Potential Margin Distortion in Breast Tissue by Specimen Mammography

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Hypothesis: There is a potential for margin distortion associated with the use of a compression plate in specimen mammography (SM) devices.

Design: Prospective observational study.

Setting: Two tertiary care teaching hospitals.

Patients: Breast biopsy tissue dimensions were recorded in 15 patients undergoing 18 operations before and after SM (group 1). After review of these data, we supervised the positioning of tissue for SM and obtained measurements for 12 breast biopsy specimens from 12 additional patients before and after SM (group 2).

Main Outcome Measures: Breast biopsy specimen dimensions recorded before and after SM, including length, width, and depth (the specimen depth along the axis of compression); data on age, menopausal status, hormone therapy, and the presence or absence of calcifications or tumor; and a national telephone survey on technique and understanding of SM at 21 institutions.

Results: The specimen depth in group 1 was markedly decreased \( (P < .001) \) along the axis of compression. The mean length and width of the specimens were marginally increased by the effect of the SM device. Specimen depth in group 2 was unchanged when minimal pressure was used on the compression plate. Tissue was adequately immobilized in both groups, and all lesions were identified by SM. Our survey revealed that 71% of hospitals reported using firm compression in SM, and diverse techniques were employed.

Conclusions: This study demonstrates the potential for specimen margin distortion with compression SM. Undue specimen compression is common in routine SM. Surgeon oversight in the method of securing the specimen within the SM container will minimize or avoid the potential for margin distortion.

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In the United States, 184 200 new cases of breast cancer are discovered annually.1 Most image-detected breast tumors are found by mammography and constitute more than 50% of all newly diagnosed cases of breast cancer.2 Specimen mammography (SM) is used by most surgeons, with specimens obtained by needle localization biopsy and positioned within a compression plate and grid device to verify the removal of the target lesion and to focus the pathologic examination.

In the surgical literature and in SM device instructions, the term compression is frequently used to describe a device or container that secures breast tissue during SM. The instructions for the device used in our hospitals instruct the user to “ratchet the compression basket slightly, just enough to stabilize the surgical tissue to prevent movement.”3 Securing the specimen within the compression device prior to SM is usually performed by ancillary personnel, including radiology technicians, circulating nurses, or operating room technicians.

Local resection of breast cancer with breast preservation is a frequently chosen treatment option and requires verification that tissue margins are free of malignancy.4 Absolute margin width or involvement with tumor may influence major treatment decisions, including the addition of adjuvant therapy or even reoperation and conversion to total mastectomy.5,7 If the reported pathologic margin of resection is distorted by compression SM, final treatment recommendations may be significantly modified.

The overall value of SM has been questioned along with its potential for predicting margin involvement.8,9 Bimston et al8 found that only 1.8% of SMs added to the clinical decision-making process. Simi-
men within the SM device. The parameters measured included length, width, and 3 depth measurements. The depth measurements were spaced 1 cm apart along the potential axis of compression and centered at the thickest point. Standard SM was then performed with a TranSpec Specimen Radiography Device (E-Z-EM Inc, Westbury, NY), which contains a compression plate and grid. The specimens in group 1 were uniformly positioned within the device by radiology technicians and/or operating room nursing staff. Subsequently, it became our practice to directly oversee the positioning of each specimen within the SM compression device with the least pressure needed to secure the specimen. Specimens from group 2 were evaluated in this manner. After review of the SM by the surgeon, the tissue was transported to the pathology department, where the specimen dimensions were measured for a second time after specimen removal from the SM device. Other data collected included menopausal status, hormone therapy, presence or absence of calcifications or tumor, and outcome of SM.

**SURVEY**

Twenty-one hospitals were selected at random for a telephone survey from 100tophospitals.com (http://www.100tophospitals.com) and harvard.edu/hospitalweb.html (http://neuro-www.mgh.harvard.edu/hospitalweb). The survey identified individuals who handle and position breast specimens prior to SM at each institution. Specific questions included (1) Is compression used in SM? Light or firm? (2) What device and/or technique do you use? (3) Do you have any concerns about the degree of specimen compression? and (4) Is your hospital university-based or a private institution?

**RESULTS**

Eighteen specimens were measured from the 15 patients in group 1. Ten of the specimens came from postmenopausal patients. Five of these patients had received hormone therapy, and calcifications were detected in 10. Cancer was present in 5 of these 15 patients. In group 2, 8 of the patients were postmenopausal, 5 were taking hormone therapy, and 6 underwent biopsy for calcifications. Six of the 12 patients had cancer.

**Figure 1A** shows the compression effect of SM on specimen depth in group 1, coinciding with the axis of compression. A similar compression change was identified for all 3 depth sites. Figure 1B shows the compression effect of SM on depth in each specimen from group 2. Specimen depth was quantified by taking the ratio of the mean depth after compression to the mean depth before compression for each specimen. To compare the 2 methods, a 2-sample t test was performed to test the hypothesis $H_0: \mu_1 = \mu_2$ against the alternative $H_1: \mu_1 < \mu_2$. The mean±SD depth measurement in group 1 was significantly greater than in group 2 ($0.622 ± 0.166$ vs $0.943 ± 0.074; P < .001$), indicating a more uniform procedure in group 2 (**Figure 2A** and B).

The mean length and width of the specimens in group 1 were marginally increased by the effect of the specimen device but did not reach statistical significance. There was no measurable difference in length or width of the specimens in group 2. Specimen mammography conclusively demonstrated the preoperative lesion within each specimen in both groups. The timing of the pathologic examination varied from immediate post-

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**METHODS**

**PATIENTS**

The institutional review board–approved study population initially consisted of 15 women (age range, 43-84 years; mean, 54 years) (group 1) undergoing excision of breast tissue after needle localization at 2 tertiary teaching medical centers. Three patients had 2 separate lesions, for a total of 18 specimens. All patients received similar care, with no variation in standard diagnostic, surgical, or medical treatment. We obtained institutional review board approval for evaluation of the same specimen dimensions in 12 additional patients (age range, 39-62 years; mean, 50 years) (group 2).

