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ORIGINAL ARTICLE **CME**

Stereotatic-guided Biopsy of Mammographic Microcalcifications: When Shall We Use Digital Add-on Unit Instead of Prone Table Machine?

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ABSTRACT

Objective: *To identify mammographic features for cases in which stereotactic-guided biopsy for breast microcalcifications failed on a prone table machine but were successful with a digital add-on unit.*

Methods: *Stereotactic-guided biopsies performed with a digital add-on unit after failure on a prone table machine between 1 January 2009 and 30 June 2013 and consecutive stereotactic-guided biopsies performed on prone table machine from 1 January 2012 to 31 March 2012 as controls were retrieved. The electronic patient records, preprocedural mammograms, stereotactic data, radiology reports, specimen characteristics, and histology of these cases were studied and the mammographic features were reviewed. Comparisons between the two groups were made using Chi-square test and independent T-test.*

Results: *A total of 54 cases performed with a digital add-on unit (mean age, 50 years) and 101 cases performed on a prone table machine (mean age, 53 years) were included. All patients were females. Five mammographic features were significantly ($p < 0.05$) associated with successful retrieval of calcification in stereotactic-guided biopsies performed with a digital add-on unit versus that on a prone table machine. These included (1) distance of microcalcification clusters from pectoralis muscle of <15 mm (35% vs. 20%), (2) size of the microcalcification clusters of ≤5 mm (57% vs. 34%), (3) number of microcalcifications of <10 (43% vs. 24%), (4) predominant microcalcification morphology of intermediate or suspicious nature (74% vs. 44%), and (5) faint density of microcalcifications (63% vs. 29%). Breast density did not demonstrate any statistically significant difference in the two groups. Similar results were obtained on comparing the two groups after only including cases with visible calcification in pathological specimens. Indication of biopsy, radiological grading, technical details, and histological outcomes showed no statistically significant difference between the two groups.*

Conclusion: *In centres where both machines are available, performing stereotactic-guided biopsy directly with a digital add-on unit should be considered for cases which demonstrate any of the five specific mammographic features described above. Further randomised trials are warranted to confirm the significance of the identified characteristics.*

Key Words: *Biopsy; Breast; Mammography; Posture; Stereotaxic techniques*

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中文摘要

乳腺微鈣化的立體定位穿刺活檢：何時使用數碼式附加組件來代替俯臥式立體定位切片機？

李芷茵、溫詠雪、呂振英

目的：探討立體定位穿刺活檢乳腺微鈣化點時，俯臥式立體定位切片機檢測失敗而在數碼式附加組件上成功檢測的病例的乳腺X線片特徵。

方法：兩組接受立體定位穿刺活檢的病人被納入本研究，其中一組於2009年1月1日至2013年6月30日期間未能在俯臥式立體定位切片機，而只有在數碼式附加組件上成功進行活檢的病人。另一組則於2012年1月1日至2012年3月31日期間所有在俯臥式立體定位切片機上成功活檢的病人。研究比較兩組病人以下的資料：電子病歷、檢測前乳房X光片、立體定向數據、放射學報告、標本特點和病例的組織學；並回顧她們的乳腺X線片特徵。採用卡方檢驗和獨立樣本T檢驗進行組間比較。

結果：使用數碼式附加組件的有54例，病人的平均年齡為50歲；而使用俯臥式立體定位切片機的有101例，病人的平均年齡為53歲。所有患者均為女性。比較數碼式附加組件和俯臥式立體定位切片機兩種方式，有五個乳腺X線片特徵與成功取樣鈣化點顯著相關（$p < 0.05$），它們分別是：微鈣化簇與胸大肌的距離少於15毫米（35%比20%）、微鈣化簇為5毫米或以下（57%比34%）、微鈣化數量少於10（43%比24%）、中度或疑似惡性性質的以微鈣化為主的形態學（74%比44%），以及微鈣化密度低而模糊（63%比29%）。兩組的乳房密度並無任何統計學顯著差異。如果只將病理標本中可見鈣化點的病例納入研究範圍，兩組之間的比較亦得到相似的結果，即活檢指徵、放射學分級、技術細節和組織學結果均無統計學的顯著差異。

