots (IGAR) are being tested for use in MRI-Guided breast biopsies. Manual image-guided breast biopsies are very technical & rely on the radiologist’s skill level.
- The IGAR-Breast system is the first automated robot used for breast biopsy procedures can be an alternative to the current standard for MRI biopsies
- The IGAR includes a manipulator that moves the VABB, workstation for viewing, & a pendant that controls the system. The patient lies prone with head resting on top of manipulator.
- The IGAR-Breast system is a safe and effective biopsy device that has been shown to reduce pain and scarring while increasing patient comfort (Anvari et al., 2023, pp. 12-13).

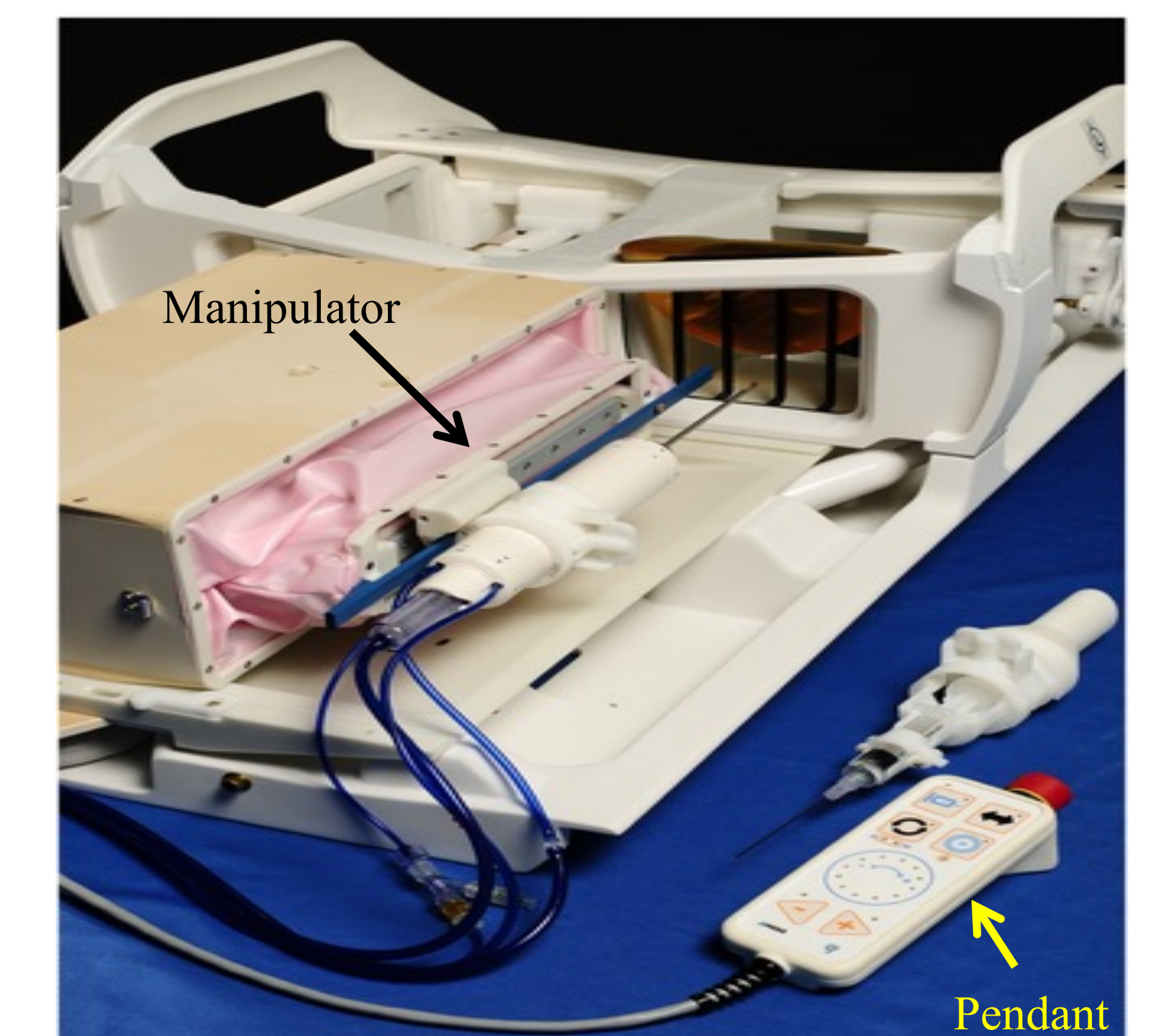


Figure 4. IGAR-Breast manipulator is positioned on a docking tray (Anvari et al., 2023, p. 3)

Conclusion

- MRI is the most sensitive breast imaging modality & essential for early detection of breast cancer. High-risk patients should have both a breast MRI & mammogram, or US. The additional screening of MRI to mammography has resulted in higher cancer detection yield. MRI-guided biopsies require the lesions to be best seen on MRI & the use of special equipment. Pre-contrast and post-contrast images help the computer system & radiologist localize lesion depth, and position. Biopsy taken, and patient has a mammogram to confirm clip placement. MRI is the best modality for lesions not detected on mammography or ultrasound.
- Recent studies have shown MRI screening remains highly sensitive for the detection of breast cancer. New techniques are being developed to increase the specificity of breast MRI (Motanagh et al., 2023, pp. 1-5).