Suboptimal Magnetic Resonance Imaging of Breasts due to Improper Positioning: Prevalence in a Regional Hospital and How to Minimise It

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Objectives

- As significant part of the breast is composed of fat, and enhancement characteristic is essential for lesion evaluation, **optimal fat saturation and free contrast flow into breasts** are important for cancer detection in MRI of breasts.
- Suboptimal patient positioning can lead to **unwanted artefacts** in magnetic resonance imaging (MRI) of breasts that impact diagnostic accuracy, including **signal flare, inhomogeneous fat saturation and uneven contrast enhancement** within breast parenchyma.
- This study aims to **evaluate the prevalence and causes of poor positioning** in breast MRI and discuss how to reduce it.

Materials & Methods

- Consecutive 52 contrast-enhanced breast MRI performed using 1.5T magnet
- Patient positioning independently reviewed by two breast radiologists retrospectively according to the standard in American College of Radiology (ACR) practice parameter
- Discrepancies were settled by consensus

ACR Criteria

1. **Free-hanging, non-deformed breasts** centering at the coil
2. **Entire breasts included** in the field-of-view (FOV) from the axillae to the inframammary folds
3. **Minimising skin folds**
4. **Nipples in profile**, symmetrically pointing down to the ground

Results

48.1% of examinations **(25/52)** did not fulfil one or more of the four criteria defined by ACR

Types of improper positioning	**Prevalence** (n= 52)
Off-centering / Deformity of breasts in coil • Part of breast too close to the coil *(Figure 1,2)* • Large breasts anteriorly compressed against the coil *(Figures 1,2)* • Inferior bulge with abdominal tissue being included *(Figures 1,3)* • Part of breast compressed by side of the coil *(Figure 4)*	**36.5%**
Breasts not entirely included in the FOV *(Figure 5)*	**17.3%**
Skin folds *(Figure 2)*	**17.3%**
Nipples not in profile *(Figure 6)*	**15.3%**

Anterior compression of large breasts, breast too close to coil & inferior bulge

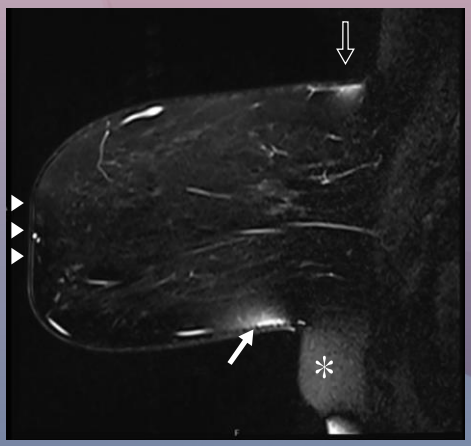

Figure (1) Sagittal T2W fat-saturated MR image demonstrates the anterior breast tissue being compressed against the coil and flattened (arrowheads). The superior part of the breast shows focal high signal area (open arrow) because of close proximity to the coil. There is inferior bulge due to included abdominal tissue (asterisk), associated with poor focal fat saturation at the inferior breast (white arrow).

Anterior compression of large breasts, breast too close to coil & skin fold

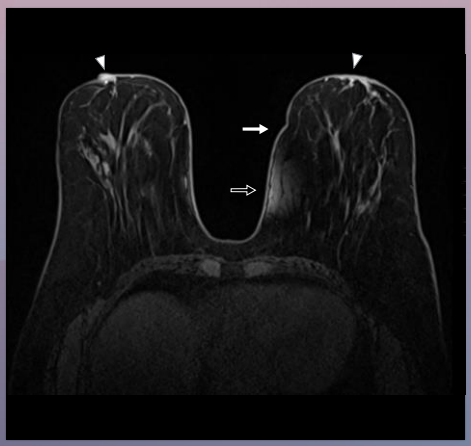

Figure (2) Axial T1W contrast-enhanced fat-saturated MR image shows large breasts being compressed anteriorly against the coil with nipples flattening (arrowheads). There is skin fold at medial left breast (white arrow). Focal poor fat saturation (open arrow) is noted as the breast tissue is touching the coil element.

