



Review article

How effective is mammography in detecting breast cancer recurrence in women after Breast Conservation Therapy (BCT) – A systematic literature review

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ABSTRACT

Breast Conservation Therapy (BCT) is now seen as the treatment of choice for early-stage breast cancer, leading to a rising demand for post-operative surveillance. Ongoing mammographic surveillance of the post-operative breast is necessary to minimise the morbidity risk from recurrence. This review evaluates the diagnostic value of mammography following BCT, and identifies the possible challenges with mammography regarding imaging, interpretation and test performance when investigating the treated breast. Relevant literature was reviewed and critically analysed.

Three studies reported that surveillance mammography provided a significant survival advantage through early detection of recurrence. Five studies recognised the diagnostic challenges of surveillance mammography following BCT, reporting reduced sensitivity after breast surgery. The need for a more tailored screening strategy after treatment for breast cancer was highlighted in four studies.

Although overall mammographic sensitivity is reduced after BCT, it is still proven to be effective in detecting recurrences, therefore remains an important surveillance tool.

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Introduction

Statistical data has shown that female death rates from breast cancer have fallen by around one fifth in the past ten years and survival rates have steadily increased over the past forty years.^{1–4} This may be attributed to earlier detection following the introduction of the National Health Service Breast Screening Programme (NHSBSP) in 1988 and improved treatments including the widespread use of tamoxifen since 1992.⁵ With more breast cancer survivors comes the need for more long-term surveillance, and it is estimated that by 2020 there will be a 48% increase in the need for breast cancer follow-up services post breast cancer treatment.^{6,7}

Breast Conservation Therapy (BCT) has replaced radical mastectomy as the treatment of choice for early breast cancer. Studies have shown equivocal survival rates for both treatments, with BCT also allowing some preservation of the unaffected breast tissue.^{8,9} BCT involves the surgical excision of a malignant tumour with a

margin of microscopically normal breast tissue, usually followed by radiotherapy and or chemotherapy.^{9,10} The goal is to remove the tumour while minimising chances of breast cancer recurrence (BCR).⁵

Ongoing surveillance is necessary as post-operative recurrence and metastases are the leading cause of breast cancer associated mortality, with approximately one in four patients who develop local recurrence dying as a result.⁸ The risk of a second primary breast cancer remains significantly elevated for up to twenty years post operatively with around 15% of breast cancer survivors developing a second breast malignancy within ten years of their initial treatment.¹¹ Early detection is key to long term recovery, a five year survival rate of between 80% and 90% for ladies with asymptomatic loco-regional recurrences detected through clinical screening has been reported, compared with 25% for those detected at later stages with distant metastases.¹² Current follow-up guidelines recommended by the National Institute for Health and Care Excellence (2014)¹³ and by the Royal College of Radiologists (2010),¹⁴ suggest that patients should receive annual mammography until they enter the NHSBSP age bracket, or for five years following treatment if already eligible for screening. These

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recommendations are based mainly on expert opinion only as there is little quality evidence on the accuracy of mammography for ladies with a history of BCT.¹⁵

The post-operative breast represents an increasing diagnostic challenge in mammographic interpretation, as alterations to the breast following BCT can often mimic or disguise early signs of BCR, delaying diagnosis and may lead to a reduced prognosis for the patient.^{10,16} The aim of this study is to review current literature to evaluate the diagnostic value of mammography following BCT, and to identify the possible challenges with mammography regarding imaging, interpretation and test performance when investigating the treated breast.

Methodology

Relevant literature from the years 2009–2015 was retrieved using electronic databases including OVID, EMBASE and Science Direct. In order to ensure that relevant information was not missed, search terms were kept broad and relevant key words were combined to refine my searches. The literature was then reviewed and critically analysed to determine the strength of each article and therefore the weight it had in my discussion. Please see [Supplementary material](#) online demonstrating research strategy.

Findings/results

Challenges of post-operative mammography

Chansakul et al. recognised the difficulties in distinguishing between normal post-operative alterations and BCR.¹⁶ They suggest that in order to minimise unnecessary recall and permit earlier detection of recurrence, the reader must review mammograms in light of previous imaging and have an awareness of the timing and morphology of expected normal mammographic appearances post-surgery. A subsequent study suggests that any change in image appearance after the stability of post-operative alterations, is suggestive of a possible recurrence.⁹ The authors advise that post-operative mammography is often of suboptimal quality due to difficulty positioning the breast after surgical disfigurement, limited compressibility and an overall increase in breast density.¹⁶ Although much of this evidence is based on expert opinion, some of the points raised have been echoed in other more empirical literature within this review.

