Baseline Screening Mammography: One vs Two Views per Breast

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To compare the advantages of one-view vs two-view mammography screening, films were reviewed for 2500 consecutive asymptomatic women undergoing baseline mammography. To provide screening at low cost, examinations were limited to two radiographs per breast, one each in the craniocaudal and mediolateral oblique projections, with the understanding that those few patients with detected abnormalities would require additional mammograms, taken with an individually directed, problem-solving approach, at considerably higher cost. Two separate interpretations were made of each case, one using only the oblique projection images, the other using both oblique and craniocaudal views. Two-view interpretations not only identified more cancers than one-view readings (27 vs 25), they also required fewer additional mammograms to evaluate potential abnormalities (179 vs 642, 7% vs 26%). These advantages outweigh the additional radiation risk and added cost. Baseline screening mammography should be done with two views per breast.

Although still grossly underused, mammography screening is being done with increasing frequency. Also gaining in popularity is the concept of high-volume, streamlined screening at low cost [1–5]. Among the various methods suggested to reduce costs is the practice of imaging each breast with one rather than two standard projections [6–8]. This approach certainly will halve the cost of X-ray film, and it may also increase patient throughput and reduce interpretation time. In addition, despite the negligible difference in oncogenic risk [9, 10], mammography at half the radiation dose might well increase patient compliance [11, 12].

Among known mammography projections, it is generally recognized that the mediolateral oblique view, when properly performed, will image the greatest amount of breast tissue, especially the deepest part of the breast in the axillary tail region of the upper outer quadrant [6, 10, 13, 14]. For this reason, and also because of cost considerations, several large-scale mammography screening programs were begun that used only oblique views of each breast [6–8, 15].

However, the adequacy of this approach has been questioned by several authors, including some who are actively involved in one-view screening programs, primarily on the grounds that no single projection will identify all mammographically detectable cancers [14, 16–21]. Further objections have been raised because one-view screening may be more likely than two-view examination to result in requests for additional images to further characterize possible abnormalities [20–22]. The present study was designed to evaluate the differences between one- and two-view baseline screening examinations with respect to the frequency of call-back studies, the number of biopsies, and the cancers detected.

Subjects and Methods

The study population consisted of 2500 consecutive asymptomatic women undergoing mammography screening for the first time. The methods used in our screening program

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already have been reported in detail [4]; the emphasis is on producing excellent studies at low cost. Since the aim of screening is to detect unsuspected abnormalities rather than to characterize them fully, we streamline the imaging procedure to involve only two screen-film images of each breast, in mediolateral-oblique and craniocaudal projection. We also limit interpretation to two diagnoses, normal and abnormal, with the understanding that only a small percentage of examinations will be abnormal and therefore require additional imaging studies, at considerably higher cost. This overall approach provides high-quality mammography to a large number of asymptomatic women at less than one-third the price of an individually directed, problem-solving examination.

To investigate the full impact of screening with one rather than two standard views of each breast, a radiologist experienced in blinded image interpretation studies read each examination twice, first using only the oblique projection images, and then using both oblique and craniocaudal views. In this way it was possible to assess the differences in frequency of abnormal interpretation of one- and two-view-per-breast examinations and, therefore, the effects of single-view screening on the number of immediate call-backs for more complete mammography, the number of mammography-generated biopsies, and the number of mammography-detected cancers.

TABLE 1: **Results of Baseline Screening Mammography in 2500 Asymptomatic Women**

Results	Reading	
	One View per Breast	Two Views per Breast
Abnormal interpretations	642	179
Mammography-generated biopsies	76	83
Mammography-detected cancers	25	27

Results

Single-view baseline screening resulted in more than 3½ times the abnormal interpretations of two-view studies, with superimpositions accounting for the bulk of the abnormal cases (see Table 1). Most commonly, overlapping normal breast structures simulated masses on the oblique view, as illustrated in Figure 1. Less frequently, several isolated tiny calcific particles projected so close to one another on oblique view as to simulate a cluster of microcalcifications. In both of these circumstances, the additional perspective provided by a craniocaudal view was sufficient to eliminate any suspicion of malignancy, so that the standard two-view-per-breast examination was interpreted as normal. Another situation prompting abnormal interpretations on single-view examinations involved clustered calcifications in the skin that projected over fibroglandular tissues on the oblique view (Fig. 2). Demonstration of the true dermal location of the calcifications on a corresponding craniocaudal view permitted the two-view examination to be read as normal.