結論：如果中心同時有俯臥式立體定位切片機和數碼式附加組件，而病例乳腺X線片上出現上述五項特徵的其中任何一項時，便應考慮使用數碼式附加組件進行立體定位穿刺活檢。須進行更多研究來確認這些特徵的重要性。

INTRODUCTION

Breast malignancy can be diagnosed in women following detection of microcalcifications at mammography. In addition, pre-invasive disease such as ductal carcinoma in situ as well as high-risk lesions such as atypical ductal hyperplasia, lobular carcinoma in situ, and atypical lobular hyperplasia can all manifest as mammographic calcifications. Early diagnosis of these lesions can reduce the mortality associated with breast malignancy.[1] For microcalcifications showing intermediate or suspicious degree of suspicion on mammography, stereotactic-guided percutaneous biopsy is preferred; this largely replaces the role of surgical biopsy in obtaining histological diagnosis.

Stereotactic-guided percutaneous biopsy can be performed with an add-on unit or on a dedicated prone table machine. The prone table machine is preferred in many centres, including in our centre, as the success rate can be increased by better immobilisation of the breasts and there is higher acceptance rate among the patients.[2] However, in some cases, procedural failure is encountered, suggesting that the prone table machine also has limitations.

In the Kwong Wah Hospital breast centre, both a digital add-on unit and a dedicated prone table machine are available. Stereotactic-guided biopsy is first attempted on the prone table machine. If this is associated with failure, biopsy is attempted and performed with a digital add-on unit. As no previous information is available to suggest when we shall use a digital add-on unit instead of a prone table, we aimed to identify mammographic features in cases for which stereotactic-guided biopsy failed on a prone table machine but were successful with a digital add-on unit; these features may be related

to the limitations of a prone table machine.

If such cases can be identified, performing stereotactic-guided biopsy directly with a digital add-on unit may be considered in centres where both machines are available. This will serve to save procedural time, minimise radiation, reduce discomfort to patients, and reduce the chance of delayed diagnosis. Ethics committee approval by Kowloon West Cluster of Hospital Authority of Hong Kong was obtained for this retrospective study. Informed consent was waived.

Figure 1. Prone table machine (Lorad MultiCare Prone Biopsy Table, Hologic) used in our breast centre.

METHODS

Patient Population

Stereotactic-guided biopsies performed with a digital add-on unit (erect table) for mammographically detected breast microcalcifications between 1 January 2009 and 30 June 2013 were retrospectively identified by searching through the hospital radiological information system, using the key words "stereotactic", biopsy", and "erect/upright/add-on unit". Cases performed with a digital add-on unit due to mechanical failure of the prone table were excluded. Consecutive stereotactic-guided biopsies for breast microcalcifications performed on a prone table machine during the period 1 January 2012 to 31 March 2012 were retrieved as control. In both groups, only cases for which preprocedural digital mammograms were available were included. Patients' demographic data including age, sex, and history of any contralateral or ipsilateral breast malignancy were retrieved from the hospital electronic patient records.

Figure 2. Digital add-on unit (Digital Stereo Loc, Hologic) used in our breast centre.

Stereotactic-guided Biopsy Procedure

All stereotactic-guided biopsies were performed on either a prone table machine (Lorad MultiCare Prone Biopsy Table, Hologic; Hologic Inc., USA) [Figure 1] or with a digital add-on unit (Digital Stereo Loc, Hologic; Hologic Inc., USA) [Figure 2]. Biopsies were performed by dedicated radiologists specialising in breast imaging or trainee radiologists under the supervision of trainers. The decision of procedural failure on a prone table machine was judged by the radiologist-in-charge. Biopsy devices were either core biopsy by a 14-gauge biopsy gun (Pro-Mag Ultra Automatic biopsy instrument; Angiotech, Denmark) or a 10-gauge vacuum-assisted biopsy device (EnCor Breast Biopsy System; Bard Biopsy Systems, USA), chosen by the radiologist-in-charge, depending on patient's factors. Specimen radiographs were acquired in all cases to look for the presence of calcification. Indication of biopsy as well as technical details including projection during biopsy, mean breast thickness during compression, mean target Z-value, mean number of specimens obtained, and presence of calcification in the radiology specimen were noted from the radiology reports and stereotactic images. Presence of any calcification in the pathological specimen and final specimen pathology was retrieved from radiology and histology reports.

