

Breast cancer screening with a high spatiotemporal MRI sequence in women at increased risk is as accurate as screening with a standard diagnostic MRI protocol

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Introduction

Breast cancer screening with MRI is advised for women with a life-time risk >20%, but appears to be cost-effective only in women carrying *BRCA* germline mutations. This is due to the high costs of the MRI exam itself.

Time-resolved angiography With Stochastic Trajectories (TWIST) is a dynamic contrast enhanced sequence with diagnostic spatial resolution that takes only 102 seconds. Using only TWIST for screening might reduce MRI costs substantially as standard diagnostic protocols usually take up to 20 minutes.

Objective: The purpose of this study is to investigate the accuracy of high risk breast cancer screening with only TWIST series compared to a full diagnostic protocol (FDP).

Material and Methods

Study population

Cases were collected from the Radboudumc MRI screening program for woman at high risk (>20%).

In total 190 MRI cases were included. Prior MRI examinations were presented if available (n=145) similar to the real world MRI screening practice:

- All 30 screen-detected cancers detected between 2010-2014
- All 51 screen-detected biopsy-proven benign lesions detected between 2010-2014
- 109 randomly selected normal cases with ≥ 24 months negative follow up

MRI Data

All scans were performed on 3T MRI scanners (Siemens, Erlangen, Germany) using dedicated 16 channel breast coils. All women underwent a full hybrid diagnostic protocol including the TWIST sequence (table 1).

	DWI	VIBE (T1)	TWIST (T1)	T2
Spatial resolution	1.5 x 1.5 x 4.0	0.9 x 0.8 x 1.0	1.0 x 0.9 x 2.5	1.3 x 1.1 x 2.5
Time points (#s)	1 (b50/b800)	5 (1 pre, 4 post)	20 (1 pre, 19 post)	1
Temporal resolution/time point	186 s	80 s	4.3 s	88s

Table 1. Standard DCE-MRI diagnostic screening protocol at Radboudumc, Nijmegen, (NL)

Reading protocol

- 7 dedicated breast radiologists read all cases once using the FDP without TWIST and once reading TWIST only in two separate reading sessions in an independent and counterbalanced crossover multi-reader-multi-case (MRMC) study. Reading sessions were at least 4 weeks apart.
- Scoring was done on case level using BI-RADS and a quasi-continuous scale (table2).

BI-RADS	Description	Range
1	Normal	0-10
2	Benign	11-20
3	Probably benign	21-30
4a	Low suspicion	31-45
4b	Intermediate suspicion	46-60
4c	High suspicion	61-94
5	Highly suggestive	95-100

Table 2. Scoring methodology in this MRMC study.

Statistical Analysis

- MRMC Receiver operating characteristics (ROC) analysis was based on the continuous scale scores, using JAFROC statistical software (v4.2.1). p-Values < 0.05 were considered significant.
- Sensitivity and specificity were determined based on the BI-RADS scores. BI-RADS 3,4 and 5 were regarded as positive. Chi-square and McNemar tests were used to compare.