The additional information contained in craniocaudal projection images also generated some abnormal interpretations

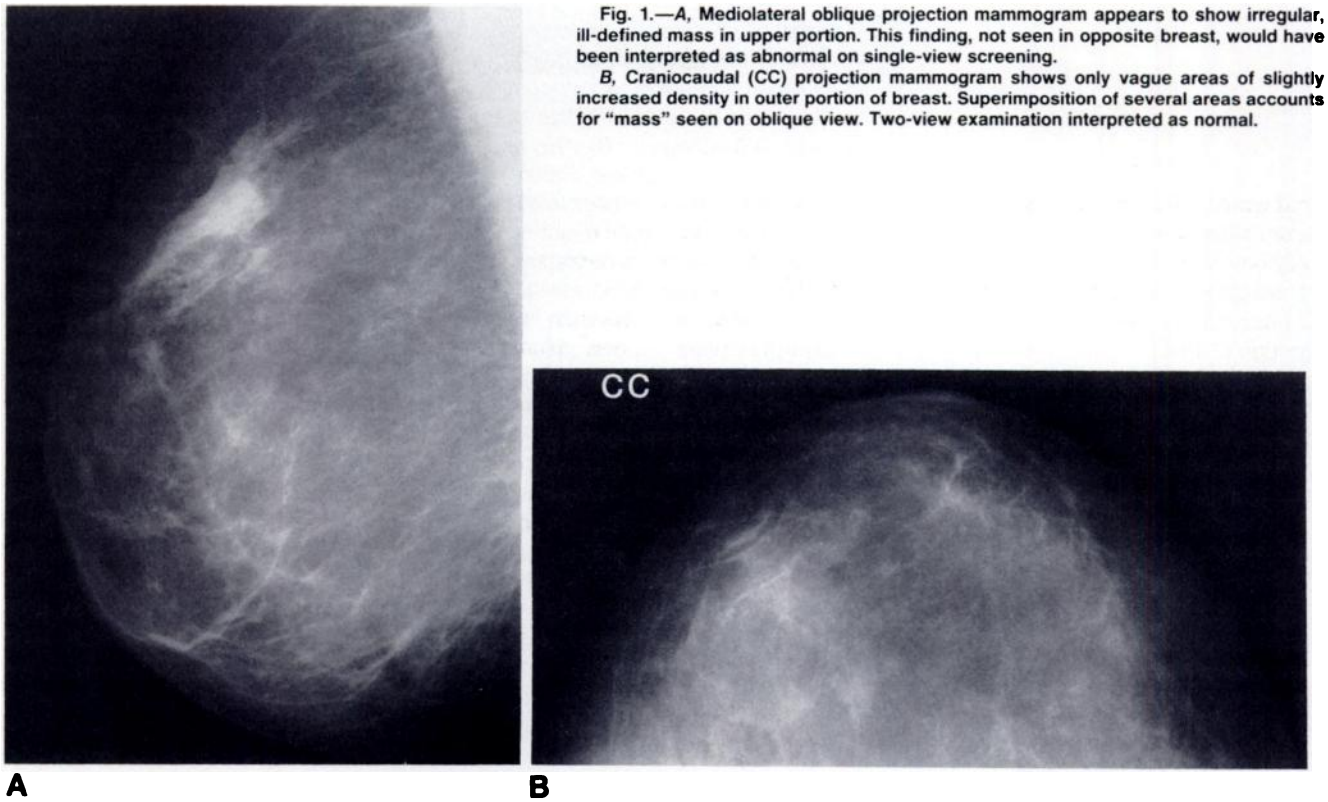

Fig. 1.—*A*, Mediolateral oblique projection mammogram appears to show irregular, ill-defined mass in upper portion. This finding, not seen in opposite breast, would have been interpreted as abnormal on single-view screening.

B, Craniocaudal (CC) projection mammogram shows only vague areas of slightly increased density in outer portion of breast. Superimposition of several areas accounts for "mass" seen on oblique view. Two-view examination interpreted as normal.

