

# Abbreviated Breast MR Protocol at Radboud University

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## Overview

<b>Motivation for abbreviated breast MRI</b>	<p>At the Radboud University Medical Center, different MRI protocols are used for breast imaging depending on the purpose.</p> <ul style="list-style-type: none"> <li>• An approximately 20-minute MRI protocol for diagnostic imaging</li> <li>• An approximately 8-minute abbreviated MRI (abMRI) protocol for screening</li> </ul> <p>The motivation to implement abbreviated breast MR imaging (abMRI) at the Radboud was to increase cost-effectiveness. The idea was to be able to scan more women within the same timeframe with MRI. This would therefore allow greater access to MRI screening to more women and reduce the time women had to spend inside the MRI scanner (anxiety, claustrophobia, lying still).</p>
<b>Population</b>	<p>According to Dutch<sup>1</sup> and European<sup>2</sup> guidelines, breast cancer screening with MRI is reserved for women with an increased risk of developing breast cancer. This includes women with hereditary germline mutations, especially BRCA1/2 gene mutation carriers, women at increased risk due to family history, women with a personal history of breast cancer, and women with extremely dense breast tissue. All women who are referred for screening by breast MRI are scanned using the abbreviated protocol, unless they have silicone implants (in which case specific silicone sequences are added) or have to be scanned for diagnostic purposes.</p>
<b>Imaging details</b>	<p>MRI systems used for breast cancer screening with the abMRI protocol:</p> <ul style="list-style-type: none"> <li>• MAGNETOM Prisma fit 3T, Breast 18 coil</li> <li>• MAGNETOM Vida Fit 3T, Breast 18 coil</li> </ul> <p>Breast MRI scans are generally scheduled weekly with a few dedicated timeslots of a couple of hours (for example, Thursday morning and Friday morning, whereby this can differ week to week). At the start of the timeslot, the scanner tables are adapted to facilitate breast imaging by positioning the breast imaging coil and placing the corresponding pillows and head rests. The table does not have to be adapted between scans, only cleaned for the next scan. For all imaging appointments, preparation time of 10 minutes per person is taken into account in the scheduling.</p>
<b>Consequence of implementation</b>	<ul style="list-style-type: none"> <li>• The major advantage of the abbreviated MRI protocol is that three patients can be scanned per hour. If DWI is omitted, it is also possible to scan four patients in one hour.</li> <li>• Another important benefit is that the MRI scanner is almost continuously in use.</li> <li>• However, the workload for technicians does increase. Due to the preparation time of 10 minutes per patient, the time overlap between scans decreases. Technicians have several tasks during and after the scan (e.g., processing and transferring images), for which there is now less time. If one scan is delayed, the whole schedule is delayed. It is therefore important to ask women to come to the appointment slightly in advance to ensure that patient flow is uninterrupted.</li> </ul>

<sup>1</sup>Dutch guidelines source: <https://richtlijnendatabase.nl/richtlijn/borstkanker/screening/screeningsmiddelen/mri.html>

<sup>2</sup>European guidelines source: <https://link.springer.com/article/10.1007/s00330-022-08617-6>