**PROCEDURE**

Patients had mammographic placement of a localization wire, with subsequent excision of the indicated area/lesion. Specimen dimensions were measured prior to placement of the speci-

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**Figure 1.** A, Group 1. Mean specimen height before and after compression plate specimen mammography (SM). B, Group 2. Mean specimen height before and after compression plate SM.
compression examination to formalin fixation within the device and examination up to 24 hours later. Patient characteristics in groups 1 and 2 are presented in Table 1.

Radiology technicians and surgical nurses participated in SM procedures. Interviews with radiology technicians, nurses, and radiologists frequently demonstrated the opinion and practice that more specimen compression during SM would yield a better SM result. Appropriate individuals responded to the survey from all 21 hospitals contacted via telephone. In 17 of the institutions, SM was handled and positioned by the radiology technician. In 4 hospitals, it was the responsibility of the operating room nurse. Fifteen hospitals surveyed were private institutions, and 6 were affiliated with universities. Fifteen of the 21 institutions reported using a “firm” compression technique (Table 2). Most responders were unable to specifically name the device used. A significant number of institutions do not use a specific device, and describe local techniques and materials, such as “sterile specimen bags,” “between 2 clear x-ray films,” “specimen board,” “compression grid,” “biohazard bag and paddle,” “sterile specimen cup,” and “specimen plastic bag.”

**COMMENT**

Determination of specimen margin parameters is of importance in evaluating the risk of local recurrence and potentially, a survival deficit. Margin parameters in breast conservation procedures may dictate the need for other therapies, including additional surgery for further margin resection, conversion to total mastectomy, additional local radiation boost treatment, or avoidance of radiation therapy. Adjuvant chemotherapy and/or hormone therapy have also been proposed or modified when margins were not satisfactory. Minimal requirements for resection margins in the treatment of invasive breast cancer remain controversial despite extensive clinical research. However, local recurrence and, possibly, survival rates are negatively affected when the margin is involved with tumor cells. Several studies suggest a worse outcome with margins of 2 mm or less.

The value of wider resection margins is less controversial in the treatment of ductal carcinoma in situ. This is likely, owing to the tendency for occult tumor extension along ducts and frequent multifocality. Silverstein et al found that margins of 10 mm or more in selected patients with ductal carcinoma in situ defined a group of patients that might safely avoid postoperative radiation therapy. Lower local recurrence rates with increasing resection margins were also reported by Vicini et al, who suggested a 5-mm minimum clear margin width. Spivack et al demonstrated increased risk of local recurrence in invasive carcinoma when microscopic involvement of the resected margin was present. A radiation boost to the primary site may be added for patients with margin involvement who forego reexcision. Patients may have a recurrence rate of up to 50% at 5 years if extensive intraductal cancer with focally positive margins is found.

The American College of Radiology judges SM to be the standard of care for needle localization biopsy procedures, although some SM reports show little patient benefit and an additional cost of up to $370 per procedure.
Predicting tissue margins by SM is correct only 24.8% of the time when comparing postoperative SM measurements to pathologic margins. This may result in unnecessary additional excision of tissue or missed tumors.8,10 Graham et al10 found that 32% of predicted negative margins were positive by histologic evaluation. However, Hasselgren et al16 recommends SM after all needle localization breast biopsies, owing to a 3.2% incidence of missed lesions and a 6.4% incidence of incompletely removed lesions with the first biopsy specimen. Focused pathologic attention to a particular site within the specimen may also be a benefit of SM in addition to confirming the removal of the target lesion.

Other authors have reported potential problems with SM. Lagios37 recommends minimizing compression to avoid fracturing or tearing the specimen, which might allow ink to seep into the lesion, creating a false-positive margin. Graham et al39 reported a decrease in specimen volume and height after SM with or without compression.

We have found that ancillary personnel handling a needle-localization breast tissue specimen may have goals and understanding of the overall treatment strategy that differ from the surgeon’s interest in demonstrating not only clear margins but the extent of those margins by objective measurement. In our patients, SM uniformly identified the target lesion in both groups. Should an SM prove inconclusive, repositioning with a new x-ray or additional compression could be added, although this was not necessary in our patients.

Our survey found a broad lack of uniformity in the handling and compression of breast tissue during SM. When asked if they had concerns about compression, responses ranged from, “I try not to break the container,” “I try to flatten the specimen to the same thickness as the container,” and “I push until I can’t push anymore” to “just enough compression to get a decent image without compressing hard, as the pathologist told us, just holding the specimen in place.”

Newly diagnosed breast cancer may be image-detected in up to 50% of patients.2 Most of these lesions will be excised by needle localization biopsy with SM. In a recent extensive review of surgical margins in early-stage breast cancer, Singletary4 tabulated 34 studies, involving 22,417 patients, that evaluated surgical margins in relationship to local recurrence. What conclusions can be safely and accurately drawn from these or other data without knowing if specimens were distorted during SM?

This study found a significant change in the measured specimen dimensions along the axis of compression in routine SM. This change may alter the final reported pathologic margin and potentially alter treatment decisions. Tissue compression that causes specimen distortion is unnecessary for successful SM. Our survey shows undue specimen compression to be common in routine SM. Surgeon oversight in securing the specimen within the SM container will minimize or avoid the potential for margin distortion and should be an integral part of SM.

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REFERENCES