and postoperative seroma. In a recent study, no association between the irradiated target volume and the original tumor size was found in patients with DCIS and early stage breast cancer [den Hartogh et al., Breast cancer res treat, October 2011]. Therefore, two hypotheses were developed:

1. Tumor delineation on pre-operative imaging could lead to smaller target volumes, which are associated with superior cosmetic results and lower radiotherapy toxicity outcomes.
2. Supine breast MRI acquisition for RT delineation would result in superior soft-tissue contrast compared to the standard CT imaging in RT.

We have performed a feasibility study to test these hypotheses in order to perform a larger prospective cohort study.

Material and Methods: To test the first hypothesis, 9 patients with early stage breast cancer (pT1N0) who were treated with breast-conserving therapy (BCT), were retrospectively analyzed. Breast tumors were delineated on pre-operative prone contrast-enhanced MRIs. Clinical target volumes (CTVs) were created by adding a 1.5 cm surrounding margin. These MRI-CTVs were compared to the CT-CTVs acquired from post-operative delineations on RT planning CT scans. CT-CTVs were created by adding a 1.5 cm margin minus the minimal microscopic margin. Consequently, a 1.5 cm margin around the tumor was minimally treated.

To test our second hypothesis, we developed a protocol for MRI of the breast in RT position, since diagnostic MRI acquisition in prone position is not suited for supine RT delineation. Patients were positioned supine on a MRI compatible wedge board.

Results: The median tumor size was 12 mm (range 11−20 mm). The median excised specimen volume was 63 ml (range 26–174 ml). The median pre- and post-operative CTV values were 49.3 ml (range 28.6–96.8 ml) and 66.9 ml (range 20.0–218.6 ml), respectively. The median relative volume reduction was 31% (range −146−87%).

Furthermore, it was technically feasible to acquire high quality MRIs in supine RT position when using a 1.5T Philips Ingenia wide bore magnet. Within 25 minutes, the following 3D MRIs with fat suppression were acquired: T1 weighted FFE (DIXON), T2 weighted TSE (VISTA) and a dynamic series of contrast enhanced T1 (THRIVE) MRIs after Gadovist® administration. The Flexcoverage anterior receive coil was positioned on a PMMA support to prevent deformation of the outer contour of the patient.

Conclusions: In early breast cancer patients, treated with BCT, preoperative irradiation can result in a substantial reduction of irradiated target volumes in BCT. The developed MRI sequences are applied in a prospective cohort study which is currently running at our department. Pre- and post-operative target volume delineation and interobserver variability will be compared on both CT and MR imaging.

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Radiation-induced Pulmonary Injury After Radiotherapy for Early Breast Conserving Therapy

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Purpose: We observed a rare and unique occurrence of radiation-induced pulmonary injury after radiotherapy for early breast conserving therapy. We separated the pulmonary injury into inside and outside the tangential field. The goal of this study was to report and determine the incidence, analyze the characteristics of the pulmonary lesions on the images.

Materials and Methods: A retrospective analysis was conducted of 750 consecutive patients that underwent breast-conserving therapy (BCT) from January 1992 to December 2010. The patients were observed at least one year after radiotherapy for BCT. Radiotherapy was administered by 4 MV photons in all patients. The patients underwent chest X-rays and/or computed tomography (CT) periodically. We divided the appearance time of radiation pneumonitis into the super-early stage (during radiation therapy to 3 months after radiotherapy), the early stage (3 to 12 months after radiotherapy), and late stage (over 12 months after radiotherapy). If the pneumonitis was found on chest X-P, chest CT was conducted to identify the characteristics of the pulmonary lesion inside and/or outside the radiation field.

Results: The findings outside radiation field appeared to be idiopathic and were called radiation-induced bronchiolitis obliterans organizing pneumonia (BOOP) syndrome. The incidence of the radiation-induced BOOP syndrome was about 1.8%. We did not find a relationship between the characteristics of patients and the occurrence of radiation-induced BOOP syndrome. The pulmonary findings were classified into four patterns on chest CT. Progression of the pulmonary lesions observed on chest X-ray was classified into three patterns. Pneumonitis appeared within 6 months after radiotherapy was completed and disappeared within 6−12 months after its onset. The incidence of rate of the interstitial pneumonitis outside radiation field appeared in the super-early stage is 0.1%. On the other hand, the occurrence of the pulmonary findings inside field appeared in the early and late stage is approximately 85%. But these patients have no respiratory symptoms.