Inferior bulge

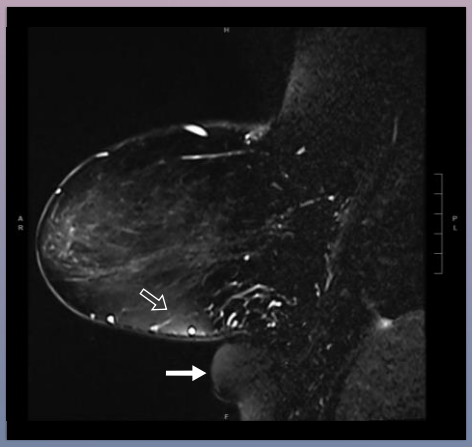

Figure (3) Sagittal T2W fat-saturated MR image shows inferior bulge (white arrow) due to included upper abdominal tissue within the coil. Note the focal area of inhomogeneous fat saturation at the inferior aspect of the breast (open arrow).

Breast compressed by side of coil

Figure (4) Axial T1W contrast-enhanced fat-saturated MR image demonstrates an asymmetric bulging at the medial left breast (white arrow), which is due to insufficiently pulled down breast with trapped breast tissue between the chest wall and the centre partition of the coil.

Inadequate field-of-view

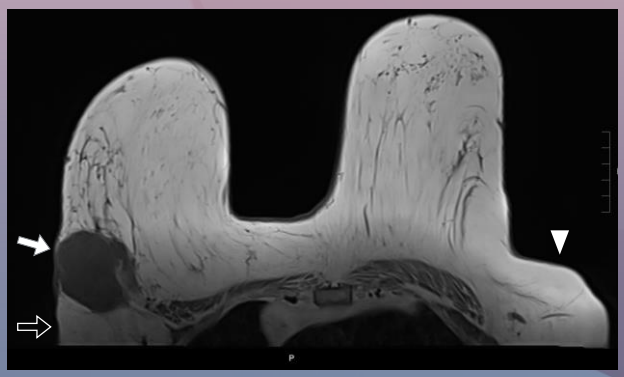

Figure (5) Axial T1W non-fat-saturated MR image demonstrates the known T1 hypointense tumour (white arrow). Note the right axilla is minimally included in the field-of-view (open arrow), comparing to the contralateral side (arrowhead).

Nipples not in profile

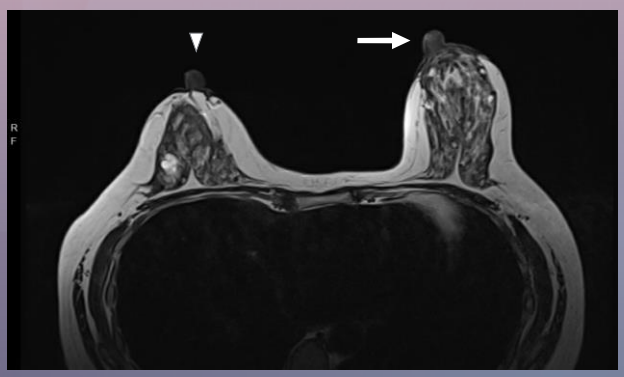

Figure (6) Axial T2W non-fat-saturated MR image demonstrates the left nipple is deviated medially (white arrow). Note the properly positioned right nipple (arrowhead) which is pointing down to the ground.

Solutions to minimise the improper positioning and related artefacts

- Perform **visual checking** in open coil system to ensure the breasts are symmetrically centered in the coil and are free-hanging without compression
- Always **review the triplane localiser images** before image acquisition +- repositioning
- **A reminder and compliance checklist** placed in the MRI suite as quick reference for MR technologists
- **Place a pad anterior to the chest of patients with big breast sizes** to reduce the chance of anterior breast compression
- **Use a fat saturation pad in difficult cases** to help smooth the breast contour and achieve homogeneous fat saturation

Conclusion

Undesirable patient positioning in breast MRI is not uncommon. They can be avoided by careful planning, inspection and special positioning techniques.

References:

1. Yeh ED, Georgian-Smith D, Raza S, Bussolari L, Pawlisz-Hoff J, Birdwell RL. Positioning in breast MR imaging to optimize image quality. Radiographics. 2014 Jan-Feb;34(1):E1-17.

2. American College of Radiologists (ACR) practice parameter for the performance of contrast-enhanced magnetic resonance imaging (MRI) of the breast. Revised 2023 (Resolution 8).