Image Acquisition and Processing

Preprocedural mammograms were retrieved from the Tung Wah Group Well Women Clinic or Kwong Wah Hospital Picture Archiving and Communication System database. Mammograms taken in the Tung Wah Group Well Women Clinic were performed with a full-field digital mammography unit (Selenia Digital Mammography, Hologic or Dimensions 2D Full-Field Digital Mammography, Hologic; Hologic Inc., USA) with mediolateral oblique and craniocaudal projections. Mammograms taken in Kwong Wah Hospital were performed with a full-field digital mammography unit (Selenia Digital Mammography, Hologic; Hologic Inc., USA) with mediolateral, mediolateral oblique, and craniocaudal projections. Magnified mediolateral or craniocaudal views of the targeted microcalcification cluster were available.

All mammograms were reviewed by two radiologists blinded to the method of biopsy using a workstation (SecurView, Hologic; Hologic Inc., USA); discrepancies were resolved by discussions. Mammographic breast density was recorded according to the Breast Imaging–Reporting and Data System classification and assigned into two groups: entirely fatty or with scattered fibroglandular density, and, heterogeneously dense or extremely dense. Distance of microcalcification clusters from the pectoralis muscle was measured by the shortest perpendicular distance from the pectoralis muscle or edge of the film on magnified mediolateral or craniocaudal views (Figure 3). Size of the microcalcification clusters was measured as its maximal dimension on a magnified view (Figure 4). Number of microcalcifications present in the cluster was recorded in groups of <10, 10-20, or >20. Predominant morphology of microcalcifications in the cluster was recorded as benign (including round or punctate), of intermediate concern (including amorphous, indistinct, sand-like, or coarse heterogeneous) or suspicious (including pleomorphic). Density of the microcalcifications was classified as faint if there was no obvious calcified focus in the cluster standing out from the adjacent breast tissue.

A radiological grading was given to each case according to the Royal College of Radiologists Breast Group classification system and assigned into two groups: no-to-low–risk group (category 1-2) and moderate-to-high–risk group (category 3-5).

Statistical Analysis

Comparisons of indications, mammographic features

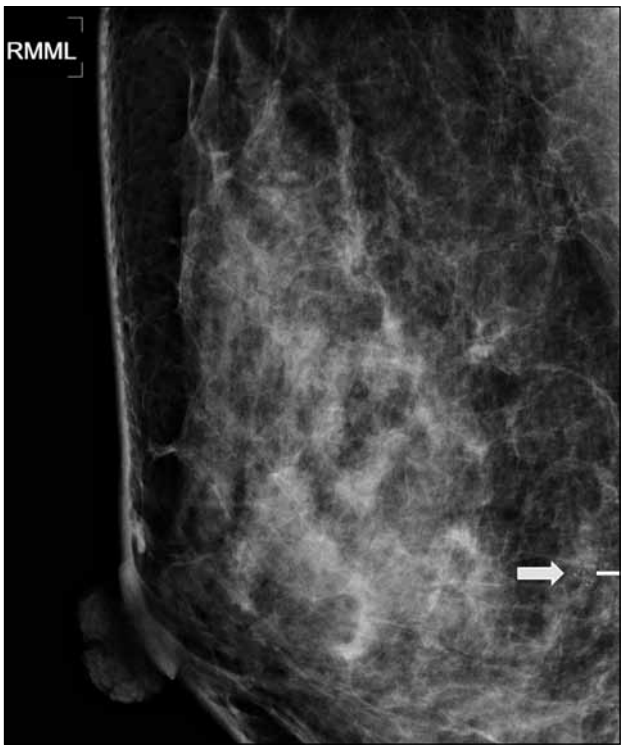

Figure 3. The targeted cluster of microcalcifications is shown (arrow). The white line shows how measurement of the shortest perpendicular distance from the edge of the film on magnified mediolateral view is performed.

Figure 4. The white line shows how the maximal dimension of the same microcalcification cluster is measured.