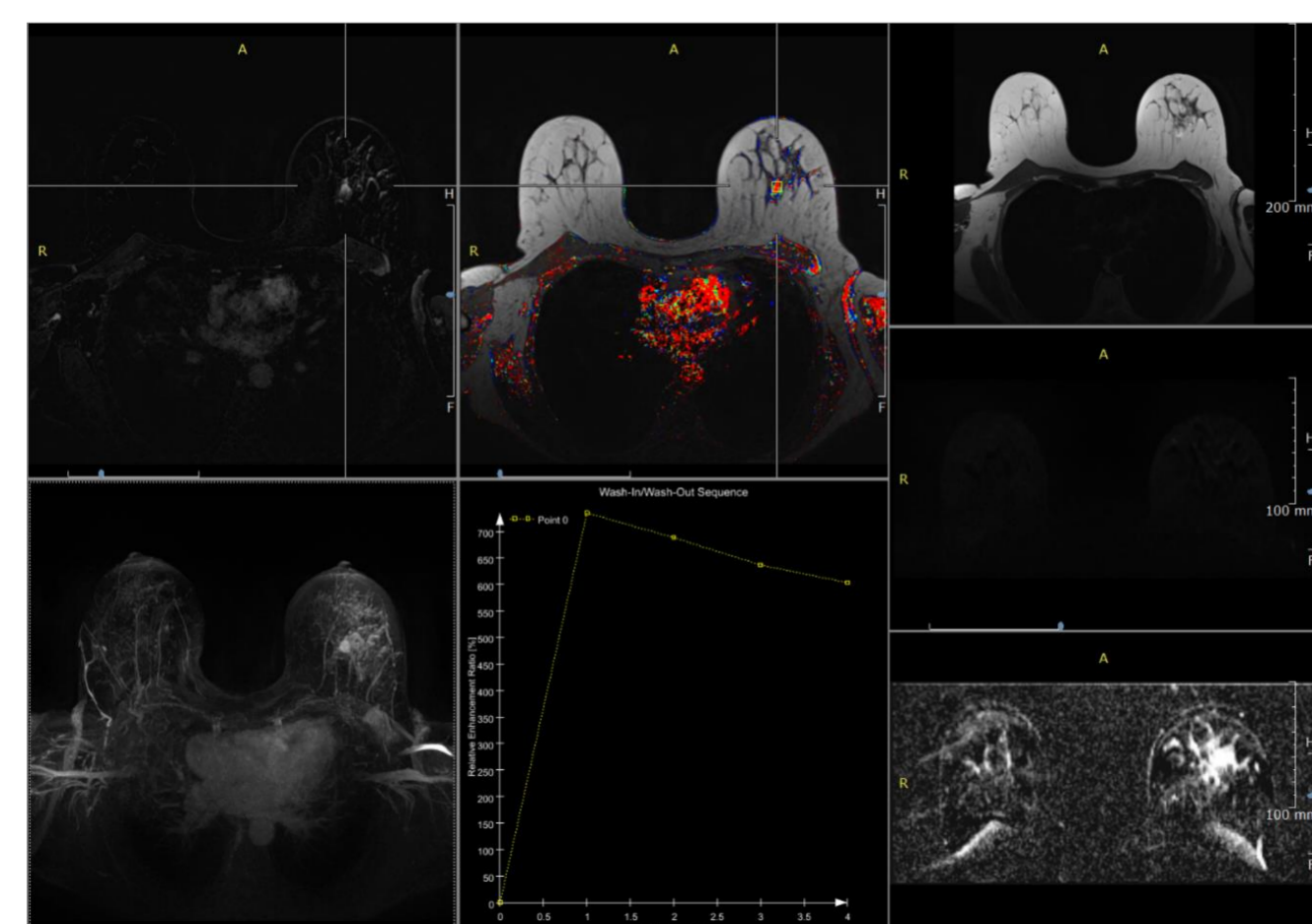


Figure 1. Full diagnostic protocol viewing station, showing dynamic VIBE T1 post-contrast (subtracted) images and MIPs, curve type analysis software, diffusion weighted imaging (b50/800) corresponding ADC maps and native T2 images were available.

