

Previous dosimetric breath-hold technique studies focused on anticipated cardiopulmonary toxicity. In this study we compared inspiration gating (IG) with free breathing techniques focusing on breast coverage.

**Materials and Methods:** 49 consecutive patients with left sided BC were included in this study. All of the patients underwent lumpectomy and then treated with adjuvant radiation using the RPM system, at the Sheba Medical Center, during 2009-2012.

Two CT simulations were generated for each patient prior to treatment: the first during free breathing (FB) and the other during RPM IG. Planning target volume (PTV) and clinical target volume (CTV) were defined as the whole left breast and the tumor excision area, respectively (using RTOG definition). An optimized treatment plan was created for each scan, and a dosimetric comparison regarding breast (PTV and CTV) coverage as well as heart and lungs doses, was carried out.

**Results:** PTV V95% and Dmean were higher with IG vs. FB (82.38% vs. 78.88%,  $P=0.002$ , 95.73% vs. 93.63%,  $p<0.001$ , respectively). CTV V95% and Dmean were also higher with IG (98.87% vs. 88.92%,  $p=0.001$ , 99.14% vs. 96.73%,  $p=0.003$ , respectively). PTV V105% and maximum dose were not statistically different. The cardiac dose was lower with IG vs. FB (heart Dmean was 2.36Gy vs. 2.91Gy,  $P<0.001$ ; heart V2% was 14.62% vs. 17.59%,  $p<0.001$ ). The IG left lung dose was higher (13.28Gy vs. 12.10Gy,  $p=0.027$ ). No statistical difference was found for left lung V20.

**Conclusions:** In patients with suboptimal treatment plan due to anterior heart position on free breathing treatment plan, IG using the RPM system enabled better breast coverage, excellent CTV Dmean and reduced cardiac doses with no difference in lung V20.

These left sided breast cancer patients with anterior heart position are now routinely treated using the RPM system in our institution.

#### EP-1202

##### Survival after lumpectomy and mastectomy for early stage invasive breast cancer

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**Purpose/Objective:** Randomized clinical trials (RCT) have demonstrated equivalent survival for breast-conserving therapy with radiation (BCT) and mastectomy for early-stage breast cancer. Early stage breast cancer patients who underwent BCT or mastectomy was studied to observe whether outcomes of RCT were achieved in a single institution series, and whether survival differed by surgery type when stratified by age and hormone receptor (HR) status.

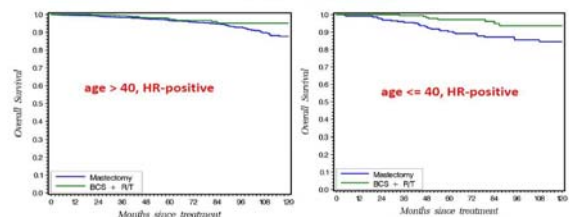
**Materials and Methods:** Information was obtained from the institutional breast cancer data base with stage I or II breast cancer between 1990 and 2007, who were treated with either BCT or mastectomy and followed for vital status through December 2012. Cox proportional hazards modeling was used to compare overall survival (OS) and disease-specific survival (DSS) between BCT and mastectomy groups. Analyses were stratified by age group ( $\leq 40$  years and  $>40$  years) and tumor HR status.

**Results:** A total of 2525 women fulfilled eligibility criteria. Women undergoing BCT had improved OS and DSS compared with women with mastectomy (adjusted hazard ratio for OS =0.6, 95% CI =0.4-0.8,  $p=0.0023$ ; adjusted hazard ratio for DSS =0.6, 95%CI =0.4-0.8,  $p=0.0028$ ). The group achieving greatest benefit in DSS with BCT relative to mastectomy were women aged 40 or younger at diagnosis with HR-positive tumors (hazard ratio =0.3, 95% CI =0.1-0.7,  $p=0.007$ ); however, this trend was seen among all subgroups analyzed.

