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Utility of tomosynthesis in decreasing skin calcification workup rate

Anna Holbrook[1*], Brianna Vey[1], Yoon Jin Kim[2], Yuan Liu[3], Mary Newell[1]

[1] Emory University, 1365C Clifton Rd NE Suite C1104 Atlanta, GA 30322

[2] University of California San Francisco, 513 Parnassuss Ave., S 261, San Francisco, CA 94143

[3] Emory University, GCR 352, 1518 Clifton Rd, Atlanta, GA 30322

ABSTRACT

Aim: Tomosynthesis permits some skin calcifications to be identified as such without diagnostic workup. We aim to quantify the reduction in skin calcification workups at our institution after the advent of tomosynthesis.

Methods: This study was approved by the Institutional Review Board with waiver of informed consent. We searched the medical record from 3/1/2011 to 3/31/2017 for all cases of screening mammography with the terms "skin" or "dermal" included in the report. We excluded all cases that did not include a recommendation for skin/dermal calcification workup and/or tangential views. Of the included cases, note was made of whether the screening examination was done without or with tomosynthesis. We calculated the percentage of cases recalled for skin calcification workup that were done without and with tomosynthesis. We then compared the percentages using chi-squared to evaluate for significance.

Results: Forty cases met the inclusion criteria. Twenty-four cases (60%) were done without tomosynthesis, and 16 (40%) were done with tomosynthesis. There were 132,789 total screening mammograms done, 65,299 (49.2%) without tomosynthesis and 67,490 (50.8%) with tomosynthesis. The percentage of all cases recalled for skin calcification workup done without tomosynthesis was 0.037%, and done with tomosynthesis was 0.024% (chi-square statistic 8587744.4875, $p < 0.00001$).

Conclusion: We found that since the addition of tomosynthesis to our screening protocol, the recall rate for skin calcification workup has decreased by 35%. However, tomosynthesis did not entirely eliminate the need for skin calcification workup.

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KEYWORDS

Skin calcifications, dermal calcifications, tomosynthesis, Digital Breast Tomosynthesis (DBT).

Introduction

One way in which malignancy may manifest in the breast is calcifications [1–3]. However, not all breast calcifications are due to malignancy [2,4,5]. Calcifications located within the skin are benign, usually due to chronic folliculitis or inspissated material within sebaceous glands [6,7]. On mammography, skin (also called dermal) calcifications classically appear lucent centered and tightly grouped and is most commonly seen in the inframammary fold, parasternal region, axilla, and around the nipple [8]. Pathognomonic skin calcifications, identifiable by either classic morphologic appearance or fortuitous visualization within the skin as it lies in tangent to the X-ray beam, require no further workup. However, not all skin calcifications have this classic appearance; they might not exhibit central lucency and will likely project within the breast confines on standard views. A clue that one might be dealing with skin calcifications is the presence of a tight grouping projecting near the skin surface on at least one view [8]. In this situation, where calcifications are suspected to be dermal but are not definitively so, a diagnostic workup with tangential views can be done to localize the calcification to the skin (Fig. 1) [9]. However, when such indeterminate calcifications are seen in the screening setting, recall for diagnostic imaging is required.

In digital breast tomosynthesis, projection images taken at varying angles are reconstructed

Contact Anna Holbrook aiholbr@emory.edu 1365C Clifton Rd NE.

