

Breast Xeroradiography:

An Analysis of Our First 17 Months

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Xeroradiography is a diagnostic radiologic method which has proven to be an excellent modality for mammary examination. It is an important tool in the detection of early and occult carcinoma and in the evaluation of a clinically palpable mass. The concept of total patient care as practiced by our medical group allows for close follow-up of cases and accurate determination of outcome in almost every instance. Our experience these past 17 months has confirmed the excellence of mammary xeroradiography.

The principle of xeroradiography was discovered by Chester Carlson, a physicist and patent attorney, in 1937. It was further developed by McMaster,² Hills¹ and others.³⁻⁶ Recent technical improvements made by the Xerox Corporation have made the work consistent, reproducible, and automatic. No review of this subject would complete without crediting John N. Wolfe, M.D., Hutzel Hospital, Detroit, Michigan whose diligent effort made this technic feasible and available to all radiologists.⁶⁻¹⁰

Xeroradiographic Process

Xeroradiography differs from conventional radiography in the substitution of a positively charged selenium-coated plate for X-ray film. The positively charged plate is placed under the breast (or other part of body to be examined) and is exposed to the conventional X-ray beam. The charge pattern remaining on the plate after exposure corresponds to the various densities in the breast, according to the amount of radiation absorbed. A negatively charged blue toner powder is dusted onto the plate, and the amount of toner attracted to the plate is proportional to the residual charge pattern. This image is then transferred onto a

sheet of plastic-coated paper as a permanent record. The image is delivered from the machine in 90 seconds. Concurrently, the plate is brushed clean—all latent images are removed, and the plate is stored and made ready for recycle and reuse. The process is essentially automatic.

Clinical Indications

Indications for xeroradiographs included fibrocystic disease, with or without pain, a dominant mass, nipple discharge, family history of mammary cancer, prior mastectomy and cancerophobia.

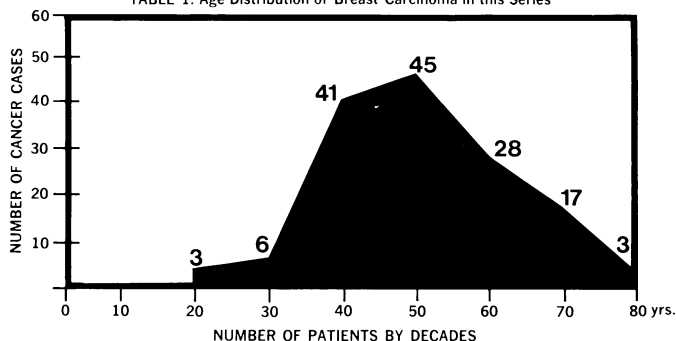
In our first 17 months, October 1971–March 1973, utilizing xeroradiography instead of conventional film mammographs, we examined 4,183 cases.

Three hundred and ninety-three of these patients subsequently underwent operation and of these, 133 were found to have carcinoma of the breast. In our series of selected patients, greater than 3% had mammary cancer. The age distribution of our mammary carcinoma population is presented in Table 1.

Eighty-one of the cancer patients had a dominant palpable mass and were suspected of having possible mammary cancer. Forty-one (51%) of these patients were subsequently proved to have “positive” axillary nodes.

Fifty-two occult carcinomas were demonstrated on xeroradiographs. These patients had no palpable mass or clinical evidence of primary mammary carcinoma. The indications for xeroradiography in this group included previous biopsy, postmastectomy check-up, tenderness, multiple bilateral breast nodules, fibrocystic

TABLE 1. Age Distribution of Breast Carcinoma in this Series



disease, and family history of cancer of the breast. Of these occult cases, 12 (22%) were subsequently proved to have "positive" axillary nodes. (Two patients with occult carcinoma had simple mastectomies because of associated medical problems. In these cases, of course, axillary node involvement could not be assessed.) *Our occult cancer pick-up rate was greater than 1:100 in our somewhat selected patients.* Analysis of our cases is diagrammed in Tables 2 and 3.

Seven of our patients had undergone mastectomy, two of whom had suspicious physical findings in the remaining breast which proved to represent carcinoma by xeroradiography and pathologic findings. Five post-mastectomy patients had no positive physical findings but proved to have carcinoma by xeroradiography and pathologic findings.