#### Cox Multivariable Analysis

		Overall Survival			Disease-Specific Survival		
		HR	95% CI	P-value	HR	95% CI	P-value
Surgery	MRM	1			1		
	BCS+RT	0.6	0.4-0.8	0.0023	0.6	0.4-0.8	0.0028
Stage	I	1			1		
	II	1.5	1.1-2.1	0.0042	1.5	1.1-2.1	0.0117
Age	> 40	1			1		
	$\leq 40$	1.4	0.99-1.9	0.0624	1.4	0.98-1.9	0.0634
HR	Positive	1			1		
	Negative	1.3	0.9-1.8	0.2048	1.3	0.9-1.8	0.2303
Nuclear Grade	I	1			1		
	II	0.9	0.6-1.3	0.5483	1.1	0.7	0.8283
	III	1	0.7-1.6	0.8874	1.2	1.7	0.4473

#### Overall survival



	Full/Total	5-Year rate	10-year rate	P-value		Full/Total	5-Year rate	10-year rate	P-value
Mastectomy	80/976	96.7%	87.8%	0.0354	Mastectomy	32/241	90.3%	84.5%	0.0035
BCS+RT	14/478	97.5%	95.1%		BCS+RT	9/212	97.2%	93.6%	

**Conclusions:** Among patients with early stage breast cancer, BCT was associated with improved DSS and OS. These data provide confidence that BCT remains an effective alternative to mastectomy for early stage disease regardless of age or HR status.

#### EP-1203

##### DIBH for left-sided breast radiotherapy: Does this equate to a reduction in OAR doses?

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**Purpose/Objective:** 1) To evaluate if there is a reduction in OAR doses when using deep inspiration breath-hold for left-sided breast radiotherapy. In particular, is there a reduction in cardiac dose which can lead to long term radiation induced cardiac toxicity. 2) Determine if traditional field markup approaches need to be adapted, in particular limiting fields to maximum central lung depths (CLD).

**Materials and Methods:** At our centres all Breast patients are CT planned and the lungs and heart are contoured on the CT dataset to allow us to analyse dose statistics volumetrically. For left breast patients where Deep Inspiration Breath Hold (DIBH) is deemed beneficial two CTs are acquired in the initial planning session, the initial scan is free breathing and the second is acquired during DIBH. Fields are placed on the DIBH CT and then, based on tissue volume equivalence, copied to the free breathing scan. Clinically optimum plans are completed on both data sets and the dose statistics analysed for comparison.

**Results:** Data from 30 patients who were treated with DIBH and Forward-Planned IMRT were analysed to determine the dose vs. volumetric effect on the lung and heart. In all cases the heart dose is drastically reduced with DIBH almost eradicating dose completely. Previously we carried out analyses of central lung depth vs. lung volume which clearly showed that there is no correlation between distance measured and volume treated. In all cases, the use of DIBH did demonstrate an increase in average CLD, however there was also no correlation between CLD and lung volume, in line with the previous study.

**Conclusions:** DIBH is beneficial for left sided breast treatments. Particular benefit is seen by reducing the heart dose as research suggests irradiating the heart can be detrimental in relation to long term radiation related cardiovascular side-effects.

#### EP-1204

##### Hypofractionated whole prone breast RT using Sagittilt system: patient comfort, setup accuracy and acute toxicity

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**Purpose/Objective:** To present the first clinical results of prone breast RT using Sagittilt© (Orfit Industries, Wijnegem, Belgium) system in terms of patient comfort, RTT satisfaction, set-up accuracy, intrafractional movement and acute toxicity.

**Materials and Methods:** Twenty patients (17 right sided/3 left sided breast cancers) underwent whole breast irradiation in prone position. The first 17 patients were treated with sequential boost (breast: 42.56 Gy/16 fractions, boost: 10 Gy/5 fractions). Three patients were treated with concomitant boost protocol (breast/boost: 45.57/55.86 Gy in 21 fractions). Tilting function was used in 4/20 patients. Treatment verification included a daily online corrected cone-beam CT (CBCT). Furthermore in order to evaluate stability of the patient position, post-treatment CBCT were performed systematically at the first 5 treatment sessions. Treatment time, patient comfort and RTT satisfaction scores were also evaluated. A radar representation was used to determine points where most improvements could be made.