(breast density, distance of microcalcification clusters from the pectoralis muscle, size of the microcalcification clusters, number of microcalcifications, predominant morphology of microcalcifications, and density of the microcalcifications), radiological grading, technical details (biopsy device used, projection during biopsy, mean breast thickness during compression, mean target Z-value, mean number of specimens obtained, and presence of any calcification in the radiological specimen), and histological outcomes (presence of any calcification in the pathological specimen and final specimen pathology that altered surgical intervention) between the two groups were analysed by Chi-square test or independent T-test. Similar comparisons were performed after only including cases with visible calcification in pathological specimens.

Statistical analyses were also performed on the two groups separately to compare the effect of all the variables on the success in retrieval of calcification in pathological specimen, using Chi-square test, Fisher's exact test, or independent T-test.

All tests were performed using computer software SPSS 16.0 (SPSS Inc., USA) and $p < 0.05$ was considered statistically significant.

RESULTS

On searching through our hospital radiological information system using the key words "stereotactic", "biopsy", "erect/upright/add-on unit", 62 cases were retrieved. Of these, eight were excluded for the following reasons: no preprocedural digital images (n=3), use of digital add-on unit due to mechanical failure of prone table machine (n=2), biopsies performed for mammographically detected density (n=2), and only fine-needle aspiration cytology was obtained during the procedure (n=1). A total of 54 cases were included in the stereotactic biopsies performed with digital add-on unit group. All patients were female, with a mean age of 50 (standard deviation [SD], 6; range, 40-72) years.

A total of 126 consecutive stereotactic-guided biopsies for breast microcalcifications performed on a prone table machine during the period 1 January 2012 to 31 March 2012 were retrieved by case registration database as controls. Of these, 15 cases without preprocedural digital images and 10 cases with biopsies performed for mammographically detected density were excluded. Finally, 101 cases were included in the stereotactic biopsies performed on prone table machine group. All patients were female, with a mean age of 53 (SD, 7; range, 35-75) years.

Table 1. Comparison of background factors between the two groups.

Background factor	No. of patients*		p Value
	Digital add-on unit (n=54)	Prone table machine (n=101)	
Indication			0.307
History of breast malignancy	9	11	
Others	45	90	
Radiological grading			0.312
No-to-low–risk group	19	44	
Moderate-to-high–risk group	35	57	
Technical details			
Biopsy device			0.937
Core biopsy needle	52	97	
Vacuum-assisted biopsy	2	4	
Projection during biopsy			0.702
LM	39	70	
ML	9	22	
CC or reversed CC	6	9	
Mean breast thickness during compression (mm)	37.4	40.6	0.094
Mean target Z-value	26.9	26.5	0.789
Mean No. of specimen obtained	9.9	9.6	0.667
Presence of calcification in radiological specimen	47	96	0.075
Histological outcomes			
Presence of calcification in the pathological specimen	44	89	0.259
Final specimen pathology altered surgical intervention	7	16	0.631

Abbreviations: CC = craniocaudal; LM = lateromedial; ML = mediolateral.
* Unless otherwise indicated.

Comparisons of indications, radiological grading, technical details, and histological outcomes showed no statistically significant difference between the two groups for these background factors (Table 1). In particular, calcification retrieval rates by positive calcification in radiological specimens and pathological specimens were 87% and 81%, respectively in the digital add-on unit group, and 95% and 88%, respectively in the prone table machine group; these were not significantly different in the two groups.

Each of the mammographic features was analysed by separating the factors using subsets or cutoff values, and the difference between the number of successful biopsies with such mammographic features between two groups was calculated accordingly (Table 2). Breast density, namely fatty or scattered fibroglandular versus heterogeneously or extremely dense, did not demonstrate any statistically significant difference between the two groups. The chances of successful retrieval of microcalcification was significantly higher in the digital add-on unit versus the prone table machine group when the microcalcifications were located at a distance of less than 15 mm from the pectoralis muscle,

Table 2. Comparison of the mammographic features between digital add-on group versus prone table machine group in all cases.