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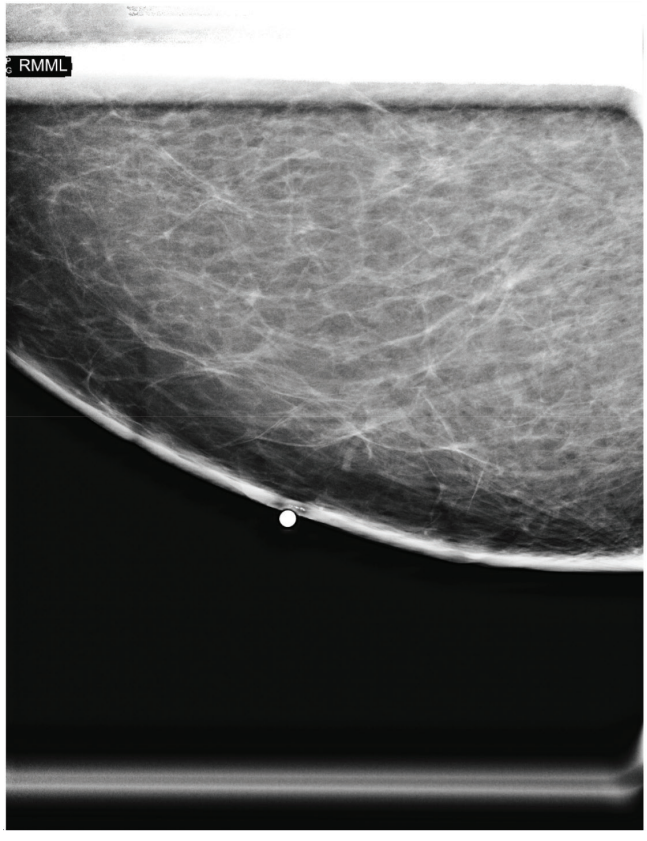


Figure 1. 40-year-old with right breast calcifications. Tangential view with metallic marker overlying calcifications indicates that the calcifications are within the skin.

into slices, allowing the breast imager to scroll through the breast from compression paddle to detector. Assuming a slice thickness of 1 mm and skin thickness of around 3 mm, the skin surface that abuts the paddle or detector will, in theory, be seen within the first and last 3 slices [10]. While the phenomenon of calcifications being seen within these bookended slices and thus categorized as dermal has been described [10,11], to our knowledge, no study has been published quantifying the impact that the advent of tomosynthesis has had on the utilization of skin calcification diagnostic workups. We hypothesize that the use of tomosynthesis facilitates the identification of skin calcifications, decreasing the need for further diagnostic workup (Fig. 2).

Materials and Methods

This Health Insurance Portability and Accountability Act-compliant study was approved by the Institutional Review Board with a waiver of informed consent. We searched the medical record from 3/1/2011 to 3/31/2017, approximately 2 years before and after tomosynthesis inception at our institution, for all cases of screening mammography with the terms "skin" or "dermal" included in the report (Fig. 3).

We then excluded all cases that did not include a recommendation for skin/dermal calcification workup and/or tangential views. Of the included cases, a note was made of whether the screening examination was done without or with tomosynthesis. We also noted which cases requiring skin calcification workup ultimately resulted in a diagnosis of skin calcification.

Of those cases done without tomosynthesis, we calculated the percentage recalled for skin calcification workup. We similarly calculated the percentage of cases who were screened using tomosynthesis and subsequently recalled for skin calcification workup. We then compared the two percentages, using Chi-squared to evaluate for significance (https://www.socscistatistics.com/tests/fisher/Default2.aspx).

From our institution's data warehouse, we queried the breast densities and ages of patients done during the study time period who were screened without tomosynthesis and with tomosynthesis to evaluate whether the populations were similar.

Our protocol for 2D screening consisted of standard craniocaudal and mediolateral oblique views of each breast (as well as any additional views obtained at the technologist's discretion for the purpose of complete tissue inclusion) using a Selenia Dimensions unit (Hologic, Inc. Marlborough MA). Our protocol using tomosynthesis consisted of craniocaudal and mediolateral oblique 2D and digital breast tomosynthesis images of each breast (with added 2D images for complete tissue inclusion, as per above) using the Selenia Dimensions unit with tomosynthesis upgrade.

