Clinical Imaging 53 (2019) 108–111

Contents lists available at ScienceDirect

Clinical Imaging

journal homepage: www.elsevier.com/locate/clinimag

Breast Imaging

Stereotactic breast biopsy efficiency: Does a pre-biopsy grid image help?

Victoria L. Mango[a,*], Donna D'Alessio[a], Elizabeth A. Morris[a], Richard Ha[b], Blanca Bernard-Davila[a], Maxine S. Jochelson[a]

[a] Memorial Sloan Kettering Cancer Center, Breast and Imaging Center, 300 East 66th Street, Suite 715, New York, NY 10065, United States of America
[b] Columbia University Medical Center, Herbert Irving Pavilion, 161 Fort Washington Avenue, New York, NY 10032, United States of America

ARTICLE INFO

Keywords:
Breast stereotactic biopsy
Grid image

ABSTRACT

Objective: Prior to stereotactic breast biopsy, some radiologists obtain a mammogram image with an overlying alphanumeric grid to mark the skin overlying the target. Our purpose is to determine if this grid image affects stereotactic biopsy efficiency and accuracy, including total images obtained, procedure time and need for re-targeting.

Materials and methods: IRB approved, HIPAA compliant retrospective review of prone stereotactic biopsy cases targeting calcifications 9/1/2015 to 9/1/2016 was performed. Images and reports were reviewed for number and type of images obtained, evidence of retargeting and biopsy table time. Attending radiologist, technologist and trainee involvement were recorded. Statistical analysis was performed utilizing SAS statistical software v 9.4 (SAS Institute, Cary, NC).

Results: Of 463 women (avg age 58.0 years, range 30–94), 392/463 (84.7%) had grid images obtained pre-biopsy. Grid patients had more images total than non-grid (avg 9.26 versus 8.44 images/patient; $p < 0.0001$) but spent less time on the biopsy table (avg 15 min 2 s versus 16 min 44 s/procedure; $p < 0.0001$). Non-grid patients were more likely to undergo initial retargeting (45% non-grid vs 30% of grid patients; $p = 0.013$); however, later retargeting after needle placement was comparable ($p = 0.3$).

Conclusion: Grid imaging increases images obtained but decreases retargeting and biopsy table time at the expense of mammogram room/technologist time to obtain the grid image. The overall result is longer total procedure time (grid time plus table time) for the patient/technologist. A grid image therefore has limited usefulness and should be used judiciously in cases where prone positioning is challenging to patients.

1. Introduction

Increased utilization of screening mammography has decreased breast cancer mortality through the detection of small non-palpable breast cancers [1–4]. Breast lesions were previously sampled by surgical excisional biopsy; however, image guided biopsy is now widespread and the preferred initial approach for tissue diagnosis when there are suspicious or indeterminate breast imaging findings [5,6]. While ultrasound guided breast biopsy is generally preferred due to patient comfort and lack of radiation, sonographically occult mammographic findings or findings that are much more conspicuous on mammography are targeted for biopsy utilizing stereotactic guidance. The most common target for stereotactic biopsies is calcifications but may also occasionally be utilized to biopsy sonographically occult masses, asymmetries and architectural distortion [7].

Stereotactic biopsy technique is a well described and validated biopsy method with prone stereotactic biopsy systems available in the US since the mid-1980s [5,7–11]. Prior to beginning the procedure, some radiologists obtain a mammogram image with an overlying alphanumeric grid to identify the biopsy target and mark the skin over the region of interest to guide patient positioning on the prone stereotactic table (Fig. 1). Obtaining this grid image prior to prone stereotactic biopsy utilizes a separate mammogram room, patient/technologist time, and exposes the entire breast to a small amount radiation; however, pre-biopsy gridding is hypothesized to assist with procedure efficiency. The skin marking may aid in patient positioning and target identification (Figs. 2 and 3), potentially decreasing the need to reposition the patient on the biopsy table thereby avoiding additional images and decreasing procedure room time.