Mammographic feature	No. (%)		p Value
	Digital add-on unit (n=54)	Prone table machine (n=101)	
Breast density			0.087
Fatty or scattered fibroglandular	13 (24)	38 (38)	
Heterogeneously or extremely dense	41 (76)	63 (62)	
Distance of microcalcification cluster from pectoralis muscle			<0.05
<15 mm	19 (35)	20 (20)	
≥15 mm	35 (65)	81 (80)	
Size of the microcalcification cluster			<0.05
<5 mm	31 (57)	34 (34)	
≥5 mm	23 (43)	67 (66)	
No. of microcalcifications			<0.05
<10	23 (43)	24 (24)	
≥10	31 (57)	77 (76)	
Predominant morphology of microcalcifications			<0.05
Benign	14 (26)	57 (56)	
Intermediate or suspicious	40 (74)	44 (44)	
Density of the microcalcifications			<0.05
Faint	34 (63)	29 (29)	
Not faint	20 (37)	72 (71)	

Table 3. Comparison of the mammographic features between digital add-on group versus prone table machine group in all cases with visible calcification in pathological specimens.

Mammographic feature	No. (%)		p Value
	Digital add-on unit (n=44)	Prone table machine (n=89)	
Breast density			0.069
Fatty or scattered fibroglandular	10 (23)	33 (37)	
Heterogeneously or extremely dense	34 (77)	56 (63)	
Distance of microcalcification cluster from pectoralis muscle			<0.05
<15 mm	15 (34)	15 (17)	
≥15 mm	29 (66)	74 (83)	
Size of the microcalcification cluster			<0.05
<5 mm	24 (55)	28 (31)	
≥5 mm	20 (45)	61 (69)	
No. of microcalcifications			<0.05
<10	19 (43)	16 (18)	
≥10	25 (57)	73 (82)	
Predominant morphology of microcalcifications			<0.05
Benign	12 (27)	48 (54)	
Intermediate or suspicious	32 (73)	41 (46)	
Density of the microcalcifications			<0.05
Faint	25 (57)	27 (30)	
Not faint	19 (43)	62 (70)	

the size of microcalcifications was less than 5 mm, and the number of microcalcifications was less than 10 ($p < 0.05$). The morphology of the microcalcifications also differed significantly between the groups with calcifications of intermediate or suspicious nature being significantly more prevalent in the digital add-on unit group versus the prone table machine group. Similarly, the density of microcalcifications was significantly different across the groups with faint microcalcifications more frequently seen in the digital add-on unit group than with the prone table machine group.

Similar results were obtained on comparing the two groups after only including cases with visible calcification in pathological specimens (Table 3).

Effect of all the variables on the success of retrieval of calcification in pathological specimens was calculated within each group independently (Table 4). It was shown that within the cases in the prone table machine

Table 4. Effect of all variables on the success of retrieval of calcification in pathological specimen in both groups.

	Digital add-on unit			Prone table machine		
	No. (%)*		p Value	No. (%)*		p Value
	Positive Ca^{++} (n=44)	No Ca^{++} (n=10)		Positive Ca^{++} (n=89)	No Ca^{++} (n=12)	
Indication			0.183			0.122
History of breast malignancy	9 (20)	0 (0)		8 (9)	3 (25)	
Others	35 (80)	10 (100)		81 (91)	9 (75)	
Radiological grading			0.728			0.446
No-to-low–risk group	15 (34)	4 (40)		40 (45)	4 (33)	
Moderate-to-high–risk group	29 (66)	6 (60)		49 (55)	8 (67)	
Technical details						
Biopsy device			0.339			0.402
Core biopsy needle	43 (98)	9 (90)		86 (97)	11 (92)	
Vacuum-assisted biopsy	1 (2)	1 (10)		3 (3)	1 (8)	
Projection during biopsy			0.051			0.456
LM	35 (80)	4 (40)		60 (67)	10 (83)	
ML	5 (11)	2 (20)		8 (9)	1 (8)	
CC or reversed CC	4 (9)	4 (40)		21 (24)	1 (8)	
Mean breast thickness during compression (mm)	38	37	0.865	41	39	0.564
Mean target Z-value	27	27	0.916	27	26	0.789
Mean No. of specimen obtained	11	7	<0.05	10	10	0.579
Presence of calcification in radiological specimen	40 (91)	7 (70)	0.109	86 (97)	10 (83)	0.075
Histological outcomes						
Final specimen pathology altered surgical intervention	7 (16)	0 (0)	0.325	16 (18)	0 (0)	0.205
Mammographic features						
Breast density			0.689			0.760
Fatty or scattered fibroglandular	10 (23)	3 (30)		33 (37)	5 (42)	
Heterogeneously or extremely dense	34 (77)	7 (70)		56 (63)	7 (58)	
Distance of microcalcification cluster from pectoralis muscle			0.728			0.058
<15 mm	15 (34)	4 (40)		28 (31)	6 (50)	
≥15 mm	29 (66)	6 (60)		61 (69)	6 (50)	
Size of the microcalcification cluster			0.489			0.212
<5 mm	24 (55)	7 (70)		15 (17)	5 (42)	
>5 mm	20 (45)	3 (30)		74 (83)	7 (58)	
No. of microcalcifications			1.000			<0.05
<10	19 (43)	4 (40)		16 (18)	8 (67)	
>10	25 (57)	6 (60)		73 (82)	4 (33)	
Predominant morphology of microcalcifications			1.000			0.221
Benign	12 (27)	2 (20)		48 (54)	9 (75)	
Intermediate or suspicious	32 (73)	8 (80)		41 (46)	3 (25)	
Density of the microcalcifications			0.072			0.501
Faint	25 (57)	9 (90)		27 (30)	2 (17)	
Not faint	19 (43)	1 (10)		62 (70)	10 (83)	