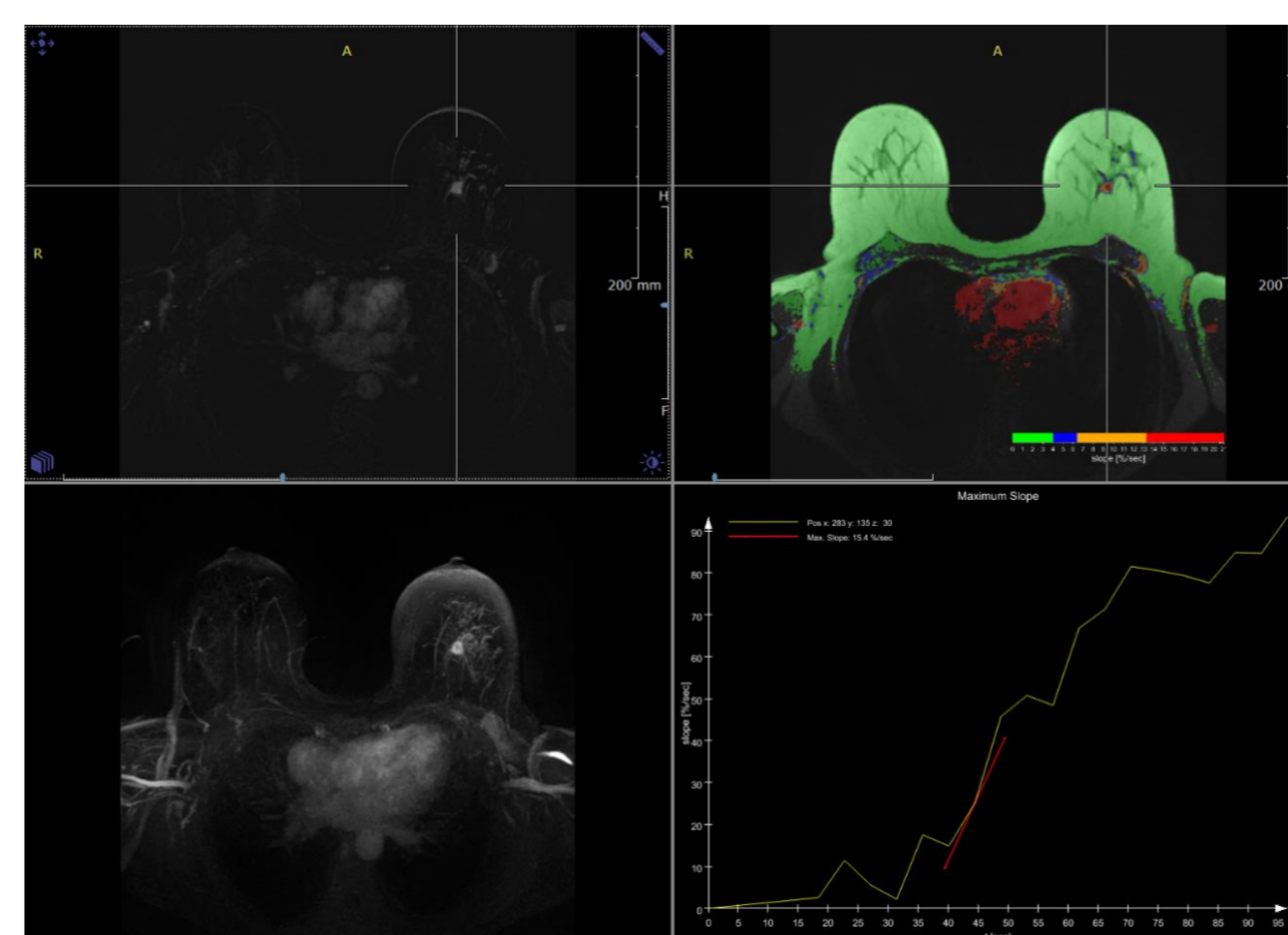


Figure 2. TWIST only viewing station for the same patient as in fig 1. The TWIST data enables morphologic analysis, and assessment of Time-to-Enhancement and gadolinium contrast agent wash-in curve types.

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Conclusion

The overall accuracy of breast cancer screening with only TWIST equals the accuracy of screening with a full diagnostic breast MRI protocol.

Reading ultrafast TWIST breast MRI only results in significantly higher specificity than a standard full diagnostic protocol including T1 dynamic CE-series, T2 and DWI.

TWIST series are acquired in less than 2 minutes and substantially reduce the time needed to acquire breast MRI for screening. Consequently, TWIST may reduce the costs of screening with breast MRI.

