

Stereotactic Vacuum-Assisted Biopsy of Microcalcifications Using an Upright Add-On Type Stereotactic Mammography Unit¹

Sung Hun Kim, M.D., Jae Hee Lee, M.D., Byoung Joo Song, M.D.², Sang Seol Jung, M.D.²

Purpose: This study examined the yield of mammographically detected calcifications following a stereotactic vacuum-assisted biopsy (SVAB) using an upright add-on type stereotactic device.

Materials and Methods: Ninety-two women underwent a SVAB between April 2002 and December 2005, and 90 calcifications obtained by the SVAB were evaluated retrospectively. The calcification retrieval rate was examined. The false negative and underestimation rates were determined by comparing the biopsy results with the results from surgery and follow-up mammography.

Results: The calcification retrieval rate was 97.8% (90/92). The histopathology of the 90 lesions was benign for 66 (73.3%), borderline for 3 (3.3%) and malignant for 21 (23.3%). A total of 22 malignancies were confirmed surgically. SVAB had a false negative rate of 4.5 % (1/22). The underestimation rate of a surgically excised atypical ductal hyperplasia (ADH) and of ductal carcinoma in situ (DCIS) was 50% (1/2) and 10% (2/20), respectively.

Conclusion: The use of SVAB with an upright add-on type stereotactic device is an efficient biopsy method for mammographically detected microcalcifications, with low false negative and high calcification retrieval rates.

Index words : Biopsy, needle
Breast neoplasms
Stereotaxic techniques
Calcification, physiological

A stereotactic core needle biopsy using a prone type device is a widely used technique for the diagnosis of nonpalpable breast lesions discovered by mammography (1 - 3). An add-on device attached to a regular mammography unit can be used for a stereotactic breast biopsy.

Its advantages are that it is less expensive than a prone table and extra space for the equipment is unnecessary (3).

There is a paucity of reports on the effectiveness of the use of stereotactic biopsies in Korea (4, 5). One report dealt with a 14G core needle biopsy of non-mass calcifications using a prone-type dedicated stereotactic mammography unit (4), and another study examined a core needle biopsy of a mass or calcifications using an add-on type stereotactic device (5). Neither report dealt with a vacuum-assisted breast biopsy.

¹Departments of ¹Radiology and ²General Surgery, Kangnam St. Mary's Hospital, College of Medicine, The Catholic University of Korea
Received May 30, 2007 ; Accepted July 19, 2007
Address reprint requests to : Jae Hee Lee, M.D., Department of Radiology, Kangnam St. Mary's Hospital, The Catholic University of Korea, 505 Banpo-dong, Seocho-gu, Seoul 137-040, Korea
Tel. 82-2-590-2944 Fax. 82-2-599-6771 E-mail: heerad@catholic.ac.kr

We report our 3-year experience of performing biopsies using a combination of a vacuum-assisted device (VAD) and an upright add-on type stereotactic mammographic unit for mammographically detected microcalcifications.

Materials and Methods

Between April 2002 and December 2005, 92 women (age 27 - 79 years, mean 50 years) underwent a stereotactic vacuum-assisted biopsy (SVAB) for microcalcifications. None of the lesions was either palpable or associated with masses on mammography. The categories according to the American College of Radiology Breast Imaging Report and Data System (ACR BI-RADS) on the pre-biopsy mammographic reports were Category 3 for 4 cases, Category 4 for 84 cases, and Category 5 for 4 cases.

One radiologist (J.H.L) examined 60 cases (65%), and two radiologists, who had expertise in breast imaging and intervention, examined the remaining cases. Stereotactic guidance was obtained using an OpDima Digital Stereotactic add-on attached to an upright mammography unit (Mammomat 3000, Siemens, Solna, Sweden) (Fig. 1A). An 11-gauge VAD Mammotome probe (Ethicon Endo-Surgery, Cincinnati, OH U.S.A.) was used as the biopsy device. Before scheduling an SVAB, the mammographic images were reviewed in order to determine the feasibility of a SVAB with special consideration given to the breast size as well as to the location and conspicuity of the calcifications. Written informed consent was obtained from all patients. The patients were advised of the indications, contraindications, benefits, and risks such as a hematoma and vasovagal reactions, as well as the possibility of insufficient sampling requiring re-biopsy or surgery. The patients were also recommended not to take aspirin or any other anti-coagulant drugs for three days before the procedure date. We did not routinely examine the blood profile for coagulation function.

