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ORIGINAL ARTICLE

CME

Microcalcifications on Screening Mammograms — Can Recall for Magnification View be Replaced by Analogue Magnification Using a Video Visualiser and Television?

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ABSTRACT

Objective: *To determine whether recall for magnification views for mammographic microcalcification can be replaced by analogue magnification using a video visualiser and standard television.*

Methods: *Mammograms of 141 patients that were positive for microcalcification were collected. The mammographic microcalcifications were correlated with histological diagnoses; 61 were malignant and 80 were benign. Eleven radiologists with training in breast imaging graded the microcalcifications by reading the standard craniocaudal and mediolateral oblique views. Magnification of the microcalcifications was achieved by using a video visualiser and standard television, and calcifications were graded according to a scale from 1 to 10 (1 = definitely benign and 10 = definitely malignant). The radiologists then regraded the mammograms with both the standard and the magnified views available. The results were analysed using receiver operating characteristic curves.*

Results: *The areas under the curves of the radiologists' performance for the 2 reading conditions were calculated; no statistically significant differences were found for 91% (10/11). The inter-rater reliabilities were high. The data for the 141 patients were collated individually by taking the means of the scores rated by the radiologists for each testing condition; no statistically significant differences were observed.*

Conclusion: *These results suggest that recall for magnification view can be replaced by analogue magnification using a video visualiser and standard television, thereby reducing the rate of recall for magnification views.*

Key Words: *Breast; Mammography; Radiographic magnification*

INTRODUCTION

Breast cancer is the main cause of death from cancer among women worldwide. Each year over 1.1 million women are diagnosed with breast cancer. The number of women diagnosed with breast cancer worldwide has almost doubled since 1975, and the incidence of breast cancer is increasing in most countries.[1-5]

The diagnosis and treatment of breast cancer at the earliest detectable stage results in a positive outcome for patients. Screening mammography has advanced to such an extent that its efficacy for the detection of early breast cancer is recognised and accepted throughout the world.[6]

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Clinical practice guidelines for radiologists recommend keeping the recall rate after screening mammography ≤10% to control costs and limit anxiety for women.[7,8]

This study was performed to examine whether recall for magnification views for mammographic microcalcification can be replaced by analogue magnification using a video visualiser (VV) and a standard television (TV), with a view to reducing the recall rate at Kwong Wah Hospital, Hong Kong. Kwong Wah Hospital is 1 of 2 hospitals that are part of the Well Women Clinics, and has the first and largest comprehensive self-referred breast screening programme in Hong Kong.[9]

METHODS

141 sets of mammograms taken using a conventional film-screen technique with the GE Senographe 600T system (GE Healthcare, Chalfont St Giles, UK) from 1998 to 2000 were collected from the Department of

Table 1. Basic image quality performance parameters.

	Contact mammogram using broad focus	Magnification views using fine focus
Target density	1.42	1.42
Background density	1.63	1.70
Contrast visibility	0.54	0.58
Number of line pairs/mm	11.00	11.00
Basic fog	0.20	0.20
Speed index	0.94	0.94
Contrast index	2.41	2.41
Maximum density	4.16	4.16

Radiology at Kwong Wah Hospital. The basic image quality performance parameters are summarised in Table 1.

All mammograms with pathologically proven microcalcifications taken from 1998 to 2000 were reviewed and 141 mammograms were identified. The pathology of all the mammographic microcalcifications was confirmed by either percutaneous stereotactic biopsy or wire-guided surgical biopsy; 61 were malignant and 80 were benign. Diagnoses of mass lesions or mass with calcifications were excluded. Eleven radiologists trained in breast imaging at the Kwong Wah Hospital, and with 5 to 29 years (mean, 8.3 years) experience graded the mammographic findings according to a 10-point scale, of 1 = definitely benign, 2 to 4 = probably benign, 5 and 6 = indeterminate with the former favouring benign and the latter malignant, 7 to 9 = probably malignant, and 10 = definitely malignant. The 10-point scale was expanded based on the Breast Imaging-Reporting and Data System grading scale.

Under standardised viewing conditions, the radiologists first read the standard craniocaudal (CC) and mediolateral oblique (MLO) views of each set of mammograms, and the magnified views were withheld. The radiologists were requested to magnify the microcalcifications by using a VV (Canon R-350PAL [Tokyo, Japan], with maximum 12 times zoom, 470,000 pixels, horizontal resolution 450 TV lines, vertical resolution 400 TV lines, signal-to-noise ratio 46 dB) [Figure 1] and TV (Toshiba 2975SH [Tokyo, Japan], cathode ray tube TV) [Figure 2] and grade the calcifications accordingly. All radiologists had training in using the VV. Following completion of all sets of mammograms, the radiologists were asked to grade the 141 sets of mammograms for a second time (time interval, 1 to 3 months), during which the standard CC and MLO views were provided, together with the magnified view (1.5 times magnification).