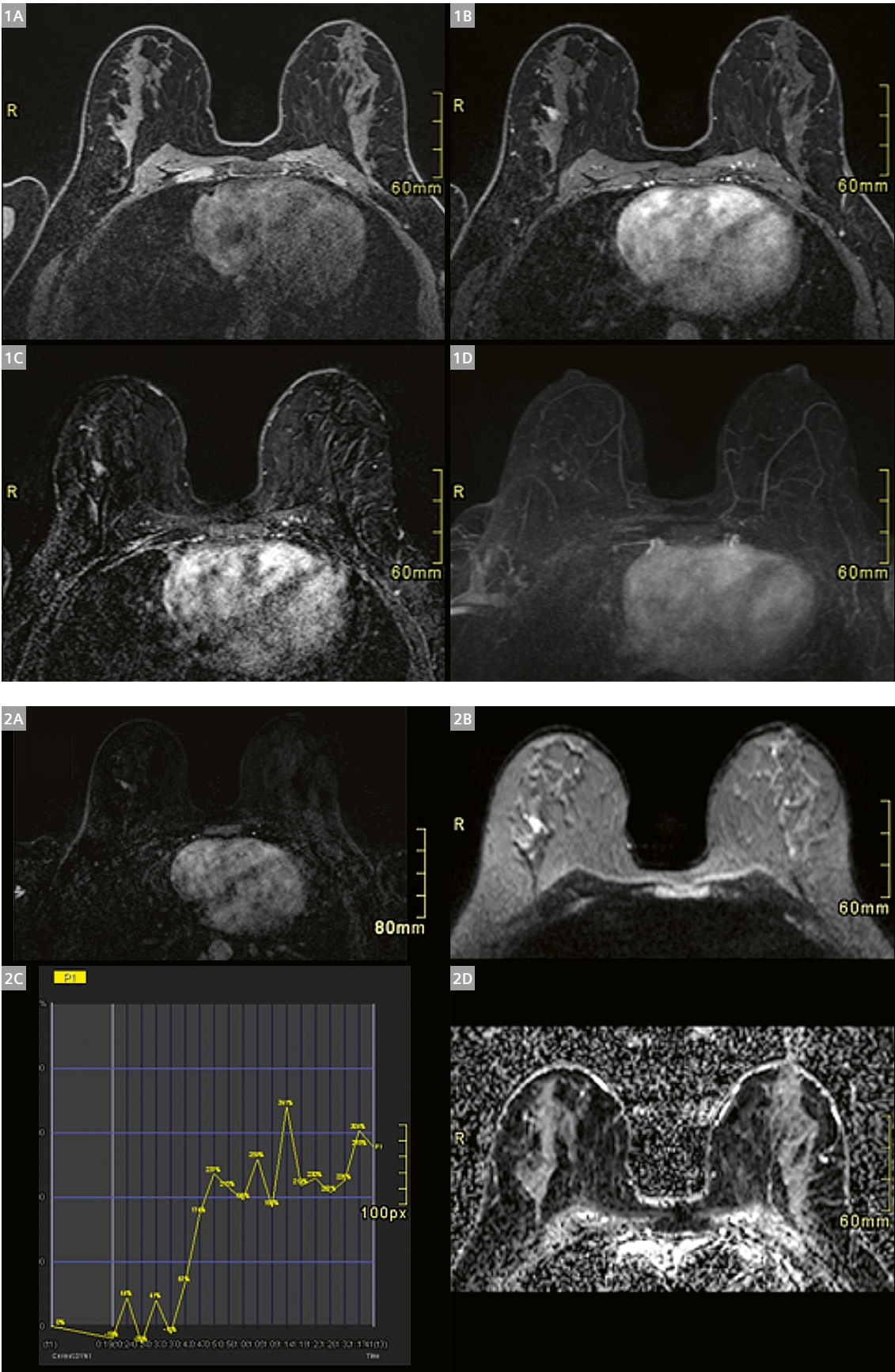
## Imaging study

<b>Patient preparation</b>	<ul style="list-style-type: none"> <li>• Patients register at the front desk and are directed to the MRI waiting room. A technician walks to the waiting room to personally call the patient and bring them to the changing room. Patients should remove upper body clothing and all other items containing metal. They are provided with a blue gown for coverage until getting to the MRI scanner. The intravenous cannula (IV) for the injection of contrast is inserted after the patient has changed into the gown.</li> <li>• Injection of contrast agent</li> <li>• Patients can sometimes go directly to the MRI scanner, but sometimes they have to wait a little until the MRI scanner is ready.</li> <li>• Patients are then positioned on the table. When positioning is done, the technician leaves the room and the scan is started.</li> <li>• Afterwards, the IV is removed immediately on the table in the MR room, and the patients can go to the changing room, change, and leave as soon as they are ready.</li> </ul>
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<b>Patient setup</b>	Patients lie prone on the scanner table, either head-first or feet-first, depending on the individual situation. Breasts are positioned in the Breast MR coil.
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<b>Imaging protocol</b>	Download the .exar1 file for 3T MAGNETOM Prisma fit and MAGNETOM Vida Fit at <a href="http://www.magnetomworld.siemens-healthineers.com/clinical-corner/protocols">www.magnetomworld.siemens-healthineers.com/clinical-corner/protocols</a>
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Sequence	Scan time (min)	Sequence details
Localizer	0:08	
T1 VIBE Dixon pre-contrast (axial)	1:31	FOV: 360 x 360 mm <sup>2</sup> In-plane resolution: 0.9 x 0.9 mm Slice thickness: 1 mm Number of slices: 144
T1 dynamic TWIST (axial)	2:03	FOV: 360 x 360 mm <sup>2</sup> In-plane resolution: 0.9 x 0.9 mm Slice thickness: 2.5 mm Number of slices: 60 Temporal resolution: 4.57 s
T1 VIBE Dixon post-contrast (axial)	1:31	FOV: 360 x 360 mm <sup>2</sup> In-plane resolution: 0.9 x 0.9 mm Slice thickness: 1 mm Number of slices: 144
RESOLVE SPAIR (axial)	2:53	FOV: 340 x 170 mm <sup>2</sup> In-plane resolution: 1.5 x 1.5 mm Slice thickness: 4 mm Number of slices: 28 b-values: 0, 800 s/mm <sup>2</sup>
Total acquisition time:	8:06 min	



## Example case

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Screen-detected mamma carcinoma in a 43-year-old BRCA1 gene mutation carrier. Primary assessment is performed using (1A) pre-contrast T1 VIBE, (1B) post-contrast T1 VIBE, (1C) subtraction image, and (1D) dynamic MIP obtained from the ultrafast T1 VIBE acquisition. Given the presence of abnormalities, additional information used for the complete evaluation of the lesions are: (2A) perfusion with T1 dynamic TWIST, (2C) inflow curve, and (2B, 2D) DWI with RESOLVE ( $b$ -value = 800 s/mm<sup>2</sup> and ADC map).

## Reading practice

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- For baseline evaluation, we use a 4-view hanging protocol, with the pre-contrast T1 water image top left (1A), the post-contrast T1 water image top right (1B), the subtraction bottom left (1C), and the dynamic MIP bottom right (1D) obtained from the ultrafast dynamic acquisitions.
- Evaluation starts with the MIP, followed by a quick scroll through the subtractions. If they are negative, reading the study is finalized within seconds.
- Reporting always contains statements about the amount of fibroglandular tissue in the breast and background parenchymal enhancement.
- In the presence of abnormalities, we judge morphology of a lesion on the subtraction and the T1 post-contrast images, time to enhancement on the dynamic MIP, and create inflow curves when required for the assessment of maximum slope. In addition, lesions are judged on the  $b$ 800 DWI acquisition and the corresponding ADC map.

## Tips & tricks

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- Tip 1: Assess screening examinations in the context of the baseline risk of the patient (i.e., you need to know!). Small focal areas of non-mass enhancement that enhance relatively late can, for example, easily be dismissed in women at relatively low risk, whereas they might warrant a biopsy in women with specific genetic mutations (e.g., BRCA2 or CDH1).
- Tip 2: Look at the dynamic MIP to appreciate the lightbulb effect: The first lesion you see, is the lesion that most warrants your attention.



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