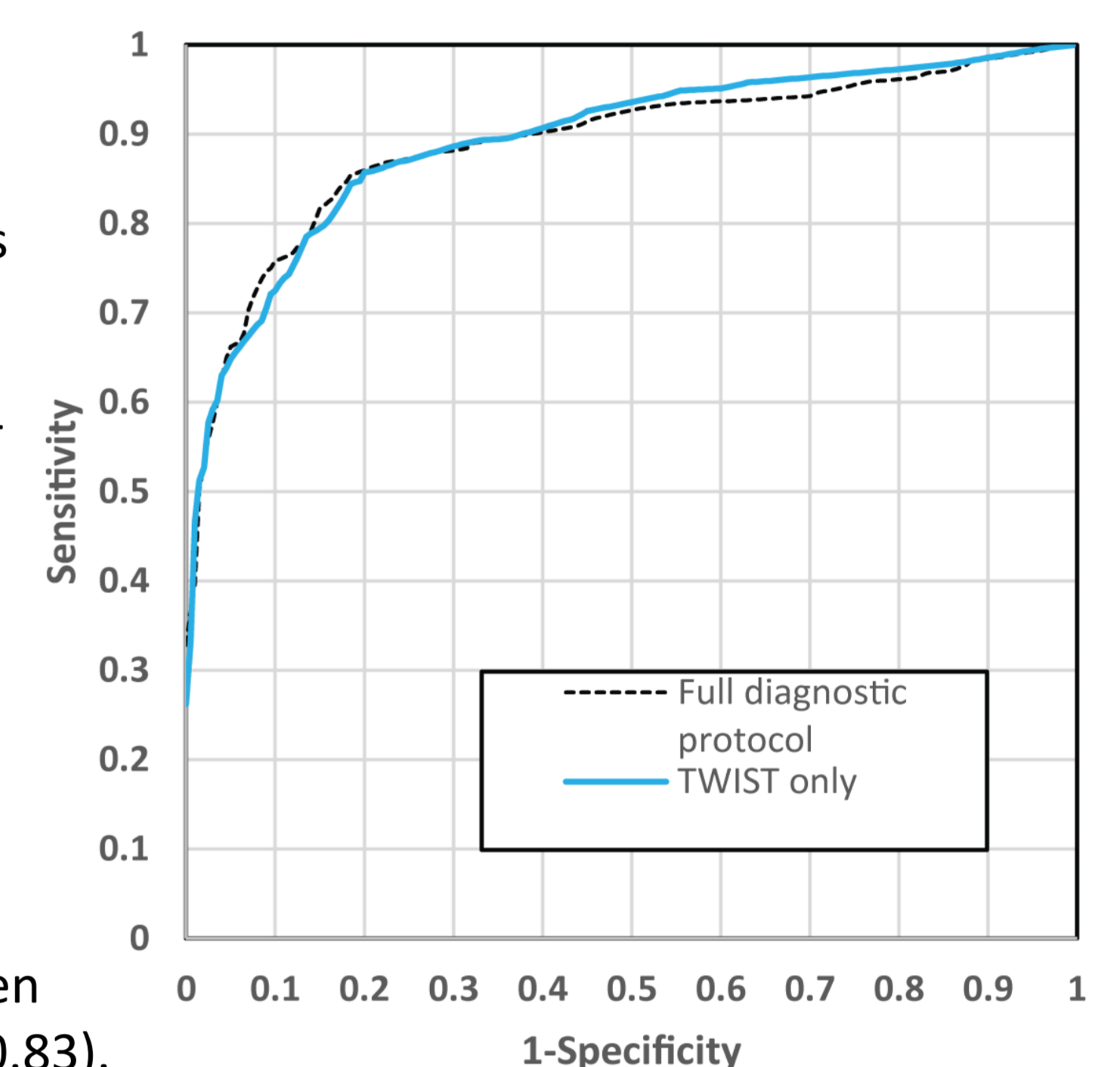
Results

Table 3 shows the performance of individual radiologists and pooled results for both FDP and TWIST.

Specificity was significantly higher in TWIST only readings than in FDP screening (average 76% vs. 81%, p<0.001).

Sensitivity was not significantly different between FDP and TWIST only reading (Average 86% vs. 84%, p=0.220).

Screening performance in terms of AUC (Graph 1) did not significantly differ between FDP and TWIST (average 0.89 and 0.89, p=0.83).



Graph 1. pooled ROC curves of TWIST only and FDP screening

Reader	Protocol	Sensitivity	Specificity	AUC	P-value (AUC)
Pooled (all 7)	FDP	86%	76%	0.890	
	TWIST	84%	81%	0.893	0.826
1	FDP	93%	77%	0.890	
	TWIST	90%	74%	0.923	0.263
2	FDP	83%	83%	0.887	
	TWIST	80%	86%	0.906	0.346
3	FDP	83%	66%	0.846	
	TWIST	80%	80%	0.880	0.364
4	FDP	87%	82%	0.902	
	TWIST	78%	85%	0.894	0.762
5	FDP	90%	70%	0.914	
	TWIST	80%	78%	0.881	0.127
6	FDP	83%	78%	0.877	
	TWIST	87%	81%	0.879	0.958
7	FDP	87%	78%	0.913	
	TWIST	90%	82%	0.891	0.497

Table3. Screening performance of all individual breast radiologists and pooled over all readers in terms of sensitivity and specificity, and area under the ROC curve (AUC).

TWIST References:
Mann et al. (2015) *Investigative Radiology*
Platel et al. (2014) *TMI*