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Radiographer-led breast boost localisation – A service evaluation study

S. Smith*, C. Comins

Bristol Haematology and Oncology Centre, Horfield Road, Bristol BS2 8ED, United Kingdom

A R T I C L E I N F O

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A B S T R A C T

A radiation boost to the tumour bed as part of breast conserving therapy reduces the rate of local recurrence. Radiographer-led planning for tangential field radiotherapy has been the practice at our centre since 2007. The transition from conventional simulation to computed tomography (CT) and virtual simulation enhanced the radiographer's role in the breast planning process. Electron boost mark ups continued to be marked up freehand by doctors using available imaging to determine tumour bed.

The paper reports on a service evaluation undertaken to establish a change in practice for electron breast boosts to be simulated using the virtual simulator by suitably trained radiographers. The retrospective simulation of ten patients confirmed the consistency of radiographer tumour bed localisation, followed by the prospective simulation of ten patients' boost fields. The introduction of a radiographer-led planning breast boost service has given greater autonomy and job satisfaction to individuals as well as resulting in a cost effective use of available resources.

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Introduction

The addition of a radiation boost to the tumour bed as part of breast conserving therapy to reduce the rate of local recurrence is well supported.[1,2] The historical practice within our centre for an electron boost has been for the clinical oncologist to manually define the field borders as a free-hand mark up (FHMU). Information regarding the position of surgical clips and possible seroma formation was provided from the computed tomography (CT) planning data with the patient in the treatment position as well as preoperative imaging, surgical notes and palpation.[3] Since 2007 the clinical marking of breast cancer patients and their subsequent tangential beam placement has been performed by a suitably trained radiographer after successful completion of a breast mark-up module.

A service evaluation study[4] was undertaken to establish whether a suitable electron boost field could be accurately created and positioned using the whole breast CT planning data utilising the virtual simulator. The patient would be physically marked up for their boost on the treatment simulator. This latter step would eventually be phased out in favour of marking the patient on the treatment unit thereby eliminating one patient appointment. The boost marking role was to be transferred to the radiographers. A single radiographer was involved in the study with a retrospective training period followed by a prospective, monitored introduction of the new technique.

Although there is a plethora of evidence to support the use of CT planned electron breast boosts[5] there is a dearth regarding radiographers performing such a role. Because the delivery of the treatment did not differ and the radiographer's work was continually monitored by a consultant it was decided that ethical approval was not required to undertake this study. Each stage of the study was approved by an in-house multi-disciplinary radiotherapy group committee. Written permission was obtained from the patient whose images were used in this article.

Background

Radiographer-led planning for breast cancer patients has been our routine practice since 2007. At that time it was a combination of clinical breast border definition, coned-beam CT (CBCT) and two-dimensional (2D) radiographic simulator imaging that supplied the data to produce a tangential breast plan. The process was not an efficient use of the oncologist's time as their input was intermittent throughout the session with frequent interruptions often requiring their departure. Radiographer-led localisation of other tumour sites, such as bony metastasis, lung and oesophagus, had been achieved successfully at our centre using pre-prepared instructions.

* Corresponding author. Tel.: +44 (0) 117 342 2108.
E-mail address: simon.smith@uhbristol.nhs.uk (S. Smith).

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Such practice allowed the oncologist greater freedom to work away from the simulator, being available only if required. Appreciating the economic value of radiographer-led planning, its expansion to include breast cancer freed the oncologists from a large proportion of their allotted simulator sessions. Breast cancer patients account for 35% of the department's radical workload. Although additional, formal training was undertaken to assume this advanced role, it gave the radiographer autonomy and increased job satisfaction. The installation of a new CT scanner in 2010 facilitated the smooth transition of radiographer-led breast planning to the associated virtual simulator with its improved imaging technology.

However, electron breast boost mark-ups remained unchanged. The FHMU by the oncologist continued using the information available from the patient's notes, surgical notes, pre-operative mammogram or magnetic resonance imaging (MRI) and scar position to determine the tumour bed. Additional information could be supplied from the CT planning data regarding surgical clip position and seroma formation as well as chest wall depth for accurate electron energy selection.

Once the practice of CT planning was established and expertise had been gained, all of the tangential breast field virtual simulation became the remit of the radiographers. It was a logical progression to use the new mode of imaging technology to improve breast boost planning. The placement of an electron beam to cover the tumour bed can be done with greater confidence when surgical clips and seroma formation can be visualised and outlined.[6] Depth from skin surface to deepest clip or chest wall determines the electron energy to be used. A depth greater than 5 cm may not be adequately covered by an electron beam and the use of a mini-tangential photon beam would be a more appropriate course of action[7] by delivering a more uniform dose to the tumour bed. Although the surgical scar is routinely marked with radio-opaque marker prior to the scan its position no longer has the significance it once did due to the widespread use of oncoplastic surgical techniques. The use of three-dimensional (3D) imaging is essential to define the tumour bed and reliance should not be placed upon the scar position.[8]

Methods and materials

To practice the proposed technique and to train the radiographer, electron boost plans were retrospectively created using the CT planning data of ten patients who had completed radiotherapy treatment to the breast, including a boost. The ten were selected from a list of patients who had completed radiotherapy treatment, supplied by the quality assurance department, covering a two month period. For practical reasons patients were selected in chronological order with no bias towards the consultant to whom the patient belonged. Patients were excluded if they had received a tangential boost or if their treatment was part of a clinical trial.

