Hong Kong J Radiol. 2011;14:4-9

ORIGINAL ARTICLE

CME

Stereotactic Biopsy of Thin Breasts: a Previously Unfeasible Task

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ABSTRACT

Objective: *To illustrate a new standard on how an Air-Gap Technique could be practically adopted for stereotactic-guided core biopsy on thin Asian breasts (using a homemade foam board), which was not a previously feasible task.*

Methods: *This prospective study was carried out at The Breast Centre of Kwong Wah Hospital, Hong Kong for women presenting between 1 July 2009 and 30 June 2010. All women scheduled for prone-table stereotactic core biopsy (Lorad Co, Danbury [CT], US) targeting breast microcalcifications in compressed breasts of thickness <30 mm and negative or marginal calculated stroke margins identified by short-throw biopsy needles (14G, 14-mm stroke margin, Pro-Mag 1.4; MD-Tech Inc., Gainesville, US) were recruited. An Air-Gap Technique was used for these women. It entailed a homemade foam board (12.5 mm thick), with an aperture corresponding to that on the front compression paddle, inserted between the breast and the posterior compression plate so as to allow bulging and mild mobility at the far side of the breast. The main outcome measure was the success rate in breast microcalcification retrieval; the presence of a biopsy needle puncture wound at the back of the breast was also analysed.*

Results: *During the study period, six Chinese women had breast biopsies performed with our Air-Gap Technique. Their original compressed breast thickness values ranged from 13.4 mm to 28.4 mm and after foam board insertion the thickness increased up to 43.2 mm. Before foam board insertion, the shortest stroke margin in these cases was about 5 mm. A 14G short-throw biopsy needle was used in all instances. All the cases showed calcification in specimen radiographs, while none had puncture wounds over the skin on the far side.*

Conclusion: *In the past, stereotactic core biopsy on thin breasts with thickness of less than 3 cm (not uncommon in Asian women) was regarded as unfeasible. The literature did suggest several manoeuvres (more needle pullback before firing, peripheral pressure on the breast forcing more tissue inside the front compression paddle aperture, skin hook used to pull the lesion and the adjacent tissue towards the front, and injection of generous amount of local anaesthetics to increase breast thickness) to accomplish this task. However, the results are generally unsatisfactory, regardless of the manoeuvres used whether singly or in combination. Better outcomes may be obtained using the lateral arm attachment of certain machines such as the prone biopsy table by Fischer Imaging (Denver [CO], US). Under our existing biopsy machine without a lateral arm, our modified homemade Air-Gap Technique has been shown to be safe and effective for biopsy of lesions previously deemed not feasible due to thinness of the breast. This technique is likely to be particularly helpful for achieving early diagnoses without unnecessary uncertainty in Asian women, many of whom have thin breasts.*

Key Words: *Biopsy, needle; Breast neoplasms; Mammography; Stereotaxic techniques*

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Submitted: 27 Sep 2010; Accepted: 1 Mar 2011.

中文摘要

偏薄乳房立體定向活檢：以往不可行的任務

方俊仁、麥詠詩、呂振英、林漢城

目的：以往替乳房偏薄的亞洲婦女進行立體定向穿刺切片檢查並不可行。本研究描述一種利用自製泡沫板作空氣間隔法（Air-Gap Technique）的可行性。

方法：本前瞻性研究於2009年7月1日至2010年6月30日期間在廣華醫院的乳房中心進行。對象為乳房壓後厚度少於30毫米，及經短距活檢針（14G, 14-mm stroke margin, Pro-Mag 1.4; MD-Tech Inc., Gainesville, US）確認stroke margin為負數或呈邊際值的，同時已預約進行俯臥式乳房立體定位活組織穿刺切片檢查（Lorad Co，Danbury [CT] ，US）以檢查乳腺鈣化的病人。我們替病人進行空氣間隔法作活檢。方法是利用一塊自製泡沫板，厚度為12.5毫米，中間有一個與前壓迫板相對應的孔。把泡沫板夾在乳房與後壓迫板中間來讓乳房遠側有鼓起及少量活動性。主要結果測量為找出乳腺鈣化的成功率，並檢視病人乳腺遠側是否遺留活檢穿刺針傷口。

