Magnetic resonance imaging utilises the signal produced by hydrogen ions or protons placed in a powerful magnetic field stimulated by radiowaves. The image created depends on the immediate environment in which the hydrogen ion is found. Although nuclear magnetic resonance was discovered in 1948, the first clinical examination was not performed until 1981 in Aberdeen, UK [1].

Initially it was thought that breast disease could not be usefully imaged with MRI as the signal from breast cancer was very similar to that of normal fibroglandular tissue. However, Heywang in 1986 demonstrated that by using an intravenous injection of a paramagnetic contrast agent, breast cancers rapidly enhanced with the contrast and became conspicuous against the normal background parenchymal tissue [2].

The development of surface coils improved signal reception and new software and hardware allowed more rapid imaging techniques with much higher resolution. This allowed tissue contrast differences to be much more easily visualised, and made the differentiation of benign and malignant breast disease realistic. A number of series have been published from Europe and North America, demonstrating high sensitivity for detecting breast cancer but with variable specificity [3–10] (Table 1).

Benign enhancing areas can cause problems in image interpretation resulting in low specificity. These abnormal areas can be caused by a number of benign lesions such as fibroadenomas and benign proliferative dysplasia. Both diffuse and focal transient enhancement may occur predominantly before and during menstruation, and so the examination is ideally performed between day 6 and 17 of the menstrual cycle [11,12]. Hormone replacement therapy can cause diffuse and/or focal enhancement in at least 30% of post-menopausal women.

Much work has been carried out to try and improve specificity by examining the morphology and enhancement characteristics of abnormalities. This has had variable success. However, despite the drawback of low specificity, it was felt that as MRI was the most sensitive technique for examining pre-menopausal breast tissue, it was worth carrying out studies to establish the sensitivity and specificity in asymptomatic young women.

A number of studies have been proposed or started in Europe with a variety of protocols, comparing contrast enhanced MRI with conventional x-ray mammography.

The UK magnetic resonance imaging for breast screening (MARIBS) is a multicentre non-randomised comparative study of x-ray mammography and MRI as a method of screening women at genetic risk of breast cancer. The study aims to detect an improvement in sensitivity of 15% between MRI and x-ray mammography requiring detection of 84 tumours. This would require annual recruitment of 250 gene carriers, giving a total of 2800 screens. Allowing for the assumed 40% prophylactic mastectomy rate, the screened population includes both gene carriers and those at 1:2 rate of carrying BRCA1, BRCA2 or TP53 mutations. 500 women will be recruited annually for 3 years, and screening will be performed for up to 5 years with a subsequent 2-year follow-up. This should yield a total of 6000 screening examinations. Women with BRCA1 or BRCA2...
will be recruited between the ages of 35–50 years, and women with TP53 will be recruited between the ages of 25–50 years.

This study also includes health technology assessment and psychological evaluation, particularly regarding the acceptability of the MRI examination compared with conventional mammography. This study started in 1998 and is ongoing in 15 MRI centres in the UK.

References


### Table 1

Published studies of breast MRI

<table>
<thead>
<tr>
<th>Author</th>
<th>Number of patients</th>
<th>No of cancers</th>
<th>Benign lesions</th>
<th>Sensitivity %</th>
<th>Specificity %</th>
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<tbody>
<tr>
<td>Gilles [7] (1994)</td>
<td>143</td>
<td>64</td>
<td>79</td>
<td>95</td>
<td>53</td>
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<td>Boetes [8] (1994)</td>
<td>83</td>
<td>65</td>
<td>22</td>
<td>95</td>
<td>86</td>
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</tbody>
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