Results

We identified 815 cases who included one of the search terms. Of these, 40 cases met the inclusion criteria. 24 cases (60%) were done without tomosynthesis, and 16 (40%) were done with tomosynthesis. During the study time period, there were 132,789 total screening mammograms done: 65,299 (49.2%) without tomosynthesis and 67,490 (50.8%) with tomosynthesis. The percentage of all cases done without tomosynthesis who were recalled for skin calcification workup was 0.037%, while the percentage of all cases done with tomosynthesis who were recalled for skin calcification workup was 0.024% (Chi-square statistic 8587744.4875, $p < 0.00001$). Of the 24 cases done

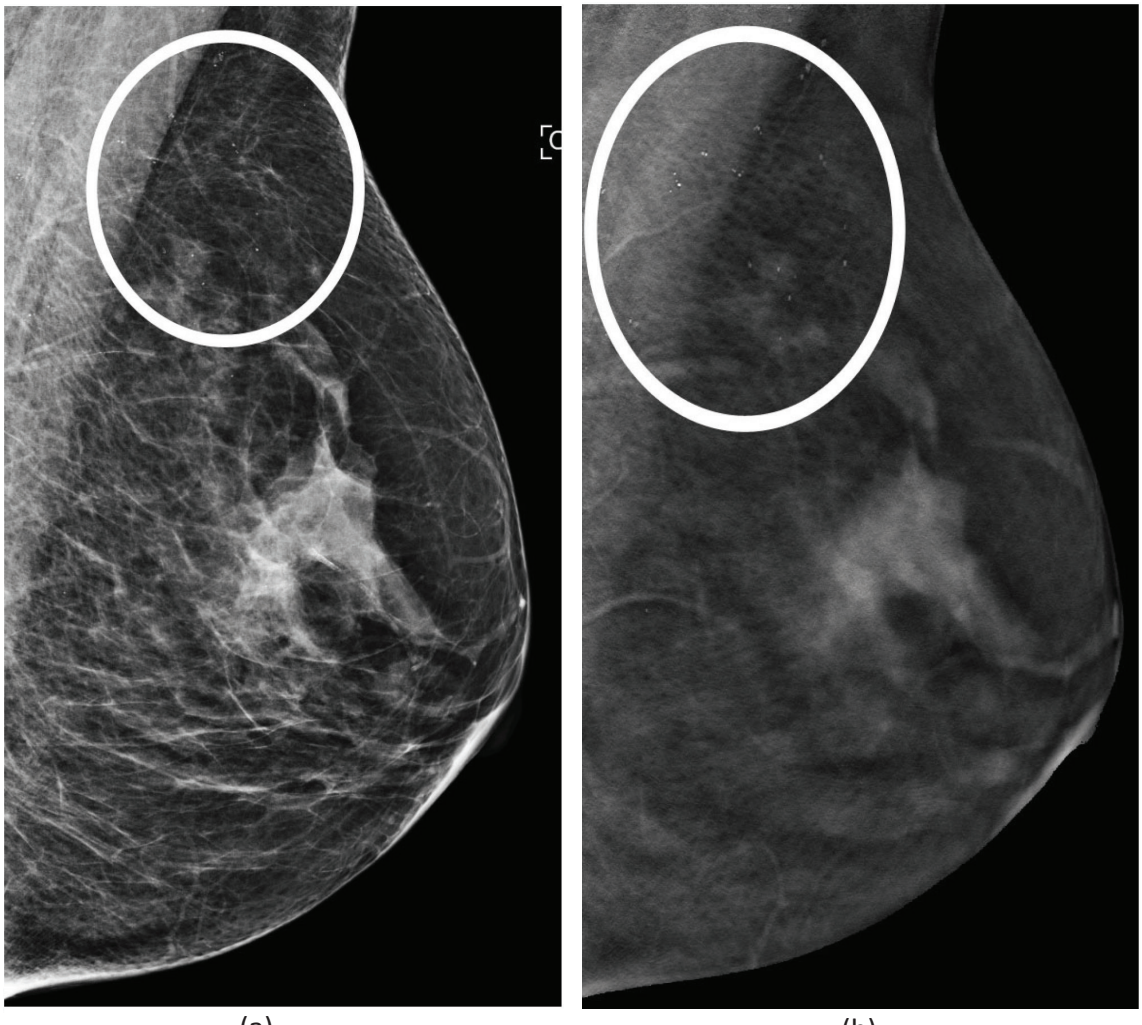


Figure 2. 67-year-old undergoing screening examination which demonstrates calcifications (circle) seen overlying the axillary tail on the left mediolateral oblique view (**a**). The calcifications (circle) appear on the third slice of the tomosynthesis images (**b**), indicating they are in the skin.

