



“Permanent marker free surface-guided breast radiotherapy: implementing a new technique”

Dr Christy Goldsmith, Deirdre Dobson, Adam Littler, Wendy Goldshaker, Prof Elinor Sawyer

Guy's and St Thomas' NHS Foundation Trust, London, King's College Hospital NHS Foundation Trust, London and Kings College London



Background

It is standard practice in our centre for patients to be given permanent skin marks during breast radiotherapy planning, for use as reliable landmarks in daily reproduction of their positioning for treatment. However, these permanent marks (tattoos) may have a significant psychological impact on patients (1). In recent years, there have been technological advances in surface-guided radiotherapy techniques (SGRT) which may provide improved set-up accuracy compared to permanent markers (PMs).

Aims

1. To evaluate if surface-guided set-up is as good, if not better, than set-up with permanent markers alone.
2. To safely implement a permanent marker (PM) free, surface-guided set-up technique.

Methods

A pilot study was conducted with tangents-only breast patients treated in free breathing (FB). Treatments were delivered on Varian TrueBeam linear accelerators, with patients immobilised on a couch indexed breast board. The study group (n=20) were set up using PMs with adjustments guided by the AlignRT® SGRT system to optimise patient positioning. MV tangent images were performed as per standard protocol on fractions 1-3, 8 and 12. Additional imaging was performed if indicated. Translational and rotational displacements calculated by the TrueBeam verification system for this group were compared to average displacements calculated for patients set up using PMs alone (the control group, n=20).

Encouraged by the results of the pilot study, the centre moved to safely roll-out the PM-free technique to include additional applications. The step-wise approach taken will be described. In addition, we will demonstrate the impact of the PM free technique on treatment times.

Results

Table 1: Mean displacements calculated from verification imaging

Displacement	20 patients: PM only (106 #s)	20 patients: PM + SGRT (114 #s)	Statistical significance
Lateral (mm)	2.27	1.56	Yes
Vertical (mm)	2.69	2	Yes
Longitudinal (mm)	1.44	1.53	No
Total Translation/ Vector (mm)	4.1	3.21	Yes
Pitch (degrees)	0.61	0.42	Yes
Yaw (degrees)	0.67	0.53	Yes

SGRT set-up demonstrated statistically-significant improvements compared to PM set-up alone with respect to lateral, vertical and total translational displacements. Longitudinal displacements favoured PM set-up alone but this did not reach statistical significance. Rotational displacements favoured SGRT set-up and the results reached statistical significance.

Given the improved set-up accuracy with SGRT, and the wish to reduce the psychological morbidity of radiotherapy for our breast cancer patients, the centre moved to safely implement a PM free SGRT technique along agreed timelines as shown in Table 2.

Table 2: Implementation of PM-free SGRT with timelines

Development stage	Detail	Date
Set up tangents only FB patients using PM + SGRT	Patients set up using PM + SGRT – pilot study showed SGRT comparable or better than PM alone (see Table 1)	Oct 2018
Breast Working Party decision to use PM + SGRT for all set-ups	To build on SGRT experience from pilot study to include all breast set-ups (nodal regions & Deep Inspiration Breath Hold, DIBH)	Sept 2019
Site visit to Birmingham, UK	Radiographer-led visit to observe PM free breast technique	Oct 2019
Report to Breast Working Party about PM + SGRT guided set up	Report showed improved consistency using SGRT and reduction in displacements for all set-ups	Nov 2019
Site Visit to Inverness, UK	Multi-disciplinary team (ClinOnc/Rad/Dosimetry) attended Inverness to review PM free CT, Planning & Treatment	March 2020
Need to Improve Social distancing from COVID19	Increased use of SGRT to maintain social distancing in RT treatment room at outbreak of pandemic	March 2020
Removal of breast borders	To simplify set up process	May 2020
Use treatment capture images to resolve set up issues + use SGRT for electron sets with PMs	Staff will have time to practice SGRT set up without using PMs before the PM-free technique is implemented	26 th May 2020
New CT protocol for DIBH	This allows fusion of scans so that patients can be set up in FB and monitored during treatment in DIBH	8 th June 2020
1 st PM free Tangent only FB patient treated	Mean translational displacements (mm) 0.05 Vert/0 Long/0.04 Lat Mean rotational displacements (o) Pitch 1.3/Roll 0/Yaw 0.9	17 th June 2020

Conclusions

Our pilot study demonstrated that surface-guided radiotherapy (SGRT) set-up is as good, if not better, than set-up with permanent markers (PM) alone in tangent-only free-breathing patients. Subsequent further analysis showed improved consistency of set-up guided by PM plus SGRT for all breast set-ups (to include nodal regions and DIBH). We have described our step-wise approach to setting up PM free radiotherapy delivery for breast cancer patients, which has additional advantages in maintaining social distancing in the COVID19 era.