Before the procedure, both the stereotactic mammographic unit and the VAD were checked carefully. Before compressing the breast for the biopsy, the patient was advised to keep calm and not move after targeting the calcifications. The patient sat in a special chair, which could be adjusted forward and backward and recline like a bed. The radiologist and radiographer that were present during the procedure attempted to make the patient feel as comfortable as possible. In order to

prevent the patient from being startled or frightened by the sound of the VAD during the procedure, the radiographer allowed the patient to hear the VAD in its active state before the procedure. The craniocaudal (CC) position was preferred if the calcifications were located in the upper portion of the breast as that procedure was easier for the radiologist to perform, and there was less chance of the downward spilling of blood. If the calcifications were located at a level that was lower than the nipple, either the lateromedial (LM) or the mediolateral (ML) position was chosen according to the location of the calcifications. A single spot mammogram was taken and the position was adjusted accordingly to move the calcifications to the center of the field (Fig. 2A). If the calcifications were in a favorable position, stereotactic double mammograms of the lesion were taken at $\pm 10^\circ$ from the zero position. Calcifications were targeted on the stereotactic images on a digital monitor, and numerical coordinates were calculated to localize the lesion in three dimensions. The skin in the window of the compressed paddle was disinfected with povidone and alcohol. An 11G VAD needle was attached to the add-on type stereotactic device and the location of the needle was adjusted according to the numerical coordinates on the digital screen (Fig. 1B). Local anesthesia was provided without administering any medicine for the sedative effects. For skin anesthesia, 2% lidocaine was used. For the deeper portions, a 5 - 10 cc mixture of 1% lidocaine was infused with 0.1 cc of a 1:100,000 epinephrine solution. Before the skin incision, the stereotactic views were obtained in order to verify the location of the needle. A 3 - 4 mm skin incision was then made with a scalpel. An 11G needle was inserted to the level of $z = 0$. Stereotactic views were again obtained (Fig. 2B) and the needle was fired if the location was favorable (Fig. 2C). Ten to 12 samples were obtained. The direction of the needle insertion was controlled with special consideration being given to the needle and the calcifications. After sampling, stereotactic views were obtained in order to ensure that the targeted calcifications had been removed (Fig. 2D). If the biopsy of the targeted calcifications were unsatisfactory, more cores were further obtained in consideration of the locations of the needle and the calcifications. If the calcifications were removed completely, a microclip (MicroMark; Ethicon Endo-Surgery) was placed at 5 mm above the biopsy site. If the calcifications remained, we did not place a microclip. Subsequently, the compression paddle was released and the biopsied breast was compressed for ap-

proximately 10 - 20 minutes for hemostasis. Specimen radiography was also performed (Fig. 2E) and specimens containing calcifications were placed in a separate container. In case the calcifications were not shown on specimen mammography, we did not retry performing the SVAB and recommended a surgical excisional biopsy.

A surgical excision was performed if the biopsy result revealed a malignancy or a borderline lesion. Atypical ductal hyperplasia (ADH) and an intraductal papilloma with atypism were included in the borderline category. Patients with benign pathology were advised to undergo a close mammographic follow-up.

The retrieval rate for a calcification observed at specimen mammography was examined. The false negative and underestimation rates for the SVAB were also evaluated. A benign or borderline pathology on a SVAB was regarded as a "false-negative" if it was found to be a malignant lesion after surgery. An SVAB diagnosis of a borderline lesion with a surgical diagnosis of an in situ or invasive carcinoma, or an SVAB diagnosis of an in situ carcinoma with a surgical diagnosis of invasive carcinoma was regarded as a "histological underestimation". We also evaluated the procedure-related complications

such as bleeding and vasovagal reactions.

Results

Calcifications were observed in 90 of the 92 cases (97.8%) by specimen mammography. The calcifications could not be retrieved in two cases as one calcification was too close to the chest wall ($n = 1$) and the other lesion was too superficial for SVAB ($n = 1$). The latter lesion was followed-up for 1 year at 6-month-intervals and did not show any interval changes. The former lesion underwent a surgical excision after needle localization due to an interval increase in the number of calcifications on the follow-up mammograms that was found to be due to fibrocystic disease.

