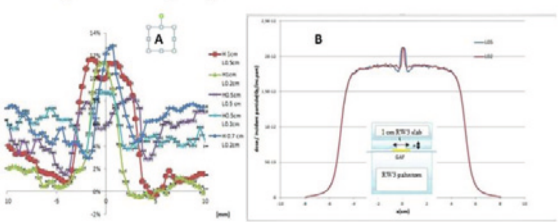
anterior rectal wall was 4.45 Gy (range 0.06-11.3). Median A-P and transverse diameter measured on pre-operative CT were 40 mm (range 27-60) and 50 mm (range 35-67) respectively. Median A-P diameters on intra-operative ultrasound were 30 mm (range 22-43) and 32 mm (range 24-47) with and without prostate compression, respectively. The most used collimator (41.6%) had a 5.5 cm diameter (range 4.5–7). A bevel angle of 30° was used in 96.4% of cases; 9 and 12 MeV beam energy were used in 50% of cases, respectively. All cases were discussed in a multidisciplinary meeting. IORT procedure lasted 30' in average (range 15-45).
Conclusions: The definition of a program of QA was useful in such a multidisciplinary and complex procedure as IORT. The increasing expertise of the staff over time allowed to optimize the procedure that resulted feasible and safe.

OC-0486
Radiochromic films and Monte Carlo simulation to analyze abnormal MOSFET reading in IORT breast cancer treatment
G. Taccini[1], F. Cavagnetto[1], L. Ferri[1], R. Bampi[1], M. Guenzi[2], G. Iaccarino[3], A. Soriani[3]
[1]*AOU IRCCS San Martino IST, Medical Physics, Genova, Italy*
[2]*AOU IRCCS San Martino IST, Radiation Oncology, Genova, Italy*
[3]*Istituto Regina Elena, IFO, Rome, Italy*

Purpose/Objective: To compare Radiochromic films and MOSFET measurements with Monte Carlo simulation in RW3 slab phantom with air gap in order to analyze overdosage measured with MOSFET during intraoperative electron radiotherapy in breast cancer treatment.
Materials and Methods: Patients affected by early-stage breast cancer underwent IOERT, treatments were performed using a mobile Linear accelerator (4, 6, 8, 10 MeV electron beams; LIAC, Sordina S.p.A., Italy). Dose was prescribed at the deeper part of the target normalized at 90%. MOSFET (BestMedical, Canada) detectors, placed inside a sterile catheter, fixed at the centre of the PTFE side of a shielding disk used to minimize the thoracic wall irradiation, were used in clinical routine to determine the dose collected by the deeper part of the target. Readings at half treatment in the 18% of cases are higher than 10%. Our hypothesis is that air gaps and non homogeneous tissues can create high dose hot spot in the irradiated glandular tissue. We have first simulate air gap and non homogeneous tissue using a filled water glove and a dose calibrated GAFCHROMIC® MD-V2-55 radiochromic film interposed between the glove and the PTFE plate, the air gap is between two 'fingers',then as a second step, to have a reproducible set-up, we have used a RW3 slab phantom with variable air gaps: high range: 0.5 - 1 cm and large range: 0.2-0.5 cm with the film interposed in the same way. Monte Carlo simulation (EGSnrc/BEAMnrccode, 1 mm simulation step, voxel dimension 1x5mmx29mm) has been utilized with an gap 1 cm high and 0.2 and 0.5 cm large.
Results: MD-V2-55 film interposed between glove and PTFE disk shows overdosages until 15% in the interface between water and air, the same values were found with RW3 slab phantom and with Monte Carlo simulation. Figure1A shows MD-V2-55 profiles obtained in phantom at different air gap dimension and Figure1B shows Monte Carlo simulation profile with the same phantom, the peak is 14% high.

Figure1 **A**: MD-V2-55 profiles obtained in phantom at different air gap dimension. **B** Monte Carlo simulation profile in the same geometry



Conclusions: Monte Carlo simulation and MD-V2-55GAFCHROMIC® film measurements might confirm that overdosage measured during IOERT breast cancer treatment might be due to nonhomogeneous tissues and air gaps, the next step will be to used MD-V2-55 GAFCHROMIC® film in vivo during IOERT to investigate dose distribution along the irradiated volume.