Utilization of this alphanumeric grid has been described as a routine initial step in a stereotactic biopsy [12–14]. In clinical practice however, utilization of this grid image varies between institutions and

* Corresponding author.
E-mail addresses: Mangov@mskcc.org (V.L. Mango), DAlessiD@mskcc.org (D. D'Alessio), morrise@mskcc.org (E.A. Morris), rh2616@cumc.columbia.edu (R. Ha), bernardb@mskcc.org (B. Bernard-Davila), jochelsm@mskcc.org (M.S. Jochelson).

https://doi.org/10.1016/j.clinimag.2018.10.007
Received 8 June 2018; Received in revised form 12 September 2018; Accepted 5 October 2018

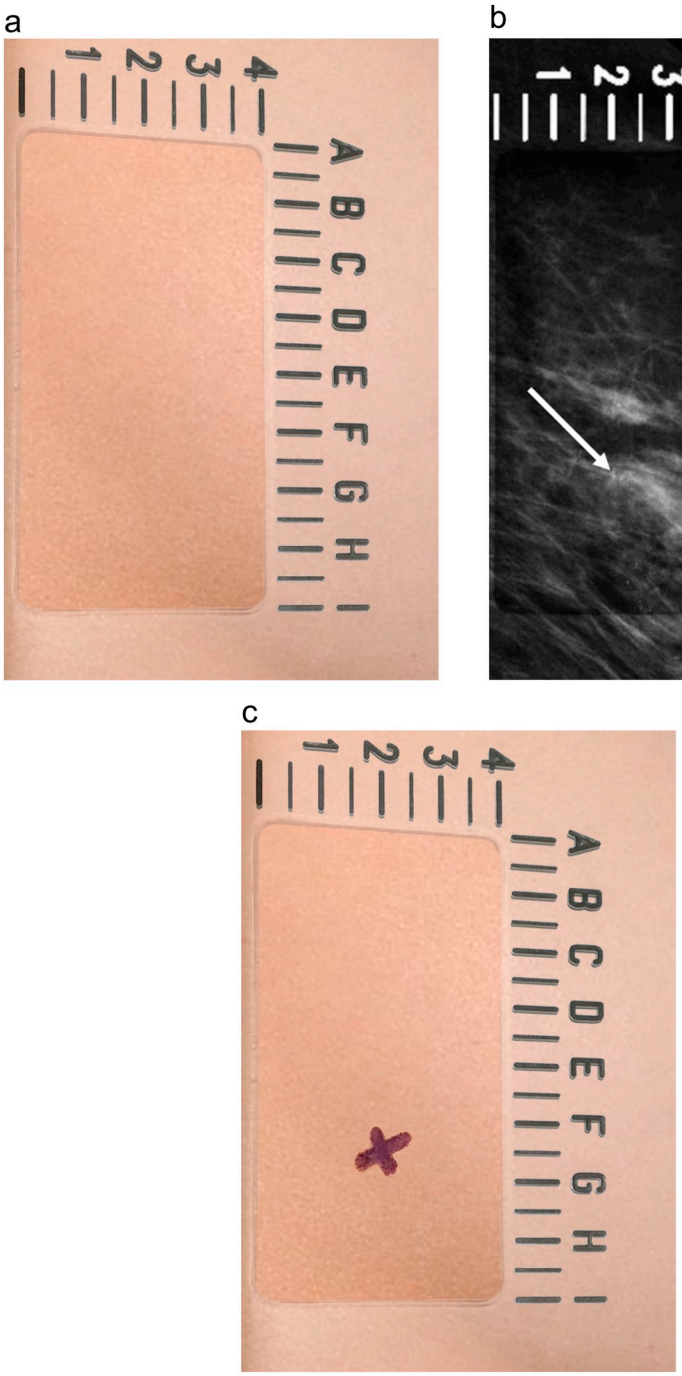

Fig. 1. Obtaining a grid image prior to stereotactic breast biopsy. 74 year old with history of right breast cancer status post lumpectomy and radiation therapy with new right upper outer quadrant fine pleomorphic calcifications spanning 1.1 cm for which stereotactic biopsy was recommended.
a. The patient is positioned in the mammogram unit with the planned skin entry site exposed by an open paddle with an embedded alphanumeric grid.
b. Mammogram image enables identification of the target location, in this example calcifications (arrow) at the intersection of 2 and halfway between F and G.
c. A mark is placed on the patient's skin to indicate where the target is located.

individual radiologists, with some using it routinely, some only with anticipated challenging targets and some rarely or not at all.