Of the 90 cases where retrieval of the calcifications was successful, the pathological diagnoses were malignant in 21 cases (23.3%), borderline in 3 cases (3.3%), and benign in 66 cases (73.3%). All pathological results were concordant to the imaging findings. Surgery was performed in 24 cases. Table 1 gives a comparison of the pathological diagnoses by SVAB and surgery.

Of the 21 cases of malignancy diagnosed by SVAB, 20 cases (95%) were due to a ductal carcinoma in situ



Fig. 1. The instruments used for the stereotactic vacuum assisted biopsy

A. The Opdimat Digital Stereotactic Add-on unit is attached to the film-screening mammography.

B. A vacuum assisted device with an 11-gauge needle is set on the Mammomat 3000, and the numeric coordinates are displayed.

(DCIS) and only 1 case (5%) was an invasive ductal carcinoma. Of the 21 cases, 17 patients underwent subsequent definitive surgical treatment at our institution. Four patients underwent surgery in another hospital, and final pathologies were obtained by contacting the patients as well as the radiologists of the other hospitals. Of the 20 DCIS cases, two (10%) were upgraded to an

invasive ductal carcinoma after surgery (Table 1): one lesion was a 0.3 cm-sized invasive component with a 3.4 cm-sized intraductal component and the other lesion revealed a 0.3 cm-sized invasive component with a 1 cm diameter intraductal component. Both lesions contained mainly intraductal components. One invasive ductal carcinoma on biopsy showed the same result on a surgi-