OC-0487
In vivo dosimetry using MOSFET and radiochromic films in intraoperative radiotherapy for breast cancer treatment
F. Cavagnetto[1], L. Ferri[1], S. Agostinelli[1], M. Gusinu[1], M. Guenzi[2], F. Pupillo[1], R. Corvò[2], G. Taccini[1]
[1]*AOU-IRCSS-S.Martino IST, Medical Physics, Genova, Italy*
[2]*AOU-IRCSS-S.Martino IST, Radiation Oncology, Genova, Italy*

Purpose/Objective: To check accuracy and uniformity of the dose delivered to the breast lumpectomy target during intraoperative electron beam radiotherapy (IOERT): we analyzed and compared radiochromic film and MOSFET reading in a sample of 19 patients.
Materials and Methods: 459 patients affected by early-stage breast cancer underwent IOERT, treatments were performed using a mobile Linear accelerator (4, 6, 8, 10 MeV electron beams; LIAC, Sordina S.p.A., Italy),using cylindrical applicators and steel-PTFE plates (3mm+3mm) placed between the residual breast and the pectoralis muscle to minimize the thoracic wall irradiation. Dose was prescribed at the deeper part of the target normalized at 90%. MOSFET (Best Medical, Canada) detectors, placed inside a sterile catheter, fixed at the centre of the PTFE side of the shielding disk, were used in clinical routine to determine the dose collected by the deeper part of the target. Delivered dose is divided in two parts and monitor unit are corrected if MOSFET reading exceed 10% of prescribed dose. Readings at half treatment in the 18% of cases are higher than 10%, therefore in a sample of 19 patient, in order to analyse dose uniformity along the target, a GAFCHROMIC® MD-V2-55 radiochromic film was interposed between MOSFET and shielding disk. The two detectors were calibrated at theLinac electron beam energies in the same geometry of daily dosimetry check. MD-V2_55 2D profile are acquired in region clearly patchy to determine: hot spot 2D dimension (width at half height) and hot spot value (HSV) defined as the % difference between expected dose and the mean between the maximum dose found in the hot spot and the respective 95%; HSV has been defined considering that dose prescription is assigned at R90, therefore a plus 10% in dose values is get in.
Results: 6/19 (31%) of GAFCHROMIC® MD-55 exposed films have shown occasional hot spot regions with values higher than 15%, **Figure1** shows an example of exposed film and **Table1** analysed HSV, hot spot size and taken up percentage of film size .HSV mean values: 26+2 Gy, mean size 1.4 +0.3cm^2 and mean percentage between hot spot size and the corresponding irradiated film is 7.6%.

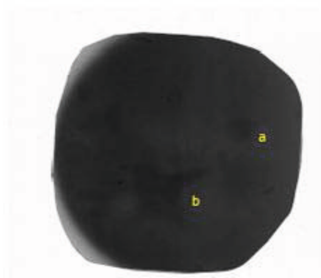


Fig1: Exposed film #6 with two hot spot analyzed:

a: D_{HSV}=(2802±73)cGy **b**: D_{HSV}=(2396±79)cGy

Table1: hot spot value, hot spot size and the comparison in percentage between hot spot size and the corresponding irradiated film.

#Film HSV id	HSV(cGy)	Size (mm^2)	%filmSize
1a	2484±97	61±19	4%
1b	2365±64	45±18	3%
2	2905±85	428±51	19%
3	2415±76	262±39	10%
4a	2631±110	141±30	12%
4b	2757±100	52±17	4%
5a	2720±88	239±39	17%
5b	2718±97	110±25	8%
5c	2782±85	97±24	7%
6a	2802±79	404±49	13%
6b	2396±79	103±25	3%
9a	2459±77	89±23	7%
10a	2450±98	43±16	3%
10b	2682±59	16±11	1%
10c	2559±90	25±12	1%
11a	1177±45	133±28	7%
11b	1148±21	238±38	12%
13a	2973±103	76±21	5%
13b	2777±60	77±23	5%
14a	2261±61	97±27	5%
16a	2770±86	233±40	16%
16b	2618±44	180±33	12%
18a	2618±127	98±24	6%

Conclusions: GAFCHROMIC® MD-V2-55 radiochromic films has been an useful tool to know real dose administration along the breast target and to understand some abnormal MOSFET reading.