Abbreviations: Ca^{++} = calcification; CC = craniocaudal; LM = lateromedial; ML = mediolateral.
* Unless otherwise indicated.

group, when number of microcalcifications is less than 10, there would be significantly lower success of calcification retrieval in pathological specimen ($p < 0.05$). None of the mammographic features demonstrated statistical significance in the digital add-on unit group for retrieval of calcifications in pathological specimen. However, within the cases in digital add-on unit group, the lower mean number of specimens obtained was significantly correlated with negative calcification in pathological specimen.

DISCUSSION

Percutaneous stereotactic-guided breast biopsy has become an accepted alternative to open surgical biopsy with proven efficacy and safety for breast lesions that are detected on mammography.[3,4] Commonly, percutaneous stereotactic-guided breast biopsy can be performed on a dedicated prone table machine or with an add-on unit to a standard mammographic unit that converts into a stereotactic biopsy system. Prone table is preferred in many centres because it was believed that it helps minimise the patient's anxiety as the patient is unable to observe the procedure in progress. In addition, it is believed to be associated with increased tolerance and minimal movement during the procedure. Vasovagal reactions are also less likely with the procedure.[2,5,6] In contrast, the advantages of an add-on unit include its small size, flexibility, and relatively low cost. Nowadays, the add-on unit is designed so that biopsy can be performed while the patient is sitting upright or lying in the lateral decubitus position. The decubitus system combines some advantages of the prone table, such as reducing the rate of syncope.[7] Previous studies have shown that the conventional mammographic unit with an add-on stereotactic device is comparable with a dedicated prone biopsy table in sensitivity, specificity, accuracy, and safety.[8-12] One study on digital upright stereotactic core biopsy of mammographic microcalcifications demonstrated that the specimen calcification yield is similar when using an add-on unit compared with a prone table machine.[13] Reported overall tolerance also demonstrated no significant difference between biopsies performed in the sitting or the prone position.[14] Choice between a dedicated prone table machine or an add-on unit, thus, depends on the treatment centre.

In our centre, both a dedicated prone table machine and a digital add-on unit are available. Biopsy is usually performed or attempted on a prone table machine. When the performing radiologist is unable to locate the lesion on a prone table, biopsy will be attempted and performed with a digital add-on unit. Our study characterised the mammographic features of microcalcification clusters in these difficult cases, which also likely represent the limitations of a prone table machine.

Our results demonstrated that when the micro-calcification cluster is closer to pectoralis muscle, its retrieval is more likely to fail on a prone table. From the statistical analysis, we defined the cut-off value at 15 mm. A previous study by Philpotts et al[15] showed a number of biopsies that were cancelled on the prone table machine because of suboptimal location including lesions located posteriorly. Lee et al[16] recommended surgical biopsy instead of stereotactic biopsy if a lesion is too close to the chest wall. According to Cousins et al,[5] it is difficult to visualise very posteriorly located lesions and lesions that are located deep in the axillary tail of the breast on a prone table machine. This problem is more significant when the breast is too thin or of small size,[5,15,16] which is commonly encountered in the Asian population. Our study demonstrated high success rate with the digital add-on unit in such posteriorly located lesions that are close to the pectoralis muscle. We attribute this to the high flexibility in positioning the patient with an add-on unit, thus facilitating the retrieval of microcalcifications located close to the chest wall or axillary tail.