Case Report

Case 1. A 40-year-old woman had previous breast biopsies and then developed "nodules" in her left breast. Xeroradiograph (Fig. 1) reveals benign fibroadenomata plus carcinoma calcifications adjacent to benign lesion. This case demonstrates the value of preoperative xeroradiographic examination.

Case 2. A 66-year-old woman clinically had only bilateral benign fibrocystic changes. The superiority of xeroradiography is evident here (Fig. 2A-E).

Case 3. A 54-year-old woman had a mass beneath her left nipple associated with nipple retraction. This is a typical carcinoma (Fig. 3A-D).

TABLE 2. Cases: 17 Months of Breast Xeroradiography

XERORADIOGRAPHY EXAMINATIONS	4,183
SURGICAL-PATHOLOGICAL CORRELATIONS	393
CARCINOMAS	133
CLINICALLY SUSPICIOUS (51% POSITIVE AXILLARY NODES)	81
OCCULT CARCINOMAS (22% POSITIVE NODES)	52

TABLE 3. Carcinoma Analysis (133 Cases)

81 CLINICALLY SUSPICIOUS CASES	52 OCCULT CASES
49% NO NODE INVOLVEMENT	78% NO NODE INVOLVEMENT
51% POSITIVE NODES	22% POSITIVE NODES

Interpretation of Results

The substitution of xeroradiography for conventional mammography has significantly reduced diagnostic errors. In this series of 4,183 patients examined by xeroradiography, 2% of the women who had suspicious findings by palpation were falsely reported benign. Using conventional mammography in a previous series of 2,000 patients, our error rate for "false negatives" was 12%. Similar analysis of benign lesions demonstrates the superiority of xeroradiography. Most important, in our preceding series using film mammography, only four occult carcinomas were found. Fifty-two occult carcinomas were demonstrated xeroradiographically this year.

Nine errors in diagnosis—errors in not correctly diagnosing carcinoma—were made during these first 17 months. Four of these errors were misinterpretations of radiologically demonstrable masses. In two instances, lesions that were clinically palpated in the medial aspect of the breast were not demonstrated on the xeroradiograph. (We now use a special xeroradiographic technique for demonstration of palpable medial lesions.) One patient with a strong family history but no physical evidence of carcinoma of the breast, had a suspicious asymmetry of breast tissue on xeroradiographs. Before her requested follow-up study was to be performed, a fast-growing mass developed, and at operation a small focus of intraductal carcinoma was demonstrated. Experience has taught us that radiologists must read xeroradiographs on a regular basis in order to maintain high accuracy.

Discussion

At the Southern California Permanente Medical Group, we have an excellent opportunity for examination, follow-up, and surgical-pathological correlation of mammary lesions examined by xeroradiography.

We have confirmed the work of Dr. John Wolfe of Detroit, Michigan and Dr. John Martin of Houston, Texas, who have found that xeroradiography of the



FIG. 2A. Lateral film X ray interpreted as benign.

FIG. 2C. Caudal film X ray interpreted as benign.



FIG. 2A

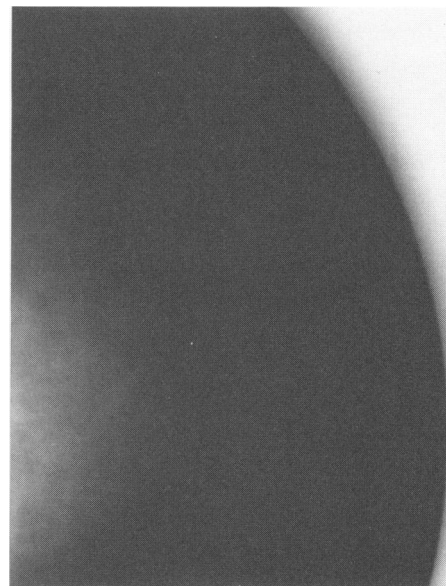


FIG. 2C

breast is superior to conventional film mammography. Xeroradiography produces images of greater detail with good overall visualization of all breast structures, permits faster and more accurate readings, diminishes the time and effort needed to obtain a good X-ray study of the breast, and reduces the amount of irradiation necessary to obtain a satisfactory image.