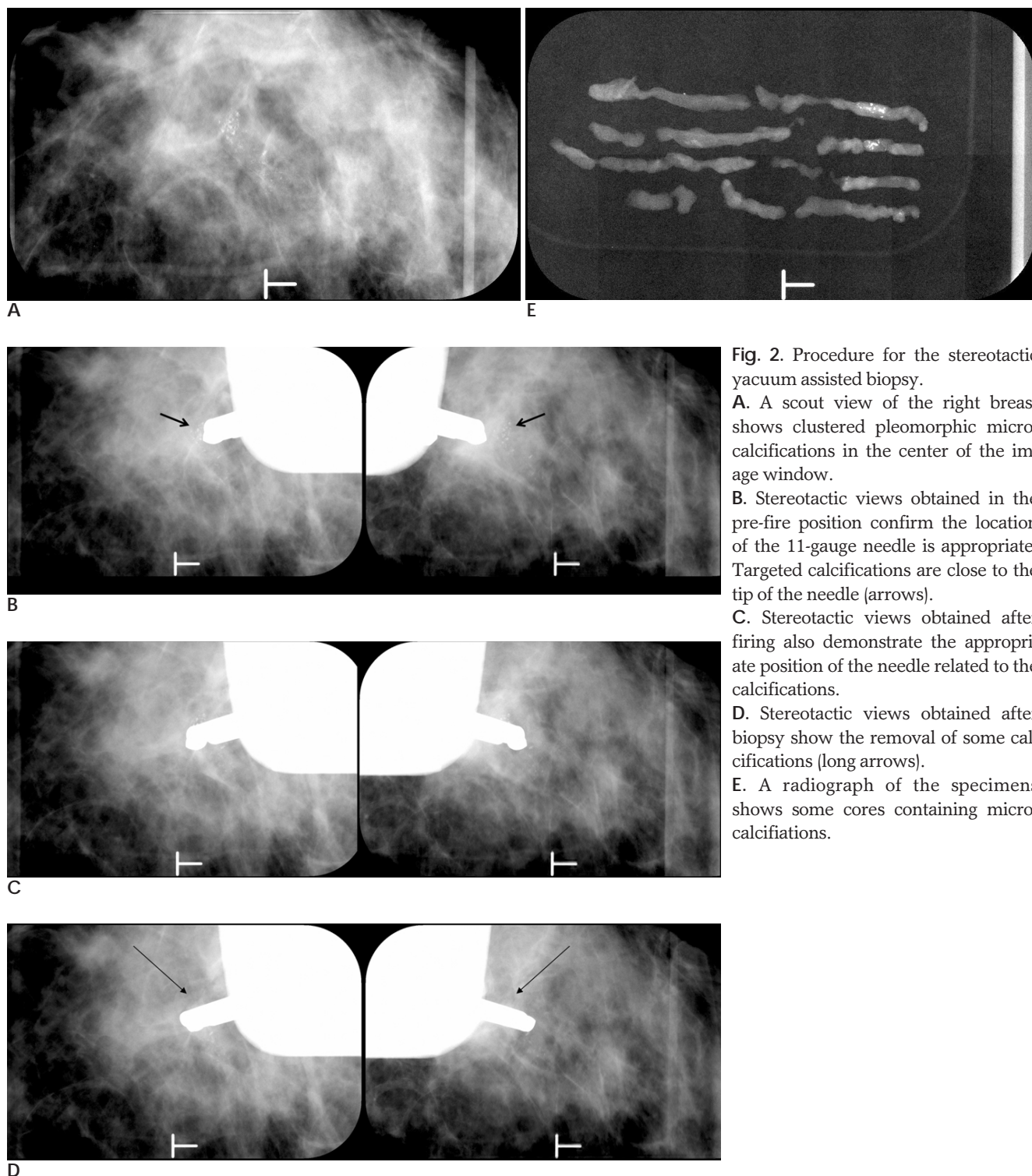


Fig. 2. Procedure for the stereotactic vacuum assisted biopsy.

A. A scout view of the right breast shows clustered pleomorphic microcalcifications in the center of the image window.

B. Stereotactic views obtained in the pre-fire position confirm the location of the 11-gauge needle is appropriate. Targeted calcifications are close to the tip of the needle (arrows).

C. Stereotactic views obtained after firing also demonstrate the appropriate position of the needle related to the calcifications.

D. Stereotactic views obtained after biopsy show the removal of some calcifications (long arrows).

E. A radiograph of the specimens shows some cores containing microcalcifications.

Table 1. Comparison of the Diagnoses by SVAB and Surgery

SVAB diagnosis	Number	Surgical Diagnosis			
		Benign	ADH	DCIS	IDC
Benign	66	1			
ADH	2	1		1	
Papilloma with atypism	1				
DCIS	20			18	2
IDC	1				1

Note - Surgery was not performed in one case of papilloma with atypism.

SVAB = Stereotactic vacuum assisted biopsy

ADH = Atypical ductal hyperplasia

DCIS = Ductal carcinoma in situ

IDC = Invasive ductal carcinoma

cal pathology (Table 1). The three borderline cases included two instances of an atypical ductal hyperplasia (ADH) and one instance of an intraductal papilloma with atypism. Of the three cases diagnosed as borderline by SVAB, one patient having an intraductal papilloma with atypism had a mammographic follow-up and showed no change over a 24-month period. Excisional biopsies were performed on two patients with an atypical ductal hyperplasia that revealed fibrocystic changes with ductal hyperplasia in one patient and a ductal carcinoma in situ in the other patient (Table 1).

A total of 22 malignancies were confirmed by surgery. The false negative rate of SVAB for diagnosing a malignancy was 4.5 % (1/22). The underestimation rate of surgically excised borderline lesions and for a ductal carcinoma in situ was 50% (1/2) and 10% (2/20), respectively.

Of the 66 benign cases, 62 cases, 2 cases, 1 case and 1 case showed fibrocystic changes, ductal hyperplasia, stromal fibrosis, and an intraductal papilloma, respectively. Of the benign cases, an excisional biopsy was performed on one patient because the patient wanted to remove the calcifications. The diagnosis from that biopsy was fibrocystic disease. The mammographic follow-up in 34 of the 66 benign patients (52.3%) for a period of 6-48 months (mean of 9.5 months) revealed no interval increase in the number or size of calcifications or the development of new areas of calcifications.

The procedure-related complications included bleeding and vasovagal reactions. Profuse bleeding during the procedure required compression for more than 30 minutes in 8 cases (8.9%) with hemostasis being successfully achieved in all cases using manual compression. Hematomas observed on the post biopsy mammography were detected in only three cases and none required surgical intervention. Vasovagal reactions developed in 6 cases (6.7%). The symptoms of a vasovagal re-

action included nausea, shortness of breath, numbness of the extremities, and fainting. These symptoms generally occurred at the end of the procedure and we ended the procedure. Vasovagal reactions were relieved completely after rest in the supine position while engaging in deep respiration.