Conclusions: We have to understand the occurrence of the radiation induced or related pneumonitis, and its associated prognosis are not significant, the patients' clinical condition must be carefully followed.

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Does the Effect of Clip Displacement On Target Volume Potentially Hamper the Concept of Partial Breast Irradiation in Prone Position?

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Background: To analyse and compare the displacement of surgical clips in prone (*Pr*) and supine (*Su*) positions and assess the consequences on target volumes in case of partial breast irradiation (PBI).

Material and Methods: 30 post-lumpectomy breast cancer patients underwent CT imaging in *Su* and *Pr*. Displacements of the surgical clips were measured by the distances from the chest-wall (CW) and from a common fix bony reference point (3D vector analysis). On each dataset, the tumour bed (TB = clips ± seroma), clinical target volume (CTV = TB+1.5 cm) and planning target volumes (PTV = CTV+1 cm) for PBI were determined and the volume pairs were compared. Volumes were studied by multiple regression analysis with respect to a set of covariates: age, body weight, left/right side, cup size, localization within the breast, number of clips, presence of seroma and 'deep' clips (defined as located <1 cm from CW).

Results: Clip displacements varied considerably with respect to their position to the CW. The largest displacement was observed for clips situated close to the skin ($p < 0.0001$). The mean volumes of seroma (8.61 ± 8.61 (*Pr*) vs. $7.67 \pm 7.51\,cm^3$ (*Su*), $p = 0.037$), CTV (88.5 ± 37.0 vs. $75.0 \pm 32.3\,cm^3$, $p = 0.0001$) and PTV (233 ± 76.4 vs. $211 \pm 70.1\,cm^3$, $p = 0.0008$) were significantly higher in *Pr* than in *Su*. The PTV volume difference (*Pr-Su*) was significantly higher in patients with presence of seroma (48.1 ± 33.2 vs. $10.8 \pm 24.8\,cm^3$, $p = 0.002$), TB locations in the superior-internal-quadrant (SIQ) and at the border of superior quadrants (bSQ) (46.4 ± 31.2 vs. $5.72 \pm 20.6\,cm^3$ $p = 0.0002$) and in case of 'deep' clips (31.2 ± 32.8 vs. $0.47 \pm 17.2\,cm^3$, $p = 0.013$). When combining these factors in a multivariate analysis, two variables remained significant: seroma ($p = 0.0037$) and localization in SIQ-bSQ ($p = 0.0006$).

Conclusions: *Pr* position in selected patients potentially leads to a significant increase in target volumes in the frame of PBI. Factors independently predicting this volume increase are the presence of seroma and location of TB in the SIQ-bSQ.

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Improved Cosmetic Outcome After TARGIT Compared with External Beam Radiotherapy for Early Breast Cancer

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Background: Early results from the randomised controlled TARGIT Trial have demonstrated non-inferiority between the novel technique of TARGIT [intra-operative radiotherapy with Intrabeam® (Carl Zeiss, Germany)] and conventional external beam radiotherapy (EBRT) in women with early breast cancer, in terms of local relapse within the treated breast and clinically significant toxicity. We report here data from a sub-protocol assessing cosmesis in 114 women over 50 years of age participating in the TARGIT Trial from one centre (Perth, Australia).

Material and Methods: Frontal digital photographs from were assessed, blind to treatment, using specialist software (BCCT.core 2.0, INESC Porto, Portugal) which produces a composite score based on symmetry, colour and scar. Statistical analysis was by generalised estimating equations (GEE) on all of the data, and logistic regression analysis at year 1.

Results: 55 and 59 patients were randomised to receive EBRT or TARGIT, respectively. The median age at randomisation was 62 years (IQR 56 to 68). Photographs were taken at baseline (before surgery) and one, two, three and four years after initial breast conserving surgery; none had subsequent breast surgery. The scores were dichotomised into Excellent and Good (EG), and Fair and Poor (FP). There was a non-significant 45% increase in the odds of having an outcome of EG for patients in the TARGIT group relative to the EBRT group (OR = 1.45, 95% CI 0.78–2.69, $p = 0.245$)