An increase in breast density due to surgical scarring can limit the interpretation of BCR on mammography by masking subtle abnormalities.¹⁷ Mammographic density (MD) is thought to be one of the strongest risk factors of breast cancer, and is linked with lower prognosis due to later detection.¹⁸ In a retrospective study by Cil et al., it was found that the risk of local recurrence after BCT was much higher in the high MD group (21% at 10 years).¹⁷ Risk was highest for women who did not receive radiotherapy and were in the high breast density group (40% risk at 10 years). The authors concluded that although there was a notable link between MD and local recurrence, there was no effect on distant recurrence or death. In a larger study by Eriksson et al., similar findings were reported, where women in the highest MD group had a three-fold increased risk of local recurrence than those in the lowest MD group.¹⁸ Again no link was found between breast density and risk of distant recurrence and survival.

Limited compressibility after BCT was investigated by Groot et al., who reported that women having a mammogram following BCT were five times more likely to experience severe pain compared to those with untreated breasts, owing to an approximate 30% reduction in elasticity.¹⁹ The study investigated the use of a sensor to calculate optimal pressure to apply to the treated breast.

An average reduction in pain by 26%, and severe pain by 77% was achieved when this technology was used. This study was based on a relatively small sample size ($n = 58$) and the main outcomes are based on model estimates.

Mathers et al., conducted a unique study into the experiences of women attending follow-up mammography appointments after breast disease, in which women described mammography as uncomfortable or extremely painful. Women reported increased anxiety due to tenderness, and some believed that this would impact on their ability to stay still during the examination.²⁰ It could be assumed that this may have a detrimental effect on resultant image quality through increased likelihood of image blurring, although this is not specified within the paper. Overall women valued the reassurance gained from having follow-up mammography and felt that this outweighed concerns of potential increased pain. This was a relatively small study with a possible selection bias, therefore may not be representative of the UK as a whole.

Mammographic surveillance after BCT

A cross-sectional study by Greenwood-Haigh, revealed a marked difference in the post-operative mammographic follow-up protocols used between centres in the UK.²¹ The majority of centres (56%) adhered to the current recommendations, performing annual mammography for five years after surgery, before discharging eligible patients to NHSBSP. Some patients however had been discharged immediately, with others receiving annual screening for up to ten years depending on geographic location. Although the authors admit that some generalisations have been made in the study, it generated an excellent response rate and highlights the lack of evidence available to determine the optimal frequency for follow-up after BCT.

A recent study compared recurrence outcomes of those having biannual compared to annual mammographic surveillance.²² It was found that recurrences detected six months post-treatment were significantly less advanced, smaller and node negative compared to those detected at annual intervals. It was suggested that biannual mammography for 5 years post-treatment could derive a significant survival benefit. This large scale study is thought to be the first to provide direct evidence comparing the effect of surveillance intervals on recurrence outcomes in the same populations. The validity of the study was questioned by Dershaw et al., who suggested that an overestimation of the real significance between the two groups had been made, as the smaller tumour size noted in the biannual mammographic surveillance cohort did not reach statistical significance.²³ Arasu et al., defended the significance of the findings stating that although tumour size did not reach maximum statistical significance, it had clinical significance as it separated smaller cancers from larger cancers, and noted that the prognosis for invasive cancers measuring 1 cm or less was around 90% survival at twenty years.²⁴

Houssami et al., have also reported a survival benefit from earlier detection of breast cancer in their retrospective study.²⁵ It was found that early detection of asymptomatic BCR improved survival by up to 47% compared with those detected symptomatically. The study found that asymptomatic cancers were smaller and more likely to be early stage, compared with symptomatic BCR. Mammography was reported to be more sensitive than clinical examination (CE) for detecting asymptomatic cancers, 87% versus 57% retrospectively. Although methods were used to minimise biases in this study, it is limited by its non-randomised design and does not report absolute survival. Similarly Lu et al., reported better overall survival for recurrences detected asymptotically by mammography rather than CE, reporting an absolute reduction in

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