The 2 sets of results were analysed using the receiver operating characteristic (ROC) curve. The ROC curve

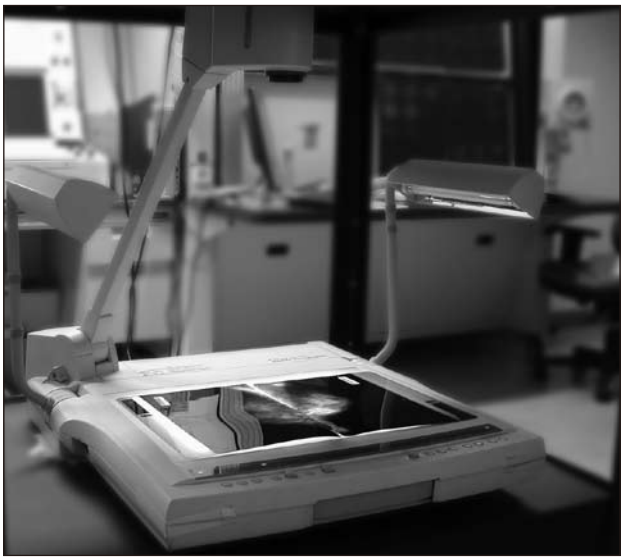

Figure 1. Video visualiser used for magnification of standard craniocaudal and mediolateral oblique views.

Figure 2. Analogue magnification of microcalcifications achieved by using a video visualiser and a television.

is a curvilinear graph generated by plotting the true-positive ratio (sensitivity) as a function of false-positive ratio (1-specificity) for a number of different diagnostic criteria or threshold levels (ranging from definitely benign to definitely malignant). The values of the areas under the ROC curves (AUC), which indicate the diagnostic accuracy of each radiologist, were analysed. The AUC of the 2 ROC curves from each radiologist were compared to assess whether there was a statistically

significant difference in diagnostic accuracy for the 2 reading conditions.

Further analysis of the general agreement of the ratings given by the 11 reporting radiologists with varied experiences in breast imaging was made by calculating the inter-rater reliabilities for each of the 2 reading conditions.

To compare the overall average performance of the reporting radiologists for each testing condition, the data for the 141 patients were collated individually by taking the means of the scores of the radiologists for each testing condition. The resultant 2 ROC curves and their corresponding AUCs were then compared.

RESULTS

ROC curves illustrating the performance of each radiologist for the standard with magnified views compared with standard views magnified by the VV and TV are shown in Table 2.

The AUC for the 11 radiologists for the standard with magnified views (AUC 1) and for the standard views magnified by VV and TV (AUC 2) were obtained and the differences between these AUCs were calculated. No significant statistical differences were shown between AUC 1 and AUC 2 ($p > 0.1$) for all but 1 of the 11 radiologists. Radiologist B, whose AUC 2 was significantly smaller than the AUC 1 ($p < 0.05$), performed better for the standard with magnified views condition than for the VV plus TV condition.

The inter-rater reliabilities using the standard with magnified views and the standard views magnified by VV and TV were high, with intra-class reliability coefficients of 0.917 and 0.931, respectively ($p < 0.001$).

Comparison of the respective AUCs for the individual collated data for the 2 testing conditions are shown in Table 3 and Figure 3; there were no significant differences between AUC 1 and AUC 2, regardless of whether or not radiologist B was included in the analysis.

DISCUSSION

The use of screening mammography in recent decades has had an impact on the detection and management of breast cancer. In 2005, Chua et al conducted a survey of 1012 Hong Kong Chinese women aged 18 to 69 years, and found that the majority (82%) of those who had heard of mammographic screening believed that it could detect early breast cancers and reduce mortality.[10] Despite a high level of acceptance of screening mammography, many women experience heightened anxiety and distress related to the screening and recall processes.[9]

Some women are recalled after screening mammography for additional procedures, such as cone compression or magnification view and ultrasound. Breast microcalcifications are commonly detected on screening mammograms. While most breast calcifications are benign, some that are indeterminate or malignant on screening studies require micro-focus (0.1 mm focal spot) magnification views in orthogonal projections. With magnification images, additional calcifications may be apparent, the morphology of individual calcifications can be characterised, and the distribution of calcifications can be better determined. In women with malignant calcifications, magnification images may be helpful for establishing the extent of disease.[11,12]

Table 2. Areas under the receiver operating characteristic curves for grading calcifications by standard with magnified views and by standard views magnified by a video visualiser and television.

Radiologist identifier	AUCs		Difference between AUCs		p Value
	Standard and magnification views (AUC 1)	Video visualiser and television (AUC 2)	(AUC 1-AUC 2)	Standard error	
A	0.704	0.698	0.00568	0.0348	0.870
B	0.829	0.763	0.06600	0.0326	0.043
C	0.816	0.756	0.06040	0.0419	0.150
D	0.679	0.685	0.00554	0.0221	0.802
E	0.739	0.759	0.01930	0.0389	0.619
F	0.743	0.791	0.04800	0.0515	0.351
G	0.583	0.562	0.02080	0.0147	0.156
H	0.694	0.740	0.04600	0.0463	0.320
I	0.744	0.766	0.02220	0.0176	0.207
J	0.769	0.782	0.01300	0.0447	0.771
K	0.840	0.850	0.00992	0.0309	0.748

Abbreviation: AUC = area under the receiver operating characteristic curve.