without tomosynthesis and recalled for skin calcification workup, 13 (54%) ultimately turned out to be in the skin. Calcifications that were not in the skin were found to be benign either by biopsy or at least 2 years of follow-up in 7 (29.2%) cases. There was one case (4.2%) of atypical ductal hyperplasia found at stereotactic biopsy, which was upgraded to invasive ductal carcinoma and ductal carcinoma *in situ* at surgical excision. Three cases (12.5%) were lost to follow up. Of the 16 cases done with tomosynthesis and recalled for skin calcification workup, 6 (37.5%) were in the skin. Calcifications that were not in the skin were found to be benign either by biopsy or at least 2 years of follow up in 10 (62.5%) cases.

Breast density distributions and mean ages of the general screening population groups are reported in Table 1. Density distributions for the cases recalled for skin calcification workup are presented in Table 2. There was no statistical difference in density between the cases recalled from screening with tomosynthesis and those recalled from screening without tomosynthesis ($p = 0.121$). The density distributions between those cases recalled for skin calcification workup and the general screening population were significantly different ($p < 0.001$), with those recalled for skin calcification workup trending toward a less dense categorization.

Discussion

We found that since the addition of tomosynthesis to our screening protocol, the recall rate for skin calcification workup has decreased by 35%. Compared with 2D mammography, tomosynthesis has many established benefits, including improved cancer detection rates and decreased screening recall rates [12–20]. While it has been reported that tomosynthesis can decrease recall rates for

