

## Evaluation of a Novel MIRA Technology Intended for Breast Cancer Detection

Dr. Sklair-Levy M., Hadassah Medical Center, Jerusalem, Israel

**PURPOSE:** To evaluate the performance of a new Mammary Infra-Red Analysis (MIRA) breast imaging device in patients who underwent conventional breast imaging and biopsy.

**MATERIALS AND METHODS:** From May 2008 to October 2008, 67 women presenting for diagnostic mammography and/or ultrasound were recruited from Hadassah Medical Center, Jerusalem. All signed a Helsinki-approved informed consent form. Recruited women were imaged using the MIRA technology prior to conventional breast imaging or biopsy. Biopsy results served as the reference standard. The diagnostic accuracy of the MIRA technology was evaluated.

**RESULTS:** A total of 67 women with 79 lesions served as the analysis set. The reference standard showed that of the 79 lesions, 12 were malignant (8 IDC, 4 DCIS), 3 were high risk and 64 were benign. MIRA imaging detected 86.7% (13/15) of the malignant + high risk lesions and 85.9% (55/64) of the benign lesions, rendering a PPV of 59.1% and NPV of 96.5%.

**CONCLUSIONS:** These preliminary results suggest that MIRA imaging has both high sensitivity for the detection of breast pathology and high specificity in differentiating between malignant/high risk and benign findings. This indicates possible use as an adjunct tool to conventional diagnostic breast imaging. Furthermore, since MIRA technology involves a non-contact, radiation-free scan followed by quantitative analysis of the recorded signals, the results obtained using MIRA can be easily integrated in the patient's diagnosis process.

## INTRODUCTION

The MIRA technology has been developed to allow efficient automated algorithmic analysis of 3D IR images of the breast. This preliminary clinical evaluation of the MIRA technology has been conducted on diagnostic patients with breast lesions that have been evaluated with mammography and handheld ultrasonography and in some of the cases with MRI. This preliminary study was aimed at testing the ability of the MIRA technology to differentiate a sick from a healthy individual.

## MATERIALS AND METHODS

Women, aged 18 years or older, presenting for diagnostic mammography and/or ultrasound secondary to abnormal mammography, US, MRI or physical examination were recruited into the study. All subjects signed a Helsinki-approved informed consent. Each participant underwent MIRA imaging prior to the conventional diagnostic treatments recommended by the radiologist. For clinical evaluation, all conventional imaging and biopsy data were interpreted and recorded in the CRF. Positive pathology outcomes were defined as all invasive carcinomas, DCIS and high risk benign lesions. The MIRA imaging analysis consisted of two phases. The first phase rendered a general positive or negative result. The second phase rendered the side of the sick breast for those who turned out to be positive in the first phase. The MIRA imaging results were then correlated with the conventional imaging and pathology results.

## RESULTS

### **Recruitment**

A total of 67 protocol-valid patients (Table 1) with 79 biopsied lesions served as the analysis set. An additional 39 patients were imaged outside the protocol guidelines. The reasons for exclusion of these 39 patients were:

- consent withdrawals (2),
- large breast deformation (an exclusion criteria) (3),
- biopsy taken within 6 weeks prior to being enrolled (an exclusion criteria) (1),
- no biopsy done (21),
- technically defective (11),
- suspicious finding in the axilla (out of the MIRA imaging's field of view) (1)

<b>Table 1: Analysis Set Participant Characteristics (N=67)</b>	
	<b>No. of Participants (%)</b>
<b>Age. Mean (range), y</b>	49.1 (21-79)
<b>Menopausal Status</b>	
Premenopausal	37 (55.2)
Postmenopausal	30 (44.7)
<b>Personal History of Breast Cancer</b>	
Breast	5 (7.5)
Ovary	0 (0)
None or other	62 (92.5)
<b>*Family History (mother, sister, grandmother, aunt, grandmother's sister)</b>	
Breast	22 (32.8)
Ovarian	1 (1.5)
Breast and ovarian	1 (1.5)
Not known (missing data)	1 (1.5)
None or other	42 (62.7)
<b>Breast Density</b>	
1	0 (0)
2	5 (7.5)
3	37 (55.2)
4	7 (10.4)
Not known (no mammography)	18 (26.9)
<b>*Mutation Status</b>	
Tested positive for BRCA	1 (1.5)
Tested negative for BRCA	3 (4.5)
Not been tested	60 (89.5)
Not known (missing data)	3 (4.5)
<b>Reason of Arrival</b>	
Screening	44 (65.7)
Palpable mass	23 (34.3)

\* Family history and mutation status were indicated by study participants via a questionnaire.