Table 3. Areas under the receiver operating characteristic curves of the collated data from 141 patients for grading of calcifications by standard with magnified views and by standard views magnified by a video visualiser and television.

	Standard and magnification views (AUC 1)	Video visualiser and television (AUC 2)	AUC 1-AUC 2	p Value
Collated data from 10 radiologists, excluding radiologist B				
AUC	0.8000	0.8030	0.00248	0.898
Standard error	0.0389	0.0387	0.01940	
Collated data from all 11 radiologists				
AUC	0.8170	0.8030	0.0139	0.486
Standard error	0.0376	0.0387	0.0200	

Abbreviation: AUC = area under the receiver operating characteristic curve.

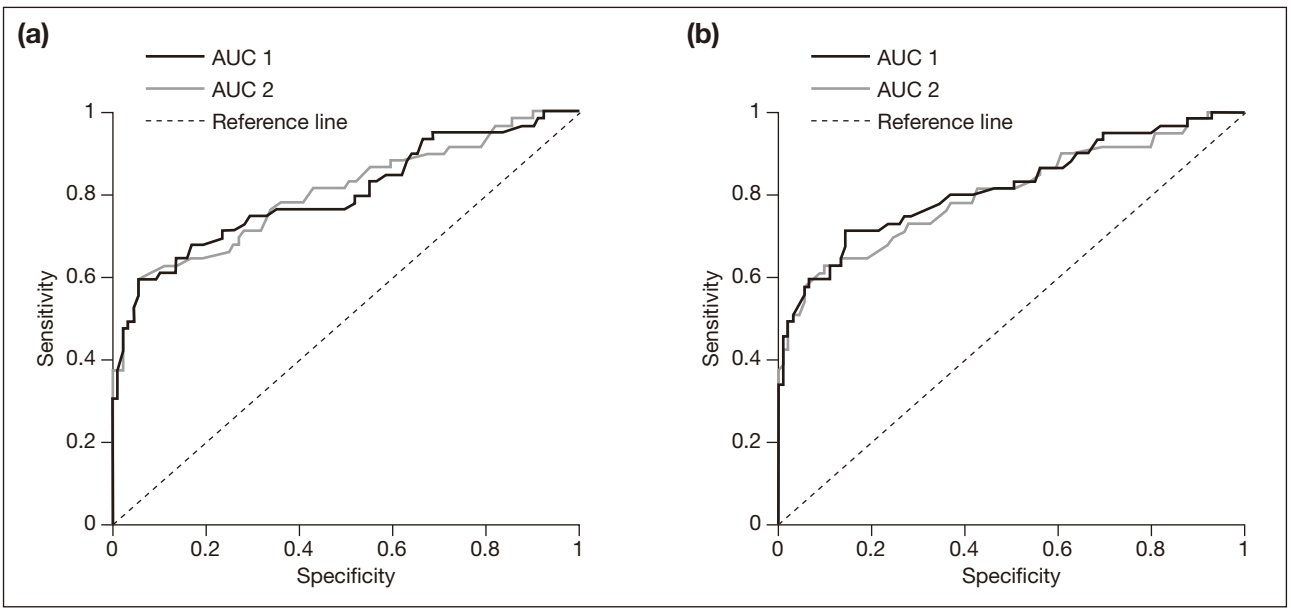

Figure 3. Areas under the receiver operating characteristic curves for (a) 10 radiologists (excluding radiologist B), and (b) all 11 radiologists. *Abbreviation:* AUC = area under the receiver operating characteristic curve.

The recent development of digital mammography has led to fewer recalls.[13] Compared with conventional film-screen mammography, digital mammography provides superior contrast resolution and dynamic range, although there is concern that the lower spatial resolution might be an obstacle for the detection and characterisation of microcalcifications.[14] Many breast screening centres have yet to acquire digital units due to resource limitations.

By comparing magnification of the microcalcifications by using a VV and TV with magnified film views using ROC analyses, this study demonstrated that there was no statistically significant difference between the interpretation of mammographic microcalcification by using a VV and TV and by reading standard views with recall magnification views.

This study was limited by the varied experience in breast imaging of the radiologists. However, this factor was unlikely to be significant. Although the junior radiologists may not have been able to correctly grade the calcifications, their knowledge base and judgement were consistent at both readings. This impression is supported by the considerably high inter-rater reliabilities.

In conclusion, using VV and TV can reduce recall rates, which may minimise patient anxiety and lighten the financial burden on health care. Larger multi-centre studies of similar study design would be beneficial prior to alteration of current practice.

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