We have been surprised and encouraged by the number of occult cancers visualized by this method, and by the difference in the incidence of axillary metastases in this group as compared to those with clinically suspicious mammary masses (Table 3).

We have devised a technic for preoperative localization of clustered calcifications in the patient without a mass. Strips of tiny plastic numbers are taped onto the patient's skin dorsally and laterally, and routine lateral and caudal views are obtained. From this derived information we have been better able to direct the surgeon to the involved segment of breast. Specimen xeroradiography may be utilized to ensure that the suspicious areas is resected, and using a marker in the specimen, we sometimes are able to direct the pathologist's attention to the specific area of concern.

Summary and Conclusions

1. Xeroradiography is an improved method of X-ray examination of the breast as evidenced in 4,183 patients during a 17-month period (October 1971–March 1973).

2. Xeroradiographs are more easily interpreted, and in several instances we have been able to prove the superiority of this technic by comparing conventional X-ray mammograms and xeroradiographs.

3. Non-palpable carcinomas of the breast are demonstrated xeroradiographically. The increase in number of "negative" axillary dissections in these occult cases is encouraging, and these patients will be part of an on-going follow-up study or program. We may have a tool which will enable us to improve survival in carcinoma of the breast.

Acknowledgment

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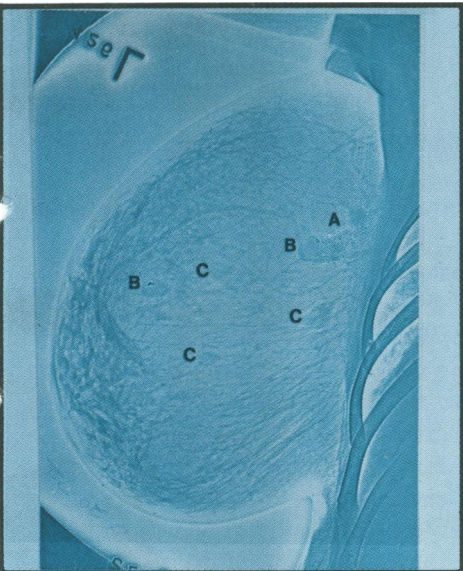