結果：研究期間共有六位華籍婦女經空氣間隔法接受乳腺活檢。病人原來的乳房壓後厚度介乎13.4毫米至28.4毫米之間，加入泡沫板後，厚度最多增加至43.2毫米。未加入泡沫板前，最短的stroke margin約為5毫米。所有病例均用14號短距活檢針。所有病變標本在放射線影像中呈乳腺鈣化，且未發現在乳腺遠側遺留穿刺針傷口。

結論：以往為乳房壓後厚度少於30毫米（亞洲婦女中並不少見）的病人進行立體定向穿刺切片被認為是不可行的。文獻中提及數種為乳房偏薄的病人進行活檢的方法，包括發射前把穿刺針再進一步往後拉、在乳房周圍加壓令更多組織推入前壓迫板孔、利用皮膚鈎把病灶及旁邊組織拉向前、注入較多麻醉劑來增加乳房厚度。可是，即使採取以上一項甚至同時多項的方法，效果並不理想。使用某些儀器的橫臂附件例如Fischer Imaging（Denver [CO] ，US）的俯臥式活檢台可能會有更佳效果。本研究證明在用無橫臂附件的活檢儀的條件下使用改良自製泡沫板作空氣間隔法是安全的，而且對於乳房偏薄而不能進行常規活檢的病人是有效的。這種方法能夠為乳房偏薄的亞洲婦女盡早作出診斷，以免導致病人不必要的憂慮。

INTRODUCTION

Worldwide, breast cancer is the commonest malignancy in women. According to World Health Organization, 1.38 million new cases were projected for 2008 and 1.6 million for 2015.[1] In Hong Kong, the incidence of breast cancer has gradually increased and accounted for 24% of all female cancers in 2007.[2] Because of this worsening trend, further work has been advocated internationally, with a view to achieving lower mortality by way of earlier cancer detection and earlier treatment.

Before it is clinically palpable, early breast cancer detection at the in-situ stage is possible by identifying microcalcifications clusters, masses, and / or abnormal asymmetrical densities in mammograms. For a breast lesion showing suspicious imaging features, a histological diagnosis is always recommended. For decades, needle-localised biopsy was recognised as the standard method and more cost-effective than the surgical approach.[3,4] If the tumour is not visible in magnetic resonance imaging (MRI) or ultrasound, however, stereotactic guidance will be the only resort for percutaneous biopsy.

According to a recent large-scale study in Hong Kong, there was a failure to retrieve calcifications in up to 7.5% of patients who had percutaneous stereotactic biopsy.[5] About one-fifth of such failures were due to unfavourable location of the calcification and 8.4% were secondary to the use of short-throw needles in patients with thin breasts.

As stated in the literature, several manoeuvres can be employed to increase the compression thickness of thin breasts and in turn reduce failures to retrieve calcifications.[6-8] The aim of this study was to illustrate

how a modified 'Air-Gap Technique' could be utilised in percutaneous biopsy for microcalcifications in relatively thin Asian breasts.[9]

METHODS

This prospective study was performed in Kwong Wah Hospital, Hong Kong. Patients' clinical and mammographic findings were discussed in multidisciplinary meetings involving radiologists and breast surgeons. Study patients were recruited from women scheduled for prone-table stereotactic core biopsy (Lorad, Danbury [CT], US) for breast microcalcifications from 1 July 2009 to 30 June 2010. The subjects had to have a compressed breast thickness of less than 30 mm and negative or marginal calculated stroke margin as determined by short-throw biopsy needle (14G, 14 mm stroke margin, Pro-Mag 1.4, MD-Tech Inc., Gainesville, US).

Our Air-Gap Technique was achieved by using a homemade soft foam board (Figure 1) inserted between the breast and the posterior compression plate to allow mild soft tissue mobility and bulging at the far side of the breast. The foam board measured 12.5 mm in thickness and had an aperture at the top, which corresponded to the compression paddle at the front.

The breast was then compressed again with the foam board inserted (Figures 2, 3) and the target was relocated under stereotactic guidance. The coordinates of the target, including X-Y-Z values, were re-obtained. Percutaneous needle biopsy was then performed using

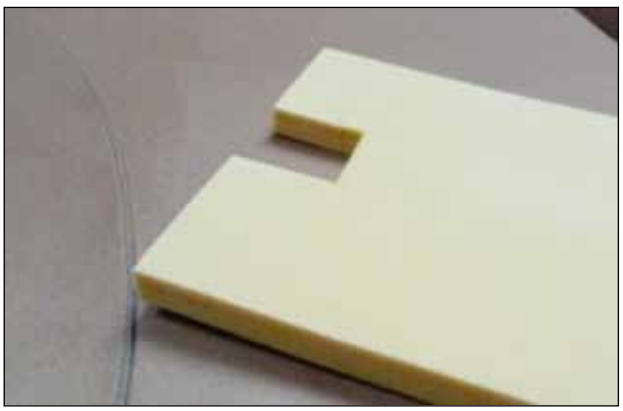

Figure 1. The homemade soft foam board used for Air-Gap Technique in stereotactic-guided percutaneous biopsy for thin breasts. The board measured 12.5 mm thick, with a 3.8 cm x 3.8 cm aperture at the top corresponding to the position of the front compression paddle.

