supine position compare to prone position. Furthermore, the maximum and mean dose to the ipsilateral lung and heart was lower in prone position compare to supine position.

Conclusion: Irradiation of patients in prone positions compare to supine positions did not improved dose distribution within target volume. Using plans generated in prone position we were able to reduce the dose to the organ at risk especially ipsilateral lung and heart.

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Titanium clip placement to allow accurate tumour bed localisation following breast conserving surgery – audit on behalf of the IMPORT Trial Management Group

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Background: Accurate tumour bed (TB) localisation is a key requirement for the national IMPORT LOW (Intensity Modulated Partial Organ Radiotherapy) trial testing risk-adapted radiotherapy (RT). We audited the use of titanium clips for TB localisation in breast RT planning.

Methods: Audit standards were set as follows: (i) 5/6 pairs of clips identified on RT planning computed tomography (CT) scan – 100%; (ii) possible clip migration – <10%; (iii) TB localisation improved with clips – >50%. At surgery, paired clips were positioned around the TB as follows: 1. Medial, lateral, superior & inferior: half-way between skin & fascia; 2. Deep: midpoint, usually the pectoral fascia (posterior); 3. Anterior: close to the suture line, avoiding skin dimpling. 30 consecutive patients with clips inserted were audited at the time of the RT planning CT scan.

Results: The median time from surgery to RT planning CT was 29 days (range 17 to 98 days). The TB could be successfully identified using CT seroma alone in only 8/30 (27%) patients. However, the titanium clips gave additional information for the remaining cases, and thus improved TB localisation around 22/30 (73%) of patients. There was no evidence of clip migration in any of the cases. TB localisation modified field borders in 18/30 (60%) patients. 5 of these patients had clearly defined seromas, so the addition of clips modified field borders in 13/30 (43%) patients (7 left and 6 right breast cancers).

Conclusion: Titanium clips provide an accurate and reliable method of TB localisation. The CT seroma cannot be used alone for TB localisation in the majority of patients. Accurate TB localisation is important for standard whole breast radiotherapy, as well as being essential for planning the RT boost and for partial breast RT. We anticipate that the audit results will lead to clips being adopted as best practice by the Association of Breast Surgeons at BASO (British Association of Surgical Oncology).

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A multidisciplinary approach to boost the breast tumor bed in 8 phases

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Purpose: To describe a new procedure for breast radiotherapy (RT) that will improve tumor bed localization and RT treatment using multidisciplinary approach.

Patients and methods: This pilot study was conducted by the department of radiation oncology, surgery and radiology. A new procedure has been implemented summarized into 8 phases from pre-surgery contrast CT to surgery, tumor bed planning treatment volume (PTV) determination and lastly breast and tumor bed irradiation.

Results: Twenty patients (pts) presenting T1N0M0 tumors were enrolled in the study. All patients underwent lumpectomy with the placement of surgical clips in the tumor bed region. During the surgery, 1 to 5 clips were placed in the cavity of lumpectomy before the plastic procedure. All patients underwent their pre- and post operative CT scan in treatment position. The 2 sets of images were registered using a match-point registration. All volumes were contoured and the results were evaluated. The PTV was including: the clips region, the gross tumor volume (GTV) and the surgical scar, with an overall margin of 5−10 mm in all directions corresponding to localization and set-up uncertainties. For each patient the boost PTV was discussed and compared to our standard forward planned PTV.

Conclusion: We have demonstrated here the feasibility using multidisciplinary approach of a tumor bed localization and treatment procedure which seems adapted to routine practice. The use of more than one clip associated with a pre to post operative CT image registration allows a better definition of the PTV boost volume.

Table 1: Tumor bed localization and treatment workflow

Phase	Actors	Week
I – Pt's selection	Surgeon, Radiation oncologist	−2
II – Pre-surgery CT scan	Radiologist, Radiation oncologist RT technologists	−1
III – Surgery with placement of clips	Surgeon	0
IV – Post-operative CT scan	Radiologist, Radiation oncologist RT technologists	+4
V – Pre-to-post surgery CT registration	Dosimetrist	+4
VI – Volume delineation	Radiation oncologist	+4.5−5
VII – Treatment volume definition	Radiation oncologist	+4.5−5
VIII – Treatment planning	Dosimetrist, Physicist, Radiation oncologist	+5.5−6

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Voluntary deep-inspiration breath-hold radiotherapy for left sided breast cancer patients – first clinical results of a fluoroscopy guided method with retrospectively dose calculation

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Background: Heart related death is observed at long term follow up for left sided irradiated breast cancer patients. Breath hold (BH) position creates a larger distance between the thoracic wall and the heart and reduces the irradiation dose to the heart. We developed a fluoroscopy guided voluntary deep-inspiration breath-hold (DIBH) radiotherapy (RT) treatment protocol.

Methods: RT planning for the breast or thoracic wall was performed in BH position. Prior to irradiation a Cone-Beam CT scan (CBCT) was acquired and used for patient setup. During irradiation the BH position was guided by kV (kilovoltage) fluoroscopy, visually validating alignment of ribs and diaphragm. In addition, images of the treatment field were acquired using the megavoltage (MV) photons of the irradiation. kV and MV images were used to retrospectively analyze the actual set-up error and stability during irradiation.

The total delivered dose to the breast or thoracic wall and to the heart, left ventricle, left anterior descending artery (LAD) and the lungs were calculated by accumulating dose distributions for each field and fraction whereby the observed position errors were taken into account. The dose in BH position was compared to the dose planned on the free breathing (FB) CT scan.

Results: To date, 10 patients were incorporated within this protocol.

The intra-fractional reproducibility of the BH position is high and the localization accuracy was about 2 mm (1SD) systematic and random. By introducing these errors into the delivered dose no decrease compared to the planned dose was observed for the volume of the breast which received more than 95% of the prescribed dose ($p > 0.05$).

The maximum heart distance within the irradiation field was reduced from an average of 1.6 cm to 0.2 cm ($p < 0.001$).

DIBH reduced significant the mean and maximum dose to the heart, left ventricle and the LAD compared to the planned dose on the FB scan. The mean lung dose was not significant different between the BH irradiation and FB planning

Conclusion: First clinical results of online CBCT and fluoroscopy guided voluntary DIBH RT showed a high localization accuracy providing good coverage of the target area and a substantially decreases of dose to the heart, left ventricle and LAD.

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Dose received by the sentinel lymph node (SLN) clip – prospective comparative study of two radiotherapy (RT) techniques of breast irradiation

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Background: SLN biopsy is now frequently used for breast cancer (BC) conservative treatment especially for small tumors. The purpose of this study is to evaluate the prophylactic dose received to the region of SLN, marked by clip.

Methods and Materials: Between August 2001 and April 2004, for 152 patients (pts), who underwent a lumpectomy with SLN biopsy followed by