**Results:** The pre-treatment CBCT resulted in a population systematic error of 2.9/3.5/2.8 mm for lateral/longitudinal/vertical direction (LA/LO/VE), while for the random error 2.0/1.0/0.8 mm. Without correction these would correspond to a margin of 6.3/8.1/5.1 mm. The average time between the two CBCTs was just above 8 minutes. The post-treatment residual error was an average of 1.5/1.3/1.9 mm and was considered good. The patient and RTT oriented comfort questionnaire's average score was 4.3 and 3.1, thus excellent and average/good. Figure 1 represents the patient comfort during the entire treatment. Acute toxicity (G0/G1/G2/G3+) was the followings: Dermatitis: 1/11/8/-, Desquamation: 17/3/-/-, Pruritus 14/5/1/-, Oedema: 14/5/1/- and Pain: 4/12/2/-.

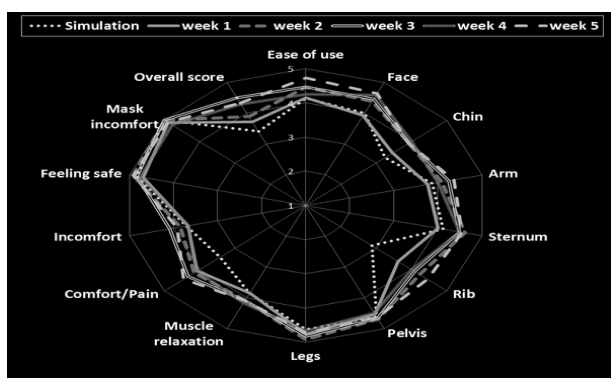


Figure 1. Radar representation of patient comfort questionnaire.

**Conclusions:** The Sagittilt© system seems to be a well-designed prone breast board as the early clinical results show good patient comfort, small setup and residual errors, and low acute toxicity. Further improvements (e.g. improve RTT satisfaction, higher setup accuracy) and larger cohort of patients are needed for reassuring the early clinical findings.

#### EP-1205

##### Hyperthermia and re-irradiation for effective treatment of loco-regional recurrences in breast cancers

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**Purpose/Objective:** Management of loco-regional recurrences (LRR) in previously irradiated and treated breast cancers is a therapeutic challenge. Hyperthermia (HT) at 41-43°C, with its radiosensitizing properties and inherent thermal cytotoxic capabilities is explored currently with re-irradiation (ReRT) for this condition. Our study is a retrospective evaluation of local thermo-radiotherapy in the management of LRR in previously irradiated breast cancer. The primary endpoint assessed is local control following ReRT and HT.

**Materials and Methods:** Between 2006 and 2013, 38 previously treated breast cancer patients, with various combinations of surgery, local radiotherapy (RT), chemotherapy and/or hormones and who later developed LRR in the ipsilateral chest wall (n=16), regional lymph nodes (n=4) or both (n=4) were considered for ReRT with HT at our institution. All patients had received previous RT to the loco-regional site. They were treated with 915 Mhz microwaves for 60 minutes to 41-43°C, once

or twice a week using BSD 500 system. Real time thermometry for the local site was carried out using multiple thermal sensors during the entire HT sessions. Depending on the site, size, dose and time of previous RT, a dose of 20 - 50Gy (mean  $\pm$  SD: 36.8  $\pm$  8.5Gy) was delivered at a dose/fr. of 1.8-4.0 Gy (mean  $\pm$  SD: 2.33  $\pm$  0.56Gy). Re-RT was carried out within 1 hour before or following HT sessions. Treatment outcomes were assessed by follow up consultations, phone calls or individual patient's follow-up records.

