# Determining the sensitivity and specificity of high spatial resolution 3.0T breast MRI in a high risk familial breast cancer screening cohort

**M. D. Pickles[1], and L. W. Turnbull[1]**
[1]Centre for MR Investigations, University of Hull, Hull, East Yorkshire, United Kingdom

**Introduction** Due to greater SNR levels breast MR examinations at 3.0T should be superior to those acquired at 1.5T. Improved SNR levels allow imaging protocols with greater spatial and/or temporal resolution than those achievable with 1.5T systems. However, breast imaging on higher field strength systems also pose specific problems such as larger chemical shift, greater susceptibility artefacts, $B_1$ inhomogeneities and increased $T_1$ relaxation times. Consequently, caution has been urged in the implementation of breast MRI at 3.0T[1]. The aim of this work was to compare the sensitivity and specificity achieved by a 3.0T MR breast screening programme against the published results of screening studies at 1.5T.

**Methods** Between May '07 and August '08 261 patients were scanned on a 3.0T HDx (GE Healthcare) scanner in combination with an 8-channel dedicated breast coil. All patients were referred due to their high familial risk of breast cancer. Imaging consisted of axial $T_1$ 3D FSPGR, sagittal $T_1$ multi-phase 3D VIBRANT (12 phases, 2 pre, 10 post, typical temporal resolution ~30 seconds, spatial resolution 0.91x1.36x2.0mm), high spatial resolution sagittal $T_1$ 3D VIBRANT (0.40x0.40x1.8mm), and sagittal $T_2$ 2D FSE fat saturated images (0.40x0.40x3.6mm). Images were reviewed and scored from 1 (normal) to 5 (highly suspicious of malignancy) according to the RCR Breast Group imaging classification[2]. For this study RCR scores were dichotomised into benign (1-3) or malignant (4 or 5). All patients were offered followed up surveillance at either 12 or 24 months depending on their relative risk.

**Results** Of the 261 patients scanned follow up data was available in 229 patients, and of these 105 had breast MR at 3.0T as part of their surveillance while the remaining 124 patients were followed up without MR data. The median surveillance interval was 14 months (min 9, max 23 months). In the initial screening round malignant RCR scores (4-5) were assigned to 8 patients while 221 were scored as benign. Further investigations (X-ray mammography, US, histology, and imaging follow up) revealed 3/8 lesions with RCR MR scores 4-5 to be malignant while the remaining tumours were determined to be benign. A malignant lesion was revealed at the second screening round for one patient who was initially scored as benign in the first screening round, consequently, the initially result was treated as a false negative finding. MR screening results against gold standard results, sensitivity, specificity, PPV, and NPV are presented in Tables I and II. In an additional 3 patients scored as RCR 3 (Indeterminate/probably benign finding further investigation is indicated) further imaging ± biopsy was undertaken resulting in a recall rate for further imaging ± biopsy of 4.8% (11/229) well below the RCR expected standard of <7%[1].

| | | Follow up | | Total |
|---|---|---|---|---|
| | | Benign | Malignant | |
| **MRI** | Benign | 220 | 1 | 221 |
| | Malignant | 5 | 3 | 8 |
| **Total** | | 225 | 4 | 229 |

**Table I** MR results against 'gold standard' follow up results

| Report | N | Sensitivity (95% CI) | Specificity (95% CI) | PPV | NPV |
|---|---|---|---|---|---|
| Current Study | 229 | 75% (22-99%)† | 98% (95-99%)† | 38% | 99% |
| Sardanelli[3] | 278 | 94% (82-99%) | NR | 63% | NR |
| Kuhl[4] | 529 | 91% (NR) | 97% (NR) | 50% | NR |
| Leach[5] | 649 | 75% (51-91%) | 82% (78-85%) | NR | NR |
| Lehman[6] | 367 | NR | NR | NR | NR |
| Warner[7] | 236 | 85%* | 93%* | 42%* | 99%* |

**Table II** Sensitivity, specificity, PPV and NPV for current study and previous 1.5T studies. Note results are for MR data only and not pooled X-ray mammography, US and MR data. †Results for 105 MR follow up patients Sen 75% (22-99%), Spec 98% (92-99%), PPV 48%, NPV 95%. * Results based on first year.

**Conclusions** Of note in this study was the low number of cancers observed, however, this is explained by the nature of the screening population studied since a significant sub-cohort were already enrolled in a non MR screening programme. The specificity was the highest of all the studies listed, however, sensitivity was low. This, in part, can be explained by the low number of observed cancers. Consequently, the one false negative case had a dramatic effect on the overall sensitivity. The small recall rate was very encouraging. In conclusion the diagnostic accuracy of MR breast screening at 3.0T does not seem to be adversely effected by high field strength related artefacts and the results are comparable to those published at 1.5T.

**References** [1]RCR Breast Group, Breast Screening Protocol, http://www.rcrbreastgroup.com. [2]RCR Breast Group, Clin Radiol. 2009; 64; 624-627. [3]Sardanelli et al. Radiology. 2007; 242; 698-715. [4]Kuhl et al. J Clin Onco. 2005; 23; 8469-8476 [5]Leach et al. Lancet. 2005; 365; 1769-1778 [6]Lehman et al. Cancer. 2005; 103; 1898-1905. [7]Warner et al. JAMA. 2004; 292; 1317-1325.