A comparison of Short and Standard Exam Time Breast MR Studies

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Target audience: MR researchers, breast radiologists, breast clinicians, oncologists, breast radiographers/imaging technicians

Background: The global demand for breast MR is growing, not least due to increasing MR screening. This rise in demand is problematic. Firstly, MR scan time is a limited and therefore an expensive commodity. Secondly, there is no consensus regarding image acquisition for breast MR examinations. There are many different pulse sequences to choose from and individual preferences coupled with historical practice tend to play a large role in sequence choice, consequently, examination times tend to be lengthy (typically >30minutes). We believe that a well devised short breast MR examination contains the necessary information to allow an accurate diagnosis. Further, we contest that this short breast MR examination will not result in a significantly different BI-RADS[1] score to that provided by a standard (~30-45minutes) breast MR scan.

Purpose: The purpose of this study is to determine the technical feasibility of a short breast MR examination and obtain preliminary comparative data regarding the BI-RADS lexicon for both the standard and short duration examinations.

Methods: Patients initially underwent the current standard breast examination [3 plane localizer, axial calibration, axial 3D T1W FSPGR, axial DWI, sagittal VIBRANT multiphase, sagittal high spatial resolution VIBRANT, axial high spatial resolution VIBRANT-flex, sagittal T2W FSE fat sat (LT), sagittal T2W FSE fat sat (RT)] with a typical scan time of 30 minutes. Post examination a clinical report was issued as per the normal pathway and patients were invited to consider this study. Following informed consent participants were rescanned utilizing the short breast MR imaging protocol [3 plane localizer, mixed temporal / spatial resolution 3D T1W multiphase, 3D T2W CUBE-IDEAL] with a typical scan time of 12 minutes. In addition to radiographic data, such as lesion longest diameter, BI-RADS pro-formas were completed for both the standard and short breast MR protocol. To reduce reader-order bias BI-RADS scoring for the standard and short MR protocols were i) separated by 3 months; ii) the presenting order was reversed after half the dataset had been read; and iii) the radiologist had not issued the original clinical report. Intra-rater agreement between the BI-RAD scores (overall and individual descriptors) and relevant radiographic data obtained for both techniques (standard and short) were assessed via weighted Kappa analysis. Bland Altman plot analysis was utilised to compare lesion longest diameter.

Results: Data was collected from 19 participants, 52 separate lesions were identified in total, standard MR revealed 44 lesions but failed to identify 8 while short MR identified 43 lesions but failed to note 9. Kappa scores are presented in Table I. Good agreement between the standard and short breast MR examinations were noted when considering the BI-RADS overall assessment category, margin, and other findings. Good agreement was also noted for the following radiographic features: focus, number of foci, and the presence of suspicious axillary nodes. Intra-rater agreement between BI-RADS shape and internal enhancement descriptors were both assessed as fair. Regarding kinetics initial rise the short examination agreed with the standard in 93% of cases while there was 86% agreement for the delayed phase. Bland Altman plot analysis revealed a mean difference in lesion LD of 1.6mm (95% limits of agreement -14.4 to 17.5mm).

Measure	Groups	K score (95% CI)	Agreement
BI-RADS 'Assessment Category'	1,2 or 3 vs. 4, 5 or 6	0.736 (0.553 to 0.918)	Good
BI-RADS 'Shape'	Round or Oval vs. Lobular or Irregular	0.327 (0.0 to 0.679)	Fair
BI-RADS 'Margin'	Smooth vs. Irregular or Spiculated	0.618 (0.351 to 0.884)	Good
BI-RADS 'Mass enhancement'	Homogeneous* vs. Heterogeneous□	0.355 (0.0 to 0.718)	Fair
BI-RADS 'Other findings'	14 groups as outlined in BI-RADS	0.954 (0.867 to 1.00)	Very good
Nodes	Reported vs. Not reported	0.721 (0.373 to 1.00)	Good
Focus	Unifocal, multifocal, multicentric, MF&MC	0.755 (0.424 to 1.00)	Good
Number of foci	N/A	0.782 (0.524 to 1.00)	Good

Table I. Kappa scores and 95% CI for various BI-RADS and radiographic measures. *Includes dark internal septations. □Includes rim enhancement and enhancing internal septations

Discussion: These preliminary results suggest that the short breast MR examination is not only feasible but has good agreement with the lengthier standard MR examination, particularly, when considering the overall assessment category, margin, focus, foci, nodal involvement, longest diameter and kinetic information. However, BI-RADS descriptors shape and mass enhancement only achieved a fair strength of agreement. The discrepancy in the acquisition of high resolution post contrast images may have affected the agreement not only for mass enhancement but also shape. For the short study high resolution images were captured when the greatest differences in contrast between tumour and parenchyma are expected (~3minutes post injection), whereas, comparable images from the standard study were not acquired until at least ~7 minutes post injection when the image contrast between tumour and parenchyma is expected to be lower (affecting shape), additionally, the image contrast within the lesion may have considerably changed (affecting mass enhancement).

Conclusion: Breast MR data can be acquired in 12 minutes with comparable agreement to traditional lengthier MR studies.

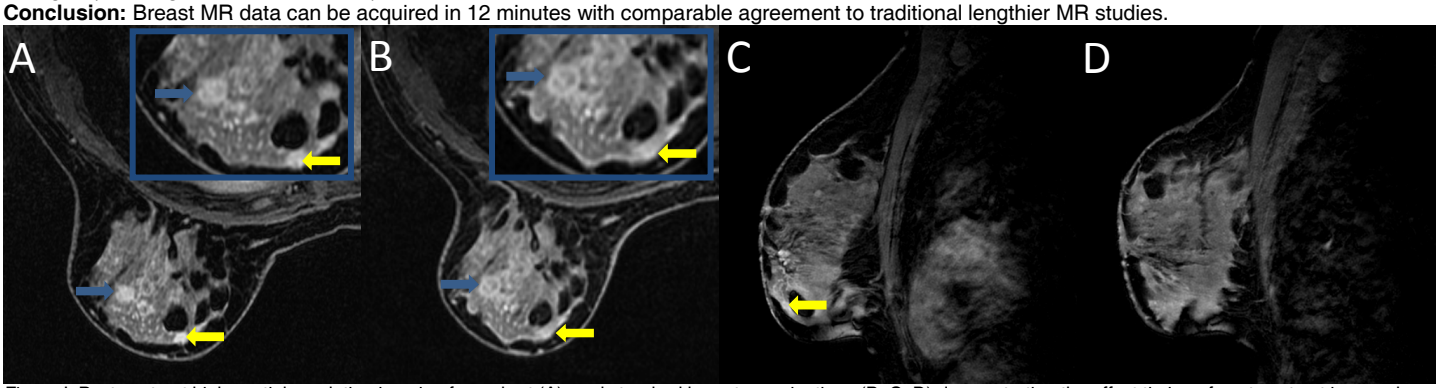

Figure I. Post contrast high spatial resolution imaging from short (A), and standard breast examinations (B, C, D) demonstrating the effect timing of post contrast images has on mass enhancement and shape. Blue and yellow arrows highlight two different lesions. Note difference in mass enhancement and shape of lesions between the short and standard MR images. Lateral lesion (blue arrow) not clearly identifiable in image D.