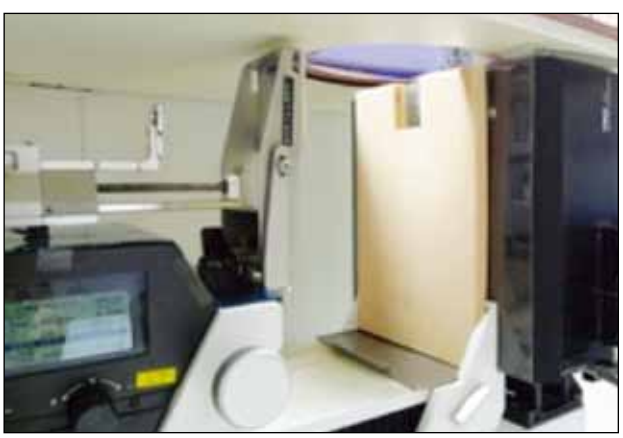

Figure 2. The foam board inserted in front of the posterior compression plate of the Lorad prone biopsy table and ready for biopsy with Air-Gap Technique. Note that the aperture at the foam board corresponds to that at the front compression paddle.

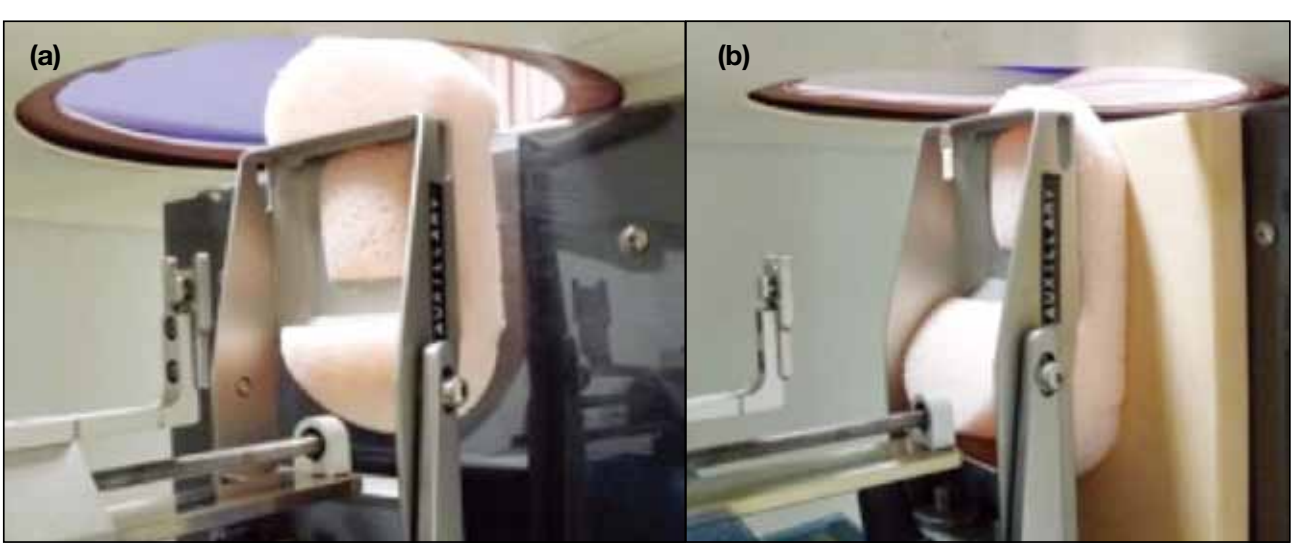

Figure 3. (a) A sponge used to simulate a compressed breast at the Lorad prone biopsy table without using the foam board for Air-Gap Technique. (b) The foam board was inserted between the sponge and the posterior compression plate.