To our knowledge there are no prior publications investigating utilization of a grid image and its effect on stereotactic biopsy efficiency and accuracy. The purpose of this study is to determine how this grid image affects stereotactic biopsy efficiency and accuracy, including total number of images obtained, procedure table time and need for retargeting for patients undergoing a single site biopsy of calcifications.

2. Materials and methods

An IRB approved, HIPAA compliant retrospective review of 463 consecutive single site prone stereotactic breast biopsy cases at our institution targeting calcifications from 9/1/2015 to 9/1/2016 was performed. Patients undergoing stereotactic biopsy of other targets, such as focal asymmetries, masses or architectural distortion, or those with more than one biopsy target were excluded. Only those undergoing prone biopsy were included due to differences in field of view on our upright stereotactic biopsy system which could potentially influence ability to identify the biopsy target.

All biopsies were performed on a prone Lorad MultiCare Platinum stereotactic biopsy table with most utilizing the Eviva breast biopsy system (Hologic, Inc. Marlborough, MA, USA) with a regular or petite needle depending on breast thickness. A few biopsies were performed with the Mammotome breast biopsy system (Devicor Medical Products, Inc., part of Leica Biosystems, Cincinnati, OH, USA).

Images and reports were reviewed for number and type of images obtained with patients divided into two groups, those who had a grid image ("grid cases") and those who did not ("non-grid cases"). Evidence of initial retargeting during the procedure was noted if more than one

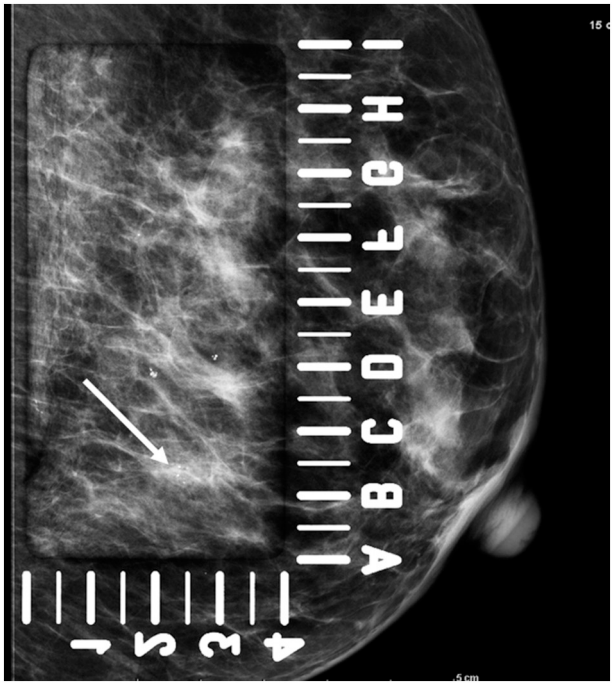

Fig. 2. 73-year-old with new coarse heterogeneous calcifications spanning 0.4 cm. Grid image enables identification of the targeted calcifications (arrow). Stereotactic biopsy yielded pleomorphic lobular carcinoma in situ associated with calcifications, a diagnosis confirmed on subsequent excision.