Our result also demonstrated that microcalcification clusters measuring less than 5 mm, number of microcalcifications less than 10, microcalcifications which are predominantly of intermediate or suspicious morphology and microcalcifications of faint density are more likely to be associated with failure of retrieval on the prone table. In previous studies, Jackman and Rodriguez-Soto[17] showed that lesion size of less than 5 mm can lead to failure of retrieval of microcalcification on a prone table machine. Reynolds et al[18] reported the use of minimum lesion size of 5 mm for stereotactic biopsy of microcalcifications using a 14-gauge core biopsy. Mainiero et al[19] reported that rates of calcification retrieval increased with increasing size of the lesion and increasing number of calcifications, although they did not demonstrate statistical significance. Lee et al[16] do not recommended stereotactic biopsy for vague or poorly defined lesions. According to Ward et al,[10] low-density lesions would have been more problematic for biopsy but no difference was seen between low- or high-density

lesion groups in biopsy performed with an add-on unit. We propose that small microcalcification cluster size, small number of microcalcifications, vague or poorly defined microcalcifications as well as too faint microcalcifications will lead to difficulty in lesion identification on prone table machine due to the limited resolution of the machine; however, these are likely to be less problematic with a digital add-on unit which has higher resolution giving images of higher diagnostic quality.

Our calcification retrieval rates by positive calcification in radiological specimens and pathological specimens in both digital add-on unit group and prone table machine group were comparable with those reported in the literature.[13,19,20] Similar results were obtained for cases with or without calcification in pathological specimens, reflecting consistency with our study findings. It is also interesting to note that fewer specimens obtained in the digital add-on unit group demonstrated statistical significance in failure of retrieval of calcification in the pathological specimen, which is consistent with another study.[17]

There are several limitations in this retrospective study. Firstly, the number of cases performed with a digital add-on unit is limited compared with those performed on a prone table machine, as it is considered the second choice in our unit, thus limiting the sample size in the study. Secondly, there are cases that failed on a prone table machine but did not proceed to an add-on unit due to various reasons, such as refusal by patient, which potentially can lead to sampling bias; however, such cases were few. Besides, there are no guidelines to judge when a biopsy has failed on a prone table machine; this was determined by the experience of the radiologist-in-charge. However, we believe that most of our radiologists are more experienced in performing biopsy on a prone table machine compared with an add-on unit, therefore performing biopsy on probe table machine is preferred, thus, justifying the decision of biopsy failure on prone table machine. Thirdly, there were variations in the technical details of each biopsy, including the biopsy device and projection during biopsy, but comparison of these factors did not show statistical significance between the two groups. Technical variation between how mammograms were taken by different radiographers may also be a concern, which may affect the distance we measured. But we assumed that each radiographer would try his / her best to include the most posterior aspect of the breast in the film taken. Lastly, we did not include or investigate those cases that were not successful on both prone table machine and add-on unit, as well as those cases performed for architectural distortion or density detected on mammography; further studies are required for investigating such cases.

CONCLUSION

We identified five mammographic characteristics which were significant in cases that failed stereotactic-guided biopsy for breast microcalcifications on prone table machine but were successful with digital add-on unit. These include (1) distance of microcalcification clusters from the pectoralis muscle of less than 15 mm, (2) size of the microcalcification clusters of less than 5 mm, (3) number of microcalcifications of less than 10, (4) microcalcifications which are predominantly of intermediate or suspicious morphology, and (5) microcalcifications of faint density. In centres where both machines are available, performing stereotactic-guided biopsy directly with digital add-on unit should be considered for cases which demonstrate any of the five specific mammographic features described above to save procedural time, minimise radiation, reduce discomfort to patients, and reduce the chance of delayed diagnosis. Further randomised trials are warranted to confirm the significance of the identified characteristics.

DECLARATION

No conflicts of interests were declared by authors.

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