Table. Results of six women having stereotactic-guided core biopsy using modified Air-Gap Technique.

Case	Original breast thickness (mm)	Original target Z value (mm)	Calculated stroke margin (mm)	Breast thickness after foam board insertion (mm)	Presence of calcification in specimen radiograph	Skin injury at far side
A	28.4	24.8	15.6	43.2	Yes	No
B	25.4	25.5	11.9	36.8	Yes	No
C	22.4	29.4	5	34.9	Yes	No
D	13.4	20.7	4.7	23.6	Yes	No
E	21.8	18.8	15	35.5	Yes	No
F	21.2	21.1	12.1	35.3	Yes	No

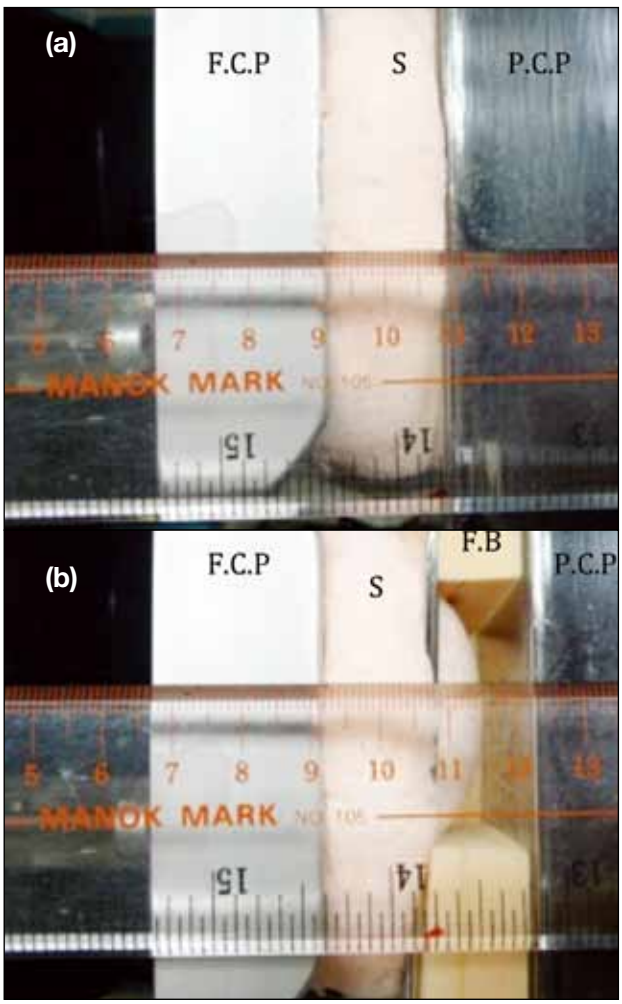

Figure 4. (a) A picture viewing from the top of prone biopsy table demonstrating a compressed sponge (S) simulating a compressed breast with thickness of about 2 cm without foam board inserted. (b) After foam board insertion, the thickness of the compressed sponge increased to about 2.5 cm.
Abbreviations: F.C.P = front compression paddle; P.C.P = posterior compression plate; F.B = foam board.

an automatic biopsy needle with the tip pointing at the target, as would perform without the use of the Air-Gap Technique. A successful procedure was defined as the presence of target calcification(s) present in the specimen radiograph. The distance of the deepest target from the Zero reference point on the front compression paddle along the needle direction (i.e. the Z value of the target coordinates), type of biopsy needle used, and the newly compressed breast thickness as well as its original thickness were recorded. Skin on the far side of the breast was examined at the end of procedure for the presence of any biopsy needle puncture wound.

RESULTS

Six Chinese women at our Breast Centre had stereotactic-guided breast biopsies utilising our Air-Gap Technique, all of whom had compressed breast thicknesses of <30 mm and had negative or marginal calculated stroke margins despite the use of short-throw biopsy needles (Table). Because of variable tissue bulging inside the aperture of the foam board and unreliable new stroke margin estimates, the new Z value after foam board insertion was not recorded in the Table, although this had been utilised for targeting the lesion during the biopsy.

Among these six patients, the thinnest compressed breast thickness before the foam board insertion was 13.4 mm while the thickest measured 28.4 mm. With our Air-Gap Technique, the compressed breast thicknesses ranged from 23.6 mm to 43.2 mm (Figure 4). A 14G short-throw biopsy needle (14G, 14 mm stroke margin, Pro-Mag 1.4; MDTech Inc.) was used in all cases without pullback before firing. The calculated stroke margins using the short-throw needle before foam board insertion ranged from 5 to 15 mm.