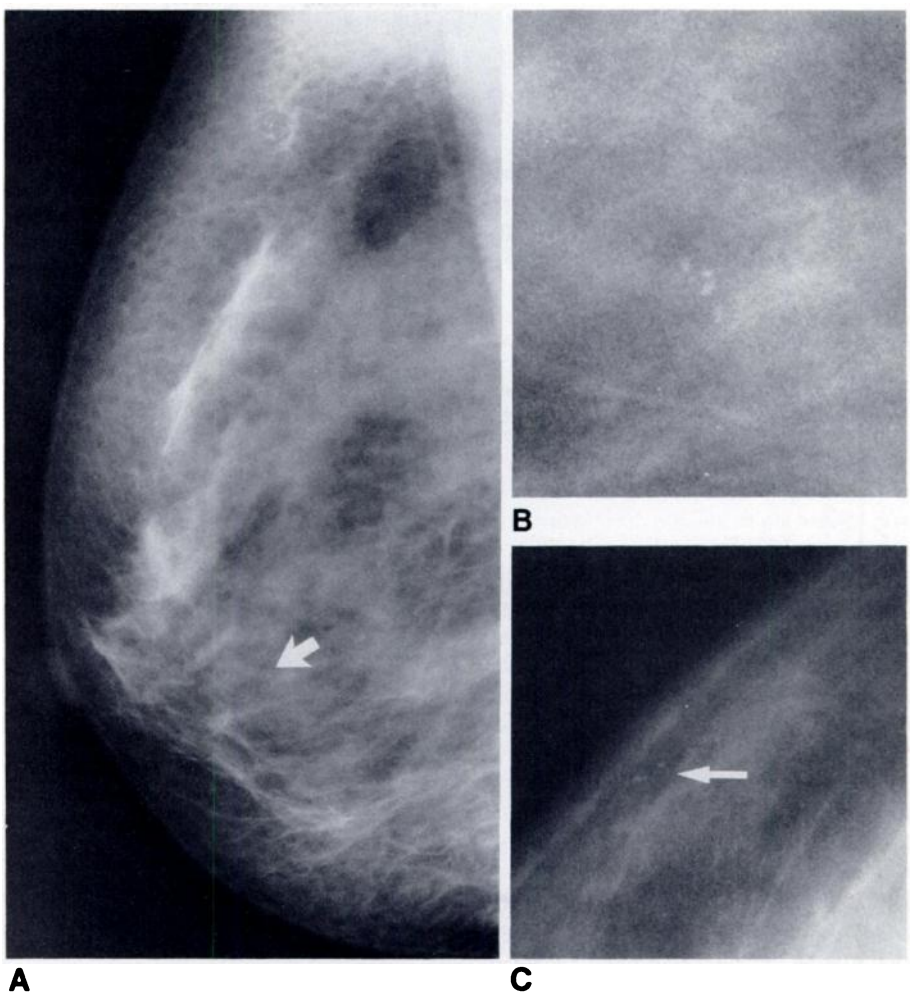

Fig. 2.—*A*, Mediolateral oblique projection mammogram shows cluster of tiny calcifications (*arrow*), apparently in retroareolar location. This finding also would have been interpreted as abnormal on single-view screening.

***B*, Photographic enlargement of area of interest shown in *A*.**

***C*, Photographic enlargement of part of craniocaudal projection mammogram shows calcifications in superficial location (*arrow*) that establishes them as dermal deposits, a clearly benign mammographic finding. Two-view examination interpreted as normal.**

that would not have been made based on single-oblique-view examinations alone. Occasionally an abnormality was seen only on craniocaudal view, either because it was located too far medially in the breast to be included on the oblique view, or because overlapping dense fibroglandular tissues obscured enough of the margins of a suspicious mass on the oblique projection image to prevent its detection. This resulted in seven biopsies that could be attributed solely to use of the craniocaudal view; two of these uncovered nonpalpable cancers (Table 1).

Discussion

It might be argued that, by halving the number of standard exposures with one-view screening, the proportionate reduction in radiation dose would encourage more patients and physicians to comply with mammography screening guidelines. However, viewed in the light of current low doses, the potential oncogenic risk of two-view examination is negligible [9, 10]. Therefore, patients who avoid mammography because of the ionizing radiation do so either because they lack knowledge of risks and benefits or because they fear radiation at any dose. Since neither of these obstacles would be overcome by further reducing a dose that already is very low, it is unlikely that single-view screening would meet with a substantially greater degree of compliance than current two-view examinations. For this reason, we have discounted considerations of radiation dose in assessing the relative merits of one- and two-view screening.