FIG. 1



FIG. 2B

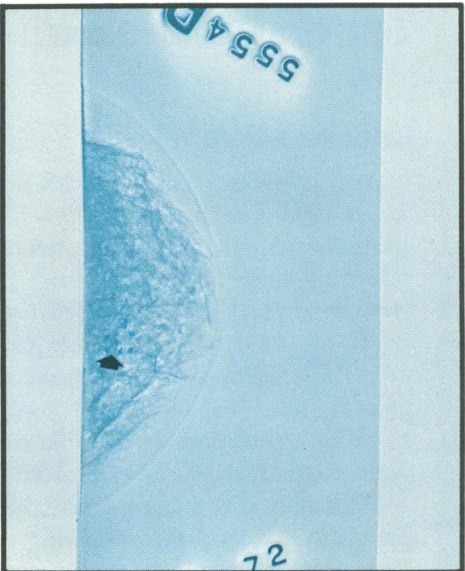


FIG. 2D

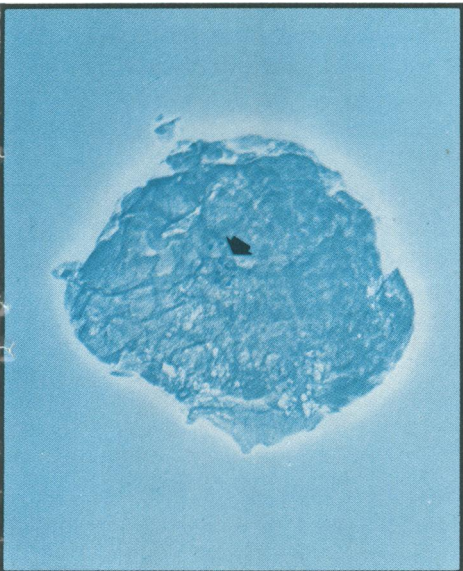


FIG. 2E

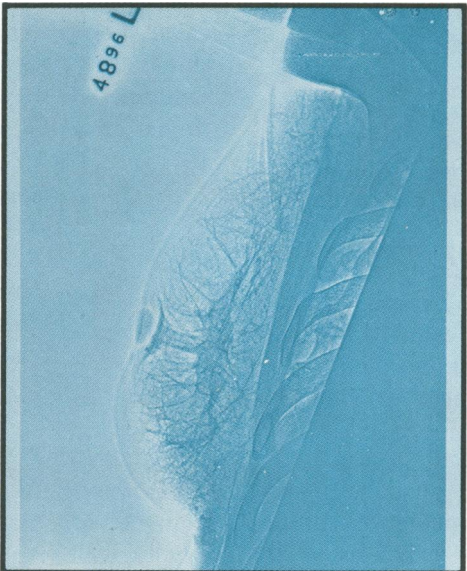


FIG. 3A

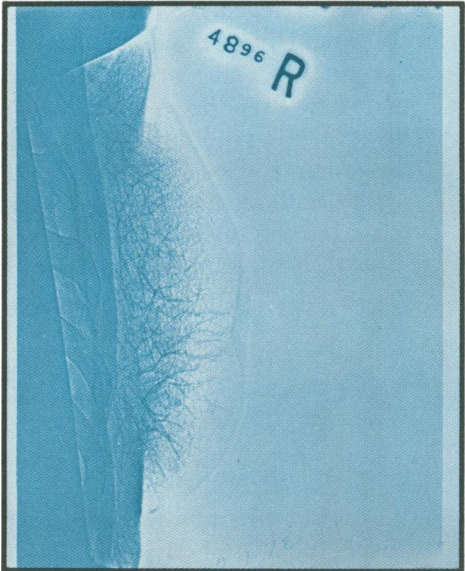


FIG. 3B

FIG. 1. Lateral xeroradiograph (a) infiltrating ductal cancer invading benign fibroadenoma, (b) fibroadenoma with benign calcification and (c) benign cyst.

FIG. 2(B). Lateral xeroradiograph. Arrow indicates clustered malignant calcifications. (D) Caudal xeroradiograph. Arrow indicates clustered malignant calcifications. (E) Specimen xeroradiograph localizing a malignancy. Arrow indicates clustered calcifications.

FIG. 3. (A) Lateral xeroradiograph of left breast demonstrating infiltrating scirrhus carcinoma with invasive mass, prominent duct pattern, skin thickening and nipple retraction. (B) Comparison view of normal right breast. (C) Caudal xeroradiograph of malignant left breast. (D) Comparison view of normal right breast.

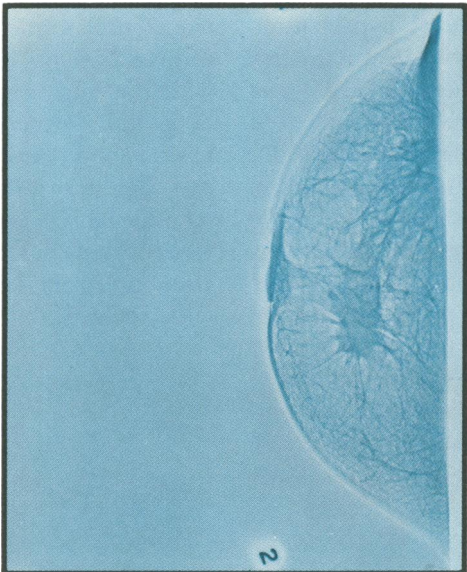


FIG. 3C

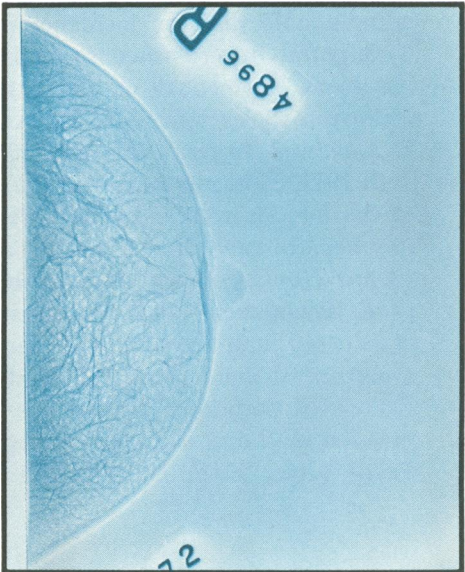


FIG. 3D