Introduction

Breast screening with mammography is not a flawless test. The incidence of interval cancers for the early years of the UK screening programme were higher than expected in some regions. Reviews of the screening mammograms suggest that a considerable proportion of these interval cancers could have been detected at screening. Since the prognosis of interval cancers are likely to be worse than screen detected cancers it is important to minimise the number of false negative screens. As a step towards this location, tissue background and imaging characteristics of true positive and false negative screens of breast cancers was studied.

Method

Study groups

- Screening mammograms for two groups of women were selected - women with true positive screen detected cancers (TPSC) and women with interval cancers following a false negative screen (FNIC).
- Matched normals were selected for both the screening mammograms of the TPSC and the FNIC.
- Incident screening mammograms were assessed, with only medio-lateral images available.
- TPSC were cancers positively identified following the assessment of a screening mammogram and confirmed by pathology. The women had at least one previous screen where they were judged to be true negative.
- FNIC were cancers diagnosed in the period between the last screen and the next scheduled screen, following an earlier benign or negative or benign assessment of a mammogram.
- Matched normals were women whose mammograms showed no signs of cancer at the time of the scheduled screen. Normals also had a subsequent screen in which they were judged to be true negatives.

Imaging systems

- Systems used are included in Table 1 below.
- A tube potential of 28 kV was used for the majority of the mammograms. 30 kV was selected for the small number of women with "tough" breasts.
- A Mo/Mg target/filter combination was used together with the zucky grid.
- A target optical density (OD) of 1.6 for a 4 cm thickness of PMMA was used and the correct operation of the AEC was checked regularly.

Case selection

- Cases were selected between 1992 and 1998.
- Selection process was randomised.
- All the FNIC were independently selected for the assessment of a screening mammogram and confirmed by pathology. The women had at least one previous screen where they were judged to be true negative.
- In 88.8% of the mammograms the mean OD in the whole cancer ROI was less than in the main breast region.
- The percentage of dense breasts in which FNIC were discovered is greater than in the TPSC. (χ² test p value of 0.109, for all mass types).
- In both cancer groups the local cancer contrast was significantly lower in dense breasts, than in mixed density or fatty breasts.
- For both normal groups the mean OD increases as tissue type changes from dense, to mixed density, to fatty.
- Mean OD data is subdivided by cancer group and breast type in Table 2 and for the normal groups in Table 3.

Deditisation and radiological review

- Mammograms were digitised using a Lumixis Lumiscan 150 kV laser scanner with a pixel size of 210 μm.
- The digitised mammograms were calibrated from image pixel values to optical density units.
- Two expert film readers viewed the mammograms.
- Screening mammograms were used to grade the breast composition as either fatty, mixed density or dense.
- Cancer locations and outlines on the screening mammograms were recorded on transparent overlays for each of the TPSC and FNIC.

Discussion

- Mean OD in the main breast ROI of the mammograms varied widely.
- Mean OD in the cancer background ROIs also varied over a wide range of optical densities, with the majority of cancers being located against mean background ODs between 1.1 and 2.0.
- FNIC were more common in dense breasts than TPSC.
- In both cancer groups the local cancer contrast was approximately a factor of two lower in the dense breasts than in other types of breast.
- A poorly defined mass is as significantly less than a FNIC. Local cancer contrast of FNIC poorly defined masses were of the order of 0.1 OD lower than for TPSC.