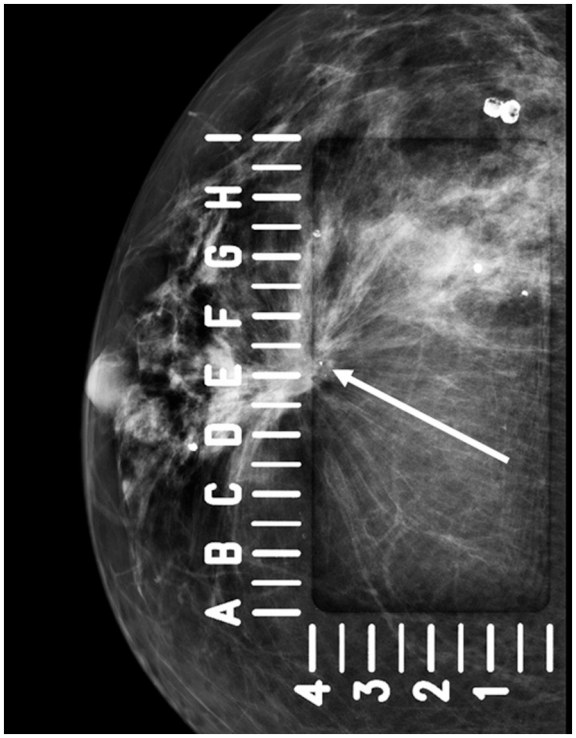

Fig. 3. 63-year-old with a remote history of breast cancer treated with lumpectomy. Routine screening demonstrates new coarse heterogeneous calcifications at the posterior aspect of the lumpectomy site. Grid image assists with identification of the suspicious calcifications (arrow). Stereotactic biopsy yielded fat necrosis associated with calcifications, a benign concordant result.

scout image was obtained before the needle was inserted. Evidence of later retargeting was recorded if additional images, beyond the standard pre-and postfire images, were necessary once the biopsy needle was inserted. Imaging time on the stereotactic biopsy table was recorded by noting the time between obtaining the first and last image.

Additional factors potentially affecting patient positioning, target identification and procedure time were also noted such as the specific technologist involved, involvement of a trainee and attending radiologist level of experience. Attending radiologists performing stereotactic biopsies were grouped by number of years out of training as follows: < 5 years, 5–10 years, 10–15 years and > 15 years. Successfully obtaining calcifications in the biopsy sample and pathology result concordance was also recorded from procedure and pathology reports.

Comparisons were made between grid utilization and variables related to stereotactic biopsy efficiency. Descriptive statistics including frequencies, medians, means, standard deviations, and percentages were calculated to characterize the patient populations with respect to procedure time, retargeting (initial/later), and persons performing the procedure. Pearson Chi-square (χ^2) tests were used to evaluate differences in participant characteristics for binary or nominal variables. Kruskal Wallis test was also used when independent variables contained two or more levels if an ordinal dependent variable was examined. When continuous variables to be compared had skewed distributions, log transformation was conducted to attain normal distribution. Continuous variables with reasonably symmetric distributions were compared with two sample *t*-test. Differences between three or more independent samples where normality was assumed were analyzed using analysis of the variance (ANOVA) test. p-Values are two-sided with statistical significance evaluated at the 0.05 alpha level.

3. Results

463 women (average age 58.0 years, range 30–94) had single site prone stereotactic guided biopsies of calcifications performed by 1 of 18 breast subspecialty radiologists during this time period. 392/463 (84.7%) had 1–3 grid images (avg 1.85) obtained pre-biopsy, 71/463 (15.3%) had none. In 1/463 (0.2%) procedures, the biopsy specimen failed to yield calcifications, was therefore considered discordant and surgical excisional biopsy was performed. The remaining 462/463 (99.8%) pathology results were concordant with imaging findings.

Patients with grid imaging had more images total per procedure (including the grid image) than non-grid patients (average 9.26 versus 8.44 images per patient; $p < 0.0001$) but spent less time on the stereotactic biopsy table (average 15 min 2 s per procedure versus 16 min 44 s; $p < 0.0001$). 39/71 (55%) of non-grid patients were successfully positioned on the stereotactic biopsy table on the first attempt compared with 274/392 (70%) of grid patients. Non-grid patients were more likely to undergo initial retargeting on the table (45% of non-grid patients, 30% of grid patients; $p = 0.013$); however, need for retargeting once the needle was placed was comparable between the two groups (14.1% non-grid patients, 9.9% of grid patients; $p = 0.3$).