### Summary of Biopsied Lesions

The morphological description, size and location of each lesion were recorded in the CRF. Out of the 79 lesions biopsied, a total of 15 positive lesions were found; 12 malignant lesions (invasive, 3 DCIS and 1 DCIS high grade with focus of microinvasion) and 3 high risk lesions. Of the 12 malignant lesions, 9 were masses with a mean lesion size of 1.3 cm. (range 0.5-2.6 cm.). Of the

79 biopsied lesions, 13 were morphologically characterized as calcifications and 66 as either masses or complex cysts (Table 2). The mean lesion size for the 66 masses was 1.2 cm. (range 0.4-3.0 cm.).

<b>Table 2: Finding and pathology characteristics of biopsied lesions (N=79)</b>	
	<b>No. of Participants (%)</b>
<b>Morphologic characteristics</b>	
Calcifications	13 (16.5)
Other (mass, complex cyst,...)	66 (83.5)
<b>Pathology</b>	
Malignant (IDC, ILC, DCIS)	12 (15.2)
Benign high risk*	3 (7.6)
Benign	64 (81.0)

### **Success**

MIRA imaging detected 86.67% (13/15) of the positive lesions (Table 3). The missed lesions (False Negatives) were characterized as a 0.8cm. IDC grade 2 lesion (1) and DCIS and LCIS low to intermediate grade (1). MIRA imaging detected 85.93% (55/64) of the negative lesions. The missed lesions (False Positives) were characterized as fibrocystic changes (4), fibroadenoma (3) and cyst (2). The positive predictive value (PPV) was 59.09%, the negative predictive value (NPV) 96.49% and the efficiency 85.93%.

### CONCLUSIONS

Our preliminary results suggest that MIRA imaging has both high sensitivity for the detection of breast pathology and high specificity in differentiating between malignant and benign findings. This indicates possible use as an adjunct tool to conventional diagnostic breast imaging. Furthermore, since MIRA technology involves a non-contact, radiation-free scan followed by quantitative analysis of the recorded signals, the results obtained using MIRA can be easily integrated in the patient's diagnosis process

Further studies to confirm initial results are currently underway.

10 June 2009

**Table 3: Characteristics of Patients with positive lesions (N=15), screening results and tumor stage**

Patient	Age, y	Mutation carrier	Family history	Personal history	CBE	Mammography	Ultrasound	MRI	Pathology	Size, cm
1122	51	No	-	Contralateral (8 y. ago)	NP	-	+	+	IDC grade 2	0.8
1156	62	Not tested	-	-	NP	+	NP	NP	IDC grade 2	0.9
1178	73	ND	+	-	NP	+	-	NP	DCIS + LCIS low to int. grade	*
1179	63	Not tested	+	-	NP	+	NP	NP	DCIS low grade	*
1186	60	Not tested	-	-	NP	+	+	NP	IDC grade 1	0.53
1191	62	No	-	Contralateral (1 y. ago)	NP	+	NP	-	DCIS + LCIS	*
1226	73	Not tested	-	-	+	+	+	NP	IDC grade 3	1.1
1233	60	Not tested	-	-	NP	+	+	+	IDC grade 2	0.9
1298	53	Not tested	-	-	NP	+	+	NP	IDC grade 2	0.8
1354	67	Not tested	-	-	NP	+	+	NP	IDC grade 1	1.1
1387	48	Not tested	+	-	NP	+	+	NP	DCIS high grade + focus of micro-invasion	2.6
1436	69	Not tested	-	-	+	-	+	+	IDC grade 2	2.5
1225	43	Not tested	-	-	NP	-	+	NP	**	0.45
1312	53	Not tested	-	-	NP	-	-	+	**	0.8
1389	44	Not tested	+	-	NP	+	+	NP	**	0.5

Abbreviations: ND – no data, NP – not performed, MRI – magnetic resonance imaging, IDC – invasive ductal carcinoma, DCIS – ductal carcinoma in situ

\* For patients # 1178, #1179 and #1191 no size measurement was given because finding was calcifications and not mass.

\*\* High risk pathologies:

1. Solid papilloma w/ stromal sclerosis and few foci of LCIS, ADH flat epithelial atypia, florid ductal hyperplasia and duct ectasia (patient 1225)
2. ADH, flat epithelial atypia and florid ductal hyperplasia (patient 1312)
3. Columnar cell hyperplasia w/ mild cytological atypia and flat epithelial atypia, fibrofatty breast tissue (patient 1389)