Our study reconfirms that two-view screening detects a slightly larger number of breast cancers than one-view examinations [14, 16–21]. No single mammographic projection portrays all of the tissues within the breast, so that the addition of a craniocaudal view to the mediolateral oblique view provides greater imaging coverage as well as a different perspective for observation. The resulting increase in lesion detection generates more biopsies and, thus, discovers more breast cancers. The price of several extra biopsies to detect a few additional cancers (seven biopsies for two cancers in our study) is one that traditionally has been accepted on the basis of both economic and social costs.

A large number of the abnormal interpretations from baseline mammography screening do not represent true lesions

detected [6, 8, 15, 22, 23]. Most management decisions, such as whether or not to biopsy, require more information than is provided by standard mammograms from either one- or two-view examinations, especially for the small and often subtle findings identified on screening. Only after more thorough characterization by additional imaging studies are some screening-detected abnormalities found to be clinically significant lesions. For this reason, single-view screening can result in many more abnormal interpretations, while two-view examinations actually generate more biopsies (Table 1).

The data collected in this study permit assessment of the relative dollar costs of one- and two-view mammography screening. Clearly, the operating expenses for one-view examinations are lower, by approximately $2.17 per patient, as summarized in Table 2. Not only are expendable supplies used up less rapidly, but there also is reduced wear and tear on fixed equipment, resulting in decreased costs for repairs and longer life in service. In addition, one-view examinations can be interpreted more rapidly than two-view studies because fewer films are read. Analysis of a consecutive series of 500 of our cases indicated a 40% reduction in interpretation time for one-view examinations. On the basis of our current $5 charge for reading two-view examinations, this could result in further savings of $2 per patient for one-view screening. One final consideration in assessing the cost savings of one-view examinations is the potential for increased patient throughput because fewer exposures are taken. However, most mammography screening programs manage patient flow efficiently by using two separate work stations, one for reception, the other for imaging. As a result, reduction in imaging time alone would not effectively increase throughput unless patient volume were high enough to justify twice as many work stations for reception as for imaging. Such an approach would require examining at least 80–100 patients per day, a volume that rarely is achieved in the United States. In summary, a realistic estimate of the total cost savings for one-view mammography screening amounts to approximately $4.17 per patient.

Weighed against these savings are the additional costs for follow-up imaging examinations generated by the increased number of abnormal interpretations resulting from one-view screening [20–23]. Our study clearly shows the magnitude of this problem, indicating that 19% more patients undergoing single-view (vs two-view) screening would require additional images to further characterize possible abnormalities. Assuming a charge of $100 for such additional problem-solving examinations, this would result in an average increase in cost of $19 per patient screened, more than four times the amount potentially saved by decreased operating expenses and interpretation fees. One-view mammography screening does not achieve substantial cost savings over two-view examinations, but rather proves to be more expensive.

The dollar costs calculated in our study apply primarily to low-cost screening programs patterned on the University of California San Francisco model [4]. However, geographic, economic, and political conditions in the United States vary sufficiently among communities to require different types of screening programs in many circumstances [2, 5]. As a result, the cost differentials between one- and two-view screening for such programs probably will not be the same as those reported here. However, our study shows that the cost excess for the additional call-back examinations generated by single-view screening is more than four times the concomitant cost saving resulting from decreased operating expenses and reduced interpretation fees. The sheer magnitude of this differential argues strongly that for any type of American screening program the overall cost of two-view examinations will be less than that of single-view screening. For this reason and because a few more early breast cancers will be detected, we recommend that baseline mammography screening be done by using two, not one, standard views per breast.

This recommendation applies only to the initial screening examination, and not to subsequent annual or biennial screenings. Many of the abnormal interpretations made on baseline examination will not be repeated on subsequent screenings [7, 24, 25], either because the abnormality will have been removed by biopsy or because the call-back examination generated by baseline screening will have shown the abnormality to be clinically insignificant. As a result, it may be appropriate to conduct follow-up screenings with single-view examinations, at least for women with fatty breasts [26, 27]. We plan to address this issue in a future study.

TABLE 2: **Estimated Savings in Operating Expenses for One-View (vs Two-View) Mammography Screening**

Operating Expense	Savings per Patient
X-ray film	$1.30
Screens	.01
Cassettes	.01
Film processor and chemicals	.12
Mammography unit	.73
Total	$2.17

Note.—Estimates of cost savings are based on actual experience whenever appropriate. Detailed explanation of these estimates will be provided by authors on request.

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