**Results:** Of the 38 patients, 14 were considered as non-evaluable as their follow-up details were not adequate to assess the treatment outcome. Thus, 24 patients were finally evaluable. They had an interval of 0-22 years (median : 6 years) between their first treatment and referral for treatment of LRR. The mean BED (Gy<sub>10</sub>) of Re-RT was 45.25 Gy<sub>10</sub> (SD:  $\pm$ 9.8) (range:28 - 60 Gy<sub>10</sub>). Patients received 2 sessions of HT per week and a total of 2 to 11 HT sessions (mean  $\pm$  SD: 7.3  $\pm$  2.3) were applied along with Re-RT. An objective response of 91.7% (22/24) was observed of which 66.7% (16/24) had a complete response (CR) and 25% (6/24), a partial response. All the 16 patients who had achieved a CR following ReRT and HT, maintained their CR status till the end of follow-up or death (median: 10 months, range: 2 to 32 months). HT was well tolerated and 41.7% and 58.3% of the patients experienced only grade I or II skin reactions respectively which recovered on conservative management within 3 to 4 weeks of completion of treatment. There was no evidence of any late toxicity.

**Conclusions:** Local HT with ReRT is an effective modality to treat LRR in previously irradiated breast cancers. The complete responses achieved with ReRT and HT is sustainable during post-treatment follow up period. Local thermo-radiotherapy can thus, be safely delivered, well tolerated and produces long term effective palliation in LRR with minimal morbidity.

#### EP-1206

##### Early clinical experience with image-guided intensity modulated accelerated partial breast irradiation

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**Purpose/Objective:** To report a phase II study protocol and early clinical experience, analysis of the dosimetric parameters, determination of setting inaccuracy of accelerated partial breast irradiation (APBI) with image-guided (IG-) intensity modulated radiotherapy (IMRT) following breast-conserving surgery (BCS) for early-stage breast cancer.

**Materials and Methods:** Between 2011 and 2013, in 51 cases of low-risk, pT1-2 ( $\leq$ 30 mm) pN0 M0 breast cancer, post operative APBI was given by means of IG-IMRT using static MLC („step-and-shoot“) technique with kVCT guidance for each fractions. The total dose of APBI was 36.9 Gy (9 x 4.1 Gy) using twice-a-day fractionation for 5 consecutive days.

**Results:** The median age was 62 years. Mean tumor size was 11.9 mm. At a median follow-up of 12 months neither loco-regional nor distant failure was observed. Median GTV (e.g. volume of surgical cavity) was 14.5 cc, median CTV was 79.9 cc, and median PTV and PTV<sub>eval</sub> were 150.8 cc and 129 cc. The dose-volume constraints, (V95<sub>PTV, EVAL</sub> = 100%, D<sub>min</sub>(PTV<sub>EVAL</sub>)  $\geq$  95%, D<sub>max</sub>(PTV<sub>EVAL</sub>)  $\leq$  110%, ipsilateral breast V100<sub>breast</sub>  $\leq$  35%, V50<sub>breast</sub>  $\leq$  60%, ipsilateral lung V30<sub>pulm</sub>  $\leq$  20%, V15<sub>heart, r</sub>  $\leq$  10%, V5<sub>heart, l</sub>  $\leq$  V5<sub>heart, tang</sub>) were met in all the treated patients. The median PTV/whole breast volume (WB) ratio was 0.16. The average standard deviations of setup inaccuracies were 1.4 mm, 1.6 mm, 1.5 mm, and the CTV-PTV margins were 5 mm, 6 mm, 6 mm in LAT, LONG, and VERT directions, respectively. The incidence of G1 and G2 skin toxicities were 29% and 4%, respectively. G1 edema was observed in 31%, G1 and G2 pain were reported by the patient in 8% and 4%. Grade 3 or worse acute side-effect was not observed. The 1 year cosmetic outcome was excellent in 62% and good in 38% of the patients.

**Conclusions:** IG-IMRT is a feasible technique for the delivery of APBI following conservative surgery for the treatment of low-risk, early-stage invasive breast carcinoma. Image-guided radiotherapy can improve daily reproducibility, allowing smaller treatment margins. Early results are promising, early radiation side effects are rare or mild, and cosmetic results are excellent.