In all instances, the target calcifications were present in the specimen radiographs. No subject manifested any symptoms or signs of biopsy needle injury (pain or erythema), nor was there any puncture wound to the skin at the far side of the breast on detailed

physical examination after the procedure.

DISCUSSION

Stereotactic percutaneous biopsy on a thin breast generally referred to a breast compression thickness of <30 mm. In the past, this type of biopsy was considered difficult or even unfeasible. However, due to genetic factors and / or lifestyle differences, the breasts of many Asians are generally thinner than those of Caucasians. It is therefore not uncommon to encounter women with thin breasts showing suspicious mammographic findings (microcalcification clusters, masses, or densities) that require further evaluation. In some subjects, other imaging modalities (ultrasound or MRI) can be tried to avoid difficult stereotactic guidance with forceful compression. Regrettably, not every lesion can be visualised with these imaging techniques and not every facility is equipped with MRI biopsy kits even if lesions are detected by MRI. Due to these limitations, tackling breast lesions in unfavourable locations under X-ray guidance seems to be the only way to help these patients.

In breast centres where a prone biopsy table is available, percutaneous tissue sampling for women with a compressed breast thickness greater than 30 mm is generally straightforward. By contrast, biopsying thinner breasts could be challenging and a nightmare for both radiologists and patients. Local anaesthesia is generally adequate for skin close to the biopsy needle insertion point but not for skin over the far side of the breast. If the tip of the biopsy needle accidentally hits the skin at the far side due to a posteriorly located target in a thin breast, it could cause pain and sometimes leave puncture wounds that patients and relatives regard as unacceptable. In the worst scenario, the biopsy needle could be damaged by hitting the posterior compression plate resulting in failure to retrieve the target lesion.[10]

To avoid unnecessary injury to the patient and target retrieval failure, some literature suggests injecting generous amount of local anaesthetic to increase the breast thickness, while other sources recommend using a skin hook to pull the lesion and adjacent tissue towards the front. These methods, however, mainly aim at increasing the breast thickness at the front of the target, and in our experience had limited bearing on minimising needle injury to the posterior skin. Other methods included more needle pullback before firing, as well as pressure applied at the periphery of the compressed breast before biopsy needle firing, to push as much breast tissue as possible along the tract of needle and increase the breast thickness, in general have not proved satisfactorily either.

Because the Lorad prone biopsy table does not support a lateral arm attachment,[11] among the solutions previously suggested, the Air-Gap Technique seemed to be the best method of tackling the problem in our setting. With our homemade foam board inserted, all the cases in this study had successful biopsies, and there was no needle injury to the skin at the far side encountered. Although we could not accurately measure the thickness of posterior breast tissue bulging in the aperture of the foam board, it was estimated to be at least 5 mm more than that without the Air-Gap Technique. In addition, mild mobility allowed for posterior breast tissue inside the aperture further decreased the chance of such needle injury to the breast.

As stated in our previous study, about 1.5% of all cases in stereotactic-guided breast biopsy failed due to unfavourable location of calcification, and slightly more than 0.6% failed secondary to the use of a short-throw needle for patients with thin breasts.[5] These two causes of retrieval failure were intrinsic and could not be corrected by technical adjustments. The success of the current study illustrates how a previously unfeasible scenario can now be successfully overcome.

Although we were only able to recruit six cases in this study, this study illustrates how an Air-Gap Technique using our homemade foam board had a practical application for stereotactic-guided core biopsies for women with thin breasts. Using the experience from cases in this study, we can even consider utilising the Air-Gap Technique in other scenarios such as vacuum-assisted breast biopsy, which generally require much thicker breast tissue to be successful.[12]

CONCLUSION

Our Air-Gap Technique is a safe and effective means of performing biopsy on suspicious lesions previously determined as unfeasible due to limited breast thickness, and thus potentially helping more women by reducing unnecessary uncertainty and to achieve early diagnosis and treatment.

ACKNOWLEDGEMENTS

We would like to express our sincere thanks to Dr LK Chan, Consultant Radiologist, and Miss Anna Leung, Radiographer, Department of Radiology, Kwong

Wah Hospital, for their excellent work in helping the production of this paper.

DECLARATION

The authors declare that no direct or indirect financial interest in the subject matter discussed in this paper.

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