Of 18 breast subspecialty radiologists performing stereotactic biopsies during this time period, 5 were < 5 years out of training, 4 were 5–10 years out of training, 2 were 10–15 years out of training and 7 > 15 years out of training. Attending level of experience and the specific technologist involved in positioning the patient did not affect procedure time ($p = 0.240$).

Breast imaging fellows were involved in 221/463 (47.7%) biopsy cases, 170/392 (43.4%) grid cases and 51/71 (71.8%) non-grid cases. In general, stereotactic biopsies without a trainee involved were significantly faster (average 14 min 13 s versus 16 min 27 s; $p < 0.0001$).

4. Discussion

Stereotactic biopsy is an accurate and minimally invasive technique for sampling mammographically identified calcifications as confirmed in our study with only 1/463 patient with discordant results requiring surgical excisional biopsy to obtain calcifications. This patient had a

faint 0.3 cm group of pleomorphic calcifications for which sampling was limited due to proximity to the nipple and underwent surgical excision yielding an intraductal papilloma and fibrocystic changes.

Performance of the grid image prior to stereotactic biopsy involves additional technologist and patient time, at our institution utilizing another mammogram room for approximately 3 min. It exposes a larger area of the breast to a small amount of additional radiation. On average patients who have the pre-biopsy grid image spend less time on the stereotactic biopsy table (average 15 min 2 s per procedure versus 16 min 44 s; $p < 0.0001$). This 1 min 42 s savings is negated by spending at least that much time having the grid image performed. In select cases when a patient has great difficulty lying prone for an extended time obtaining the grid image upright in a mammogram unit may be worthwhile to minimize time spent in the prone position if upright stereotactic biopsy is not available.

As technology improves the utility of the grid image may be less relevant as upright stereotactic and upright tomosynthesis biopsy equipment is more available. Shrading et al. recently compared total procedure time for prone stereotactic biopsies to upright tomosynthesis guided biopsies. They showed prone stereotactic biopsies take on average 29 min total (range 12–65 min) significantly longer than tomosynthesis guided biopsies performed upright in a chair or with the patient positioned lateral decubitus (mean 13 min; range 8–32 min) ($p < 0.0001$) [15]. This time difference was mostly attributed to rapid target lesion identification.

Our study demonstrated patients with grid imaging had more images per procedure than non-grid patients (average 9.26 versus 8.44 images per patient; $p < 0.0001$), which is expected as this total includes the grid image plus images obtained on the stereotactic biopsy table. The grid image itself exposes a greater portion of the breast to radiation unlike images on the prone biopsy system where a smaller field of view is utilized. Thus, patients with a grid image are exposed to a slightly increased amount of radiation. For our mammography unit utilized for the grid image an average-density breast will receive an estimated average glandular dose of 0.8 to 2.4 mGy depending on the breast thickness (range provided for 2 cm to 8 cm breast thickness) (Daniel Long, PhD, DABR, Lead Diagnostic Medical Physicist, Memorial Sloan Kettering Cancer Center, personal communication, August 9, 2018).

While a grid image prior to stereotactic biopsy may assist with initial target identification, it is not always necessary given in 55% of non-grid cases the biopsy target was identified on the first scout image. It is interesting to note that despite obtaining the grid and marking the skin, 30% of grid patients still needed to undergo initial retargeting once on the table. This is likely due to differences in positioning, upright for the grid image versus prone for the biopsy, and breast size.

Limitations of our study include that patients were not randomized to utilization of a grid image or not as this decision was based on attending preference. One of our senior attending radiologists performs all cases without the grid image. For other radiologists who intermittently use the grid, the decision to use the grid or not may have led to patients with more conspicuous targets less likely to have a grid image obtained. We also only looked at prone biopsies performed on a table, therefore these results are less useful for those using an upright or lateral decubitus chair and/or tomosynthesis imaging. Increased use of an upright system with a clear paddle and wider field of view on the scout image or utilization of tomosynthesis may assist with target identification. With advances in digital imaging the grid technique may be less relevant.

