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Mammographic changes resulting from benign breast surgery impair breast cancer detection at screening mammography

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Abstract ***Purpose:*** To study possible explanations for lower screening performance after previous benign breast surgery.
Patients and methods: We included a consecutive series of 351,009 screening examinations in 85,274 women, obtained between January 1, 1997 and January 1, 2009. The examinations of women with screen detected cancers (SDC) or interval cancers (IC), diagnosed after previous benign breast surgery, were reviewed by two screening radiologists. They determined the presence and degree of post surgical changes, classified breast density and determined whether mammographic interpretation was hampered by tissue characteristics. They also assessed whether the cancer had already been visible at a previous screen.
Results: Screening sensitivity was lower in women with prior benign breast surgery than without (63.5% (115/181) versus 73.5% (1643/2236), $p = 0.004$). A total of 115 SDCs and 66 ICs were diagnosed in breasts after previous benign breast surgery. Post surgical mammographic alterations in the breast segment where cancer was diagnosed were more distinct in ICs than in SDCs ($p = 0.001$). Women with post surgical mammographic changes at the location of the breast cancer had an increased interval cancer risk (OR = 2.12, 95% confidence interval (CI) = 1.05–4.26). Limited mammographic interpretation due to tissue characteristics was mentioned, only in three SDCs and one IC. The proportions of SDCs and ICS that were already visible at a previous screen were comparable for women with and without prior surgery (SDC: 47.5% versus 43.8%, $p = 0.3$, IC: 50.0% versus 48.4%, $p = 0.8$).
Conclusion: Previous benign breast surgery decreases screening sensitivity and this is likely due to postoperative mammographic changes.

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1. Introduction

Many countries have implemented screening mammography programmes in order to detect breast cancer at an early stage and improve breast cancer survival.[1] Mammographic interpretation after conservative breast surgery and radiotherapy is frequently hampered by the presence of scar formation, contour deformity of the breast, thickened Cooper's ligaments, skin thickening and calcifications. Previous studies have shown that these changes compromise the sensitivity of mammography for breast cancer detection and lead to more additional diagnostic tests that will turn out to be negative at confirmation.[2,3]

Although the European and the United States screening guidelines provide recommendations for screening after breast conserving surgery for malignant disease, recommendations for screening following benign breast surgery are lacking. Benign breast surgery, including excisional biopsy and breast reduction surgery, also leads to permanent postoperative mammographic changes in up to 50% of women.[4,5] A history of excisional biopsy for benign disease is associated with a higher recall rate and we recently reported a lower sensitivity of screening mammography after previous benign breast surgery.[6,7] However, it is not clear whether this impaired sensitivity is due to post surgical mammographic alterations or due to specific breast tissue characteristics such as breast density or fibrocystic changes.[7,8] The purpose of this study was to study possible explanations for lower screening performance after previous benign breast surgery.

2. Patients and methods

2.1. Study population

We included 351,009 consecutive screening examinations of 85,274 women who underwent biennial screening mammography between January 1, 1997 and January 1, 2009. Screening was performed at one of two specialised analogue screening units in the southern breast cancer screening region of the Netherlands. Women with a history of ipsilateral breast conserving therapy or breast augmentation were excluded. Written informed consent regarding patient identification and exchange of data on screening and clinical follow-up was obtained from all women participating in the breast cancer screening programme. Institutional review board approval was waived by the Dutch Central Committee on Research Involving Human Subjects (CCMO).

2.2. Screening and referral procedure

Details about the screening procedure and referral procedure have been described previously.[7,9] In brief, before screening mammography was performed, women were asked to complete a short questionnaire about the family history of breast cancer (defined as at least one first-degree relative with a diagnosis of breast cancer before the age of 50 years, or at least two second-degree relatives with breast cancer), the use of hormone replacement therapy, as well as issues related to previous breast malignancy or previous benign breast surgery. For all women with a screen detected cancer or interval cancer (an interval cancer is a breast cancer that is diagnosed after a negative screening mammography, that is screening without a recommendation for referral, and before any subsequent screening examination), we recorded the information of the basic questionnaire in our database. All mammographic examinations were performed by specialised screening mammography technicians and independently double read by a group consisting of 12 certified screening radiologists. Prior screening mammograms were always available for comparison at the time of subsequent screenings and the screening radiologists had the completed questionnaire at their disposal at the time of reading. Discrepant readings between the two screening radiologists were either solved by consensus between the two radiologists or by radiologist panel arbitration. If consensus was not reached in a discrepant reading, or in case of a suspicious or malignant lesion, the woman was referred to a surgical oncologist or breast clinic for further analysis of the mammographic abnormality.

2.3. Follow-up procedure

The follow-up period for all screened women included the time through the next screening round (the screening interval was approximately 2 years). We collected data on diagnostic procedures, breast cancer diagnosis, histopathology and TNM (tumour-node-metastasis) classification of all referred women.[10] Breast malignancies other than primary breast cancers were excluded from the analysis and we considered lobular carcinoma in situ to be a benign lesion. Procedures for the detection of interval cancers have been described previously.[11,12] Most interval cancers were identified by linking the screening records to the regional cancer registry (Eindhoven Cancer Registry), regional radiotherapy institutes and regional pathology laboratories.

2.4. Review of screening mammograms

As part of our quality assurance programme, two screening radiologists (L.D., F.J.) routinely determine whether a cancer detected at a subsequent screen was already visible at the previous screening mammogram. For each interval cancer, they determine whether the cancer was already visible at the latest screening mammogram. At review, the radiologists had no information