All CT planning data were imported into the AcQSim virtual simulator (Philips Medical Systems, Cleveland OH). Surgical clips were the sole outlining criterion and when visualised within a CT data set are regarded as the gold standard for tumour bed delineation.[9,10] The outline of the clips was expanded by 2 cm to create the planning target volume (PTV).[11] The PTV was not extended beyond the skin surface or the lung/chest wall interface.

The PTV of the consultant and the radiographer were compared both visually (Fig. 1) and by calculated volume (Fig. 2) to establish the radiographer's ability to outline to a competent standard.

A skin apposition electron beam was simulated to encompass the PTV by the radiographer (Fig. 3). A second beam was created using the data from the electron boost the patient had actually received so a visual comparison could be made between the new and old technique (Fig. 4).

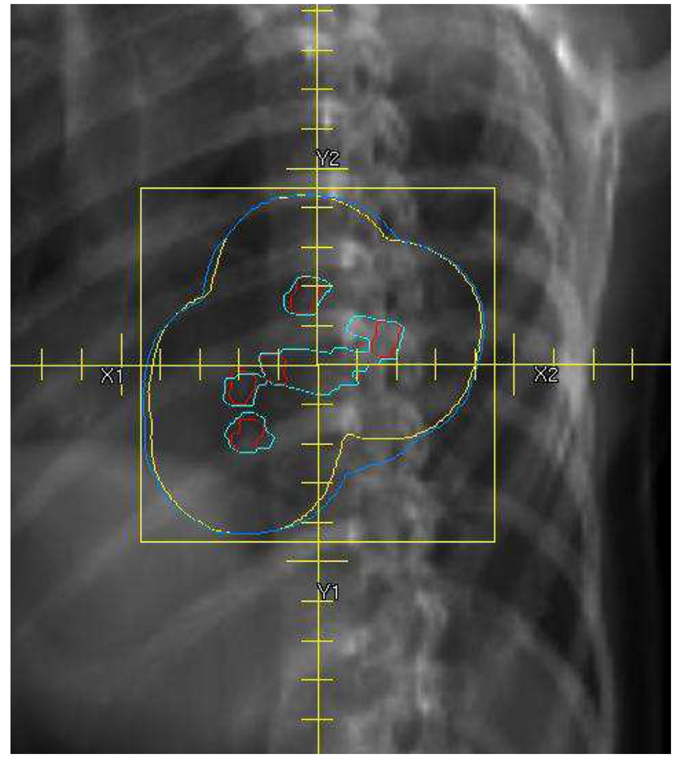

Figure 1. Clips outlined by radiographer (red) and consultant (sky blue). The included seroma by the consultant made little difference to the overall PTV, respectively, radiographer (yellow) and consultant (light blue).

After the ten simulated boosts were completed the consultant and radiographer discussed the cases and compared the radiographer's virtually simulated beams with the treatment beams that had been delivered. The volume of the delivered treatment beam that was included in the radiographer's PTV was calculated. This is shown in Fig. 5 as the percentage of the PTV that received treatment, with the assumption that the PTV coverage was 100% with the new technique.

As a typical example, the images in Figs. 1, 3 and 4 belong to patient number 1 in both graphs, and 87% of the PTV was included within the delivered beam. Although the surgical clips were included within the volume the margin surrounding them was less than 2 cm.

Once consultants were satisfied with the quality of the radiographer's outlining and the accuracy of the proposed changes in technique the second part of the service evaluation could begin.

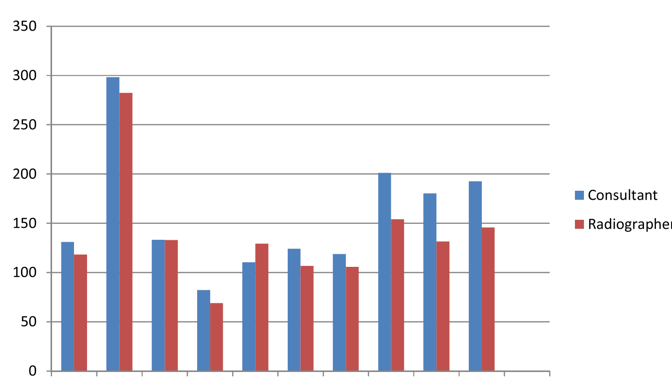

Figure 2. Graph showing the PTV volume in cm^3 for the ten retrospective patients.

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