Arguments have been made for utilization of the grid image for challenging targets, such as developing asymmetries [13]. Our study only looked at calcifications and could not address this issue. Future studies analyzing utilization of a grid image with non-calcified sonographically occult findings, such as masses, architectural distortion and asymmetries may be worthwhile.

5. Conclusion

In conclusion, patients undergoing pre-stereotactic biopsy grid imaging targeting calcifications have, on average, more images obtained and consequently a small increase in radiation exposure. They are less likely to require retargeting on the table and have shorter biopsy table times. This is at the expense of utilizing additional mammograms, technologist and room time prior to the procedure. Therefore, the overall result is longer total procedure time (grid time plus table time) for the patient and technologist. A grid image therefore has limited usefulness and should be used judiciously in cases where prone positioning is challenging to patients.

Acknowledgements

We would like to thank and acknowledge Danny F. Martinez, MS Research Project Manager from the Department of Radiology at Memorial Sloan Kettering Cancer Center for generating the patient database utilized in this study. MSK Cancer Center Support Grant/Core Grant (P30 CA008748).

Disclosures

There are no disclosures to report for any of the authors listed above.

IRB approval

Memorial Sloan Kettering Cancer Center IRB approval was obtained for this study.

References

[1] Feig SA. Decreased breast cancer mortality through mammographic screening: results of clinical trials. Radiology 1988;167:659–65.
[2] Tabar L, Fagerberg G, Duffy SW, et al. Update of the Swedish two- county program of mammographic screening for breast cancer. Radiol Clin North Am 1992;30:187–210.
[3] Nelson HD, Tyne K, Naik A, et al. Screening for breast cancer: systematic evidence review update for the US Preventive Services Task Force. Ann Intern Med 2009;151:727–37.
[4] Seidman H, Gelb SK, Silvergert E, et al. Survival experience in the breast cancer detection demonstration project. Cancer J Clin 1987;37:258–90.
[5] Schmidt RA. Stereotactic breast biopsy. Cancer J Clin May–Jun 1994;44(3):172–91.
[6] Vandromme MJ, Umphrey H, Krontiras H. Image-guided methods for biopsy of suspicious breast lesions. J Surg Oncol 2011;103(4):299–305.
[7] Huang ML, Adrada BE, Candelaria R, Thames D, Dawson D, Yang WT. Stereotactic breast biopsy: pitfalls and pearls. Tech Vasc Interv Radiol Mar 2014;17(1):32–9.
[8] Liberman L. Percutaneous image-guided core breast biopsy. Radiol Clin North Am 2002;40:483–500.
[9] O'Flynn EAM, Wilson ARM, Michell MJ. Image-guided breast biopsy: state-of-the-art. Clin Radiol 2010;65:259–70.
[10] Fahrbach K, Sledge I, Cella C, et al. A comparison of the accuracy of two minimally invasive breast biopsy methods: a systematic literature review and meta-analysis. Arch Gynecol Obstet 2006;274:63–73.
[11] Mahoney MC, Newell MS. Breast intervention: how I do it. Radiology 2013;268(1):12–24.
[12] Ed Dershaw DD. Imaging-guided interventional techniques. Springer; 2003 (Chapter 5 By L Liberman Stereotactic Core Biopsy, pp. 92–93).
[13] Price ER, Joe BN, Sickles EA. The developing asymmetry: revisiting a perceptual and diagnostic challenge. Radiology 2015;274(3):642–51.
[14] Norris TG. Stereotactic breast biopsy. Radiol Technol 2001;72(5):431–54.
[15] Schrading S, Distelmaier M, Dirrichs T, et al. Digital breast tomosynthesis-guided vacuum-assisted breast biopsy: initial experience and comparison with prone stereotactic vacuum-assisted biopsy. Radiology 2014;274(3):654–62.