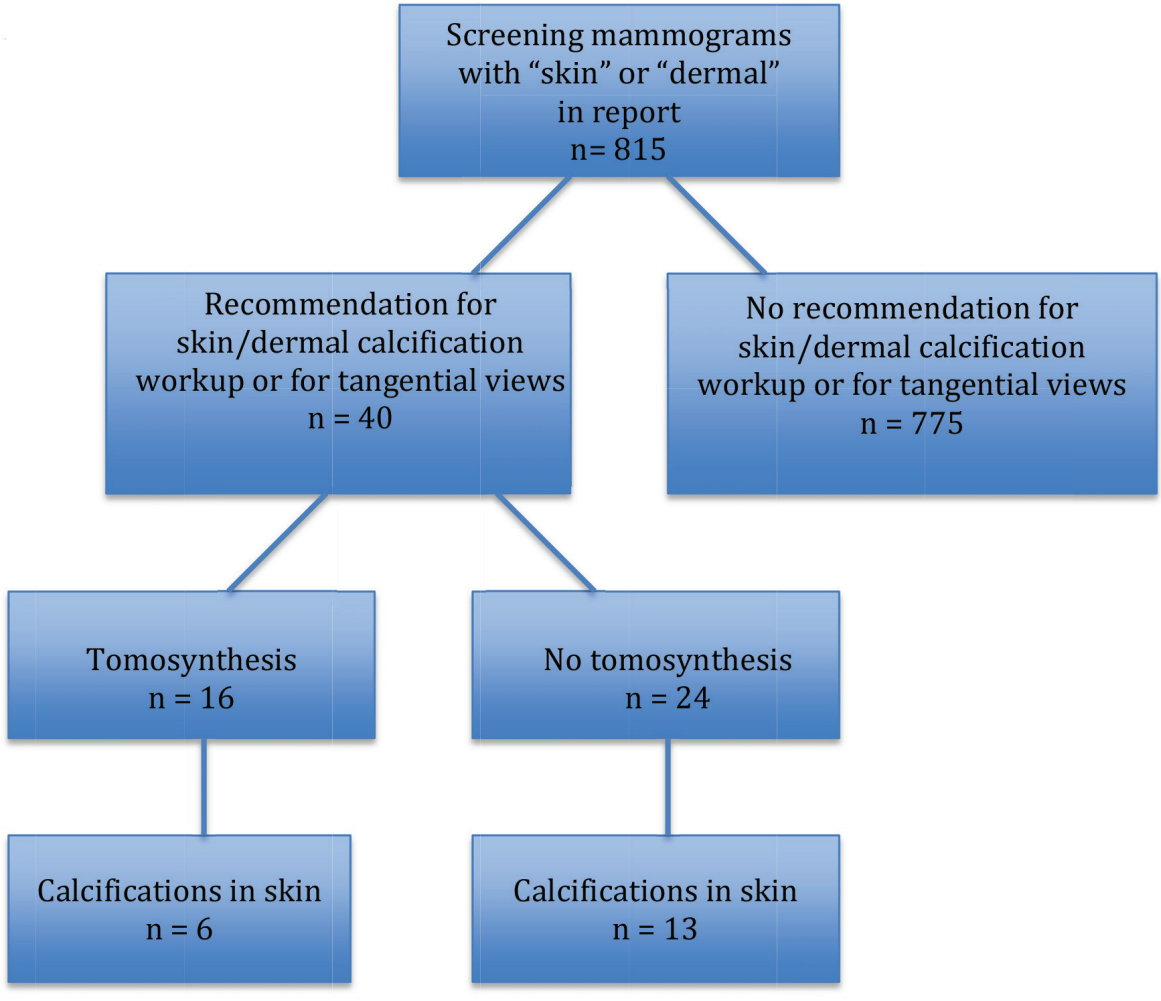


Figure 3. Flow chart detailing included and excluded cases.

Table 1. Breast density distribution and age range of patients screened without and with tomosynthesis.

	Without tomosynthesis	With tomosynthesis
Entirely fatty replaced	8868 (13.6%)	8875 (13.2%)
Scattered fibroglandular tissue	28258 (43.3%)	26371 (42.6%)
Heterogeneously Dense	25144 (38.5%)	26371 (39.1%)
Extremely Dense	3029 (4.6%)	3496 (5.2%)
Age range	22–97 (mean 59.3)	22–97 (mean 59.8)

Table 2. Breast density distribution of patients recalled for skin calcification workup.

	Without tomosynthesis	With tomosynthesis
Entirely fatty replaced	8 (33.3%)	2 (12.5%)
Scattered fibroglandular tissue	15 (62.5%)	10 (62.5%)
Heterogeneously Dense	1 (4.2%)	3 (18.8%)
Extremely Dense	0 (0%)	1 (6.2%)

calcifications in general [21], our study is the first to specifically quantify the benefit of tomosynthesis of decreasing the screening recall rate for the workup of suspected skin calcifications.

Tomosynthesis did not entirely eliminate the need for skin calcification workup. In our study, slightly more than a third of what ultimately proved to be skin calcifications were not prospectively

characterized on tomosynthesis. Friedewald suggested three reasons why not all skin calcifications are demonstrated within the skin on tomosynthesis [10]. First, calcifications may be located within skin that is not in contact with the detector or compression paddle. Second, flexing of the compression paddle anteriorly where the breast is thinner may cause the skin to appear in deeper slices. And finally, some tomosynthesis systems add additional reconstructed slices to the compression paddle side of the stack so that underestimation of compression thickness does not exclude portions of the breast. Thus, the skin may appear in deeper slices.

The cases that were recalled for skin calcification workup tended to be less dense than the general screening population. The cause of this is unclear.

Limitations of this study include the retrospective nature, as well as the low number of cases. However, the latter is to be expected, given that most skin calcifications can be readily identified as such on 2D screening examination, and requires no workup. Some cases of skin calcification workup may have been excluded if there was no specific recommendation for those views in the screening report.

In addition, the study looked at changes occurring immediately after the introduction of tomosynthesis. As experience evolves over time, the later effects of tomosynthesis on the recall rate for skin calcification workup may be different. However, as readers become more comfortable with recognizing skin calcifications in end slices of tomosynthesis, this would likely further decrease the callback rate.

Conclusion

Our study demonstrates a significant decrease in the need for skin calcification workup with the inclusion of tomosynthesis imaging in our screening protocol. This is yet another benefit of tomosynthesis, which has quickly become the standard of care in screening mammography.

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