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Impact of the transition from screen-film to digital screening mammography on interval cancer characteristics and treatment – A population based study from the Netherlands

Joost Nederend [a,*], Lucien E.M. Duijm [b], Marieke W.J. Louwman [c], Jan Willem Coebergh [c], Rudi M.H. Roumen [d], Paul N. Lohle [e], Jan A. Roukema [f], Matthieu J.C.M. Rutten [g], Liza N. van Steenbergen [c], Miranda F. Ernst [h], Frits H. Jansen [a], Menno L. Plaisier [i], Marianne J.H.H. Hooijen [j], Adri C. Voogd [c,k]

[a] *Department of Radiology, Catharina Hospital, Michelangelolaan 2, 5623EJ Eindhoven, The Netherlands*
[b] *Department of Radiology, Canisius Wilhelmina Hospital, Weg door Jonkerbos 100, 6532 SZ Nijmegen, The Netherlands*
[c] *Comprehensive Cancer Centre South (IKZ)/Eindhoven Cancer Registry, Zernikestraat 29, 5612HZ Eindhoven, The Netherlands*
[d] *Department of Surgery, Maxima Medical Centre, De Run 4600, 5504 DB Veldhoven, The Netherlands*
[e] *Department of Radiology, St. Elisabeth Hospital, Hilvarenbeekseweg 60, 5022 GC Tilburg, The Netherlands*
[f] *Department of Surgery, St. Elisabeth Hospital, Hilvarenbeekseweg 60, 5022 GC Tilburg, The Netherlands*
[g] *Department of Radiology, Jeroen Bosch Hospital, Vlijmenseweg 10, 5223 GW 's-Hertogenbosch, The Netherlands*
[h] *Department of Surgery, Jeroen Bosch Hospital, Vlijmenseweg 10, 5223 GW 's-Hertogenbosch, The Netherlands*
[i] *Department of Radiology, Maxima Medical Centre, De Run 4600, 5504 DB Veldhoven, The Netherlands*
[j] *Department of Radiology, St. Anna Hospital, Bogardeind 2, 5664 EH Geldrop, The Netherlands*
[k] *Department of Epidemiology, Maastricht University, P Debyelaan 1, 6229 HA Maastricht, The Netherlands*

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Abstract ***Introduction:*** In most breast screening programmes screen-film mammography (SFM) has been replaced by full-field digital mammography (FFDM). We compared interval cancer characteristics at SFM and FFDM screening mammography.
Patients and methods: We included all 297 screen-detected and 104 interval cancers in 60,770 SFM examinations and 427 screen-detected and 124 interval cancers in 63,182 FFDM examinations, in women screened in the period 2008–2010. Breast imaging reports, biopsy results and surgical reports of all cancers were collected. Two radiologists reviewed prior and diagnostic mammograms of all interval cancers. They determined breast density, described mammographic abnormalities and classified interval cancers as missed, showing a minimal sign abnormality or true negative.
Results: The referral rate and cancer detection at SFM were 1.5% and 4.9‰ respectively, compared to 3.0% ($p < 0.001$) and 6.6‰ ($p < 0.001$) at FFDM. Screening sensitivity was 74.1% at

* *Corresponding author:* Tel.: +31 402399111; fax: +31 402398565.
E-mail address: joost.nederend@cze.nl (J. Nederend).

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SFM (297/401, 95% confidence interval (CI) = 69.8–78.4%) and 77.5% at FFDM (427/551, 95% CI = 74.0–81.0%). Significantly more interval cancers were true negative at prior FFDM than at prior SFM screening mammography (65.3% (81/124) versus 47.1% (49/104), $p = 0.02$). For interval cancers following SFM or FFDM screening mammography, no significant differences were observed in breast density or mammographic abnormalities at the prior screen, tumour size, lymph node status, receptor status, Nottingham tumour grade or surgical treatment (mastectomy versus breast conserving therapy).

Conclusion: FFDM resulted in a significantly higher cancer detection rate, but sensitivity was similar for SFM and FFDM. Interval cancers are more likely to be true negative at prior FFDM than at prior SFM screening mammography, whereas their tumour characteristics and type of surgical treatment are comparable.

1. Introduction

Full-field digital mammography (FFDM) has gradually replaced screen-film mammography (SFM) in most Western screening mammography programmes. Several studies have shown an increased cancer detection rate at FFDM, in combination with higher referral rates and decreased positive predictive values of referral [1–3]. Because of the higher cancer detection rate at digital mammography, a decline in interval cancer rate may be expected. Interval cancers are breast cancers that are diagnosed in women after a screening examination yields negative results, defined as no recommendation for referral, and before any subsequent screen is performed. Furthermore, interval cancers show less favourable pathologic characteristics and a worse prognosis compared to screen-detected cancers [4–9].

Previous analogue screening mammography studies have shown that up to half of interval cancers may be true negative at review of prior mammograms [10–12]. Moreover, a significant portion of advanced interval cancers at SFM screening cannot be prevented through earlier detection at screening [13]. There is, however, very limited data about interval cancers diagnosed after digital screening mammography and it is not yet clear whether the interval cancers found at screen-film mammography are similar to interval cancers found at digital mammography screening. A recent Norwegian study on interval cancers diagnosed after screen-film or digital screening mammography did not find a decline in the interval cancer rate at digital screening and the mammographic features of missed cancers at digital screening were comparable to those missed at screen-film mammography screening [14].

To our knowledge, no data have been published on interval cancers at SFM and FFDM screening mammography in terms of their tumour biology and surgical treatment. In the current study we therefore not only compared the screening sensitivity and mammographic features of interval cancers at screen-film mammography and digital screening mammography, but we also determined tumour biology characteristics, including receptor status and tumour histology grade, and the type of surgical treatment (i.e. breast conserving surgery or mastectomy) of these interval cancers.

2. Patients and methods

2.1. Study population

We included a consecutive series of 60,770 screen-film screened women (6851 initial screens and 53,919 subsequent screens) and 63,182 digitally screened women (7019 initial screens and 56,163 subsequent screens). They were screened at three specialised screening units in a southern screening mammography region of the Netherlands (BOZ, Bevolkings Onderzoek Zuid) between 1st January 2008 and 1st January 2011. Of the 56,163 women with a subsequent digital screen, 29,649 were also included in the cohort of screen-film screened women. Screen-film mammography was replaced by full-field digital mammography on 26th May 2009, 3rd June 2009 and 6th April 2010 at the three units respectively. All women had given written informed consent to use their screening and follow-up data for evaluation purposes. The Central Committee on Research Involving Human Subjects (CCMO) in The Hague, The Netherlands, waived ethical approval for this study.

2.2. Screening procedure and referral

Details of our breast cancer-screening programme, offering biennial screening mammography for women aged 50–75 years, have been described previously [15,16]. In brief, screen-film mammograms were obtained with commercially available units (Performa, Oldelft, Tuusula, Finland). Dedicated mammography screens were utilised (Mamoray MR-R, Agfa, Schrobenhausen, Germany). Both dedicated film (Mamoray HDR; Agfa, Mortsel, Belgium), as well as extended-cycle dedicated processing were used. All digital mammograms were acquired with a Lorad Selenia FFDM system (Hologic Inc., Danbury, CT), with a 70 μm pixel size and a 232×286 mm field of view. All mammograms were