Discussion

Calcifications have been shown to be a component in up to 50% of malignant lesions and in 84% of ductal carcinomas in situ (DCIS) (6). Calcifications detected by mammography remain a diagnostic problem, as precise differentiation between benign and malignant lesions is difficult with clusters of microcalcifications (7). Therefore, image-guided biopsy is essential for mammographically detected suspicious microcalcifications. A stereotactic guided core needle biopsy is used preferentially in the United States (3). However, in Korea, dedicated prone-type stereotactic equipment is not as popular due to its high cost. An stereotactic breast biopsy can be performed with a dedicated prone table with its main advantage being that it can hold the breast rigidly and the patient can be biopsied in the prone position, which is more comfortable than the sitting position (3). However, its drawbacks include a very high cost and incompatibility with routine mammography. An add-on device attached to a regular mammography unit can be used for a stereotactic breast biopsy. Its advantages are that it is less expensive than a prone table and extra space for the equipment is unnecessary. However, patient movement and anxiety can be a problem. Nevertheless, by using VAD, it is now possible to obtain a large volume of tissue with only a single needle insertion, which makes the pathological diagnosis easier and faster than the use of an automated gun biopsy. In addi-

tion, VAD requires less precision to localize the needle (8, 9), and has excellent sensitivity and specificity with a very low rate of false negative results (10). For correctly diagnosing the nature of microcalcifications, the sensitivity of SVAB was found to be better than that of a core needle biopsy (11).

These results were compared with other results of VAB for microcalcifications using upright add-on type and prone type stereotactic equipment. The combination biopsy method (upright add-on type SVAB) for microcalcifications was both simple to perform and demonstrated a very high success rate.

The calcification retrieval rate in this study was 97.8 %, which is higher than reported in other studies using the upright add-on type (96.3 and 86%) SVAB (12, 13). However, the reported calcification retrieval rate of the prone type SVAB was approximately 99%, which is slightly higher than that reported here (14, 15).

The false negative rate of this study was 4.5 %, which is similar to 6.4% reported using an upright add-on type SVAB (13) and 2.8 % using prone SVAB (14).

In this study, the underestimation rates of surgically excised DCIS and borderline pathology were 10% and 50%, which are also similar to 20.8 % and 66.6 % reported in another study using upright add-on type SVAB (13). The reported underestimation rates of DCIS and ADH using the prone type SVAB vary considerably: 15.2 % and 8.3 % for DCIS, 52.1 % and 22.2 % for ADH (14, 15).

Compared with the prone type SVAB, the upright add-on type SVAB appears to have a slightly lower rate of calcification retrieval but similar false negative and underestimation rates.

In the patients with microcalcifications, the vast majority (86.3%) of malignant lesions were DCIS. This finding indicates that the detection and biopsy of microcalcifications are important for diagnosing breast malignancies in their early stage.

The complications related to the prone-type procedure are bleeding, an infection, clip migration and an abnormal mammographic density along the track (16). The complications related to the upright-type procedure are similar to those of the prone-type procedure. However, the vasovagal reaction is thought to be more frequent and important complication of the upright-type procedure (5,12,13). The vasovagal reaction is mainly due to the psychological stress experienced by patients that either were in pain or could see the wound and blood (12). Vasovagal symptoms in other studies of upright-type

procedure were reported from 3.7% (5) to 15% of cases (12). In this study, six patients suffered from vasovagal reactions (6.5%).

There are some limitations in this study. We did not obtain specimen mammography before release of the compression paddle because the other mammography unit was located on another hospital floor. However, we could determine the retrieval of calcifications by obtaining post biopsy stereotactic views and confirm the result by obtaining specimen mammography after the procedure. The follow-up mammograms were available in only 52% of cases with a benign pathology and the follow-up duration was not long enough. Some studies have reported that additional cancers were discovered during the follow-up period in patients whose stereotactic biopsy results were benign (4, 14). In order to avoid this problem in the future, it will be necessary to inform the clinicians and patients of the importance of follow-up examinations after a biopsy, even if the biopsy proves to be benign.

In conclusion, SVAB with an upright add-on type stereotactic device is an efficient biopsy method for mammographically detected microcalcifications with low false negative and high calcification retrieval rates.

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