OC-0488

Surgery and intraoperative radiotherapy for residual or recurrent anal carcinoma after primary chemoradiotherapy

C.L. Hallemeier[1], Y.N. You[2], D.W. Larson[2], E.J. Dozois[2], H. Nelson[2], J.M. Hubbard[3], K.A. Klein[1], R.C. Miller[1], M.G. Haddock[1]
[1]*Mayo Clinic, Radiation Oncology, Rochester, USA*
[2]*Mayo Clinic, Colon and Rectal Surgery, Rochester, USA*
[3]*Mayo Clinic, Medical Oncology, Rochester, USA*

Purpose/Objective: To report outcomes for patients treated with salvage surgical resection and intraoperative radiotherapy (IORT) for residual or recurrent squamous cell carcinoma (SCC) of the anus after primary chemoradiotherapy (CRT).
Materials and Methods: The prospective radiation oncology department IORT database was searched for patients treated with surgery and IORT for anal SCC. Thirty-two patients treated between 1993 and 2012 were identified. All patients had previously received primary concurrent CRT and had residual or recurrent disease based on clinical findings and/or tissue confirmation. All patients with recurrent disease received pre-operative, limited field external beam re-irradiation (median dose 30 Gray) and concurrent chemotherapy. IORT was utilized due to concern that salvage surgery alone would be unlikely to remove all gross and/or microscopic disease. Treatment-related adverse events were classified according to the National Cancer Institute – Common Toxicity Criteria Adverse Events (AEs). Overall survival (OS), disease-free survival (DFS), central failure (CF; within the IORT field), local-regional failure (LRF; tumor bed or draining lymphatics), and distant failure (DF) were estimated using the Kaplan-Meier technique.
Results: Median age at IORT was 53 years (range 34-87). Twenty-six patients (81%) were female. Salvage treatment was performed for residual disease after CRT (n=9), 1st recurrence after CRT (n=17), or 2nd recurrence after CRT and salvage abdominal-perineal resection (APR, n=6). APR was a component of the multimodality salvage attempt in 22 patients. Extent of surgical resection was R0 (negative margins, n=16), R1 (microscopic residual, n=13), or R2 (macroscopic residual, n=3). IORT was delivered with electron beams (n=31) or high-dose rate brachytherapy (n=1). Median IORT dose was 12.5 Gray (range 7.5 – 20). Median length of hospital stay was 9 days.
Nine patients (28%) were alive at last follow-up. The median follow-up duration was 1.6 years for all patients and 6.3 years for living patients. Mortality at 30 days after surgery and IORT was 0%. Fifteen patients (47%) experienced a total of 16 grade 3 treatment-related AEs. The most common Grade 3 AEs were wound complications (n=6), bowel obstruction (n=5), and ureteral obstruction (n=3). There were no grade 4 or 5 AEs. The 5-year estimates of OS and DFS were 23% and 17%, respectively. The 5-year estimates of CF, LRF, and DF were 26%, 64%, and 48%, respectively.
Conclusions: In this heavily pre-treated, high-risk patient population, aggressive salvage surgery and IORT was associated with long-term survival in a small, but significant subset of patients.

OC-0489

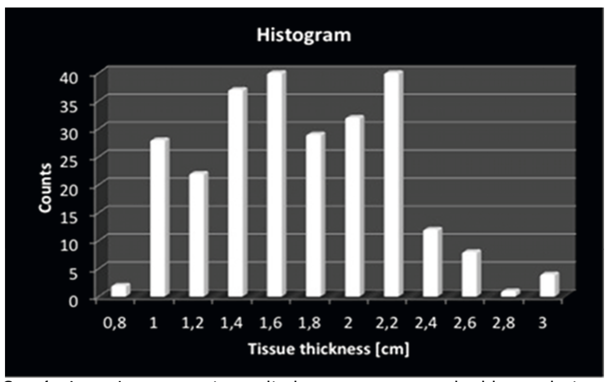
Intraoperative radiotherapy in breast cancer treatment using high energy electrons ñ four years of experience

S. Adamczyk[1], B. Urbanski[2], M. Litoborski[1], M. Kruszyna[1]
[1]*Greater Poland Cancer Centre, Department of Medical Physics, Poznan, Poland*
[2]*Greater Poland Cancer Centre, Department of Radiotherapy and Gynaecological Oncology, Poznan, Poland*

Purpose/Objective: Breast conserving therapy (BCT) with complementary radiotherapy is an effective alternative for mastectomy what was confirmed by comparable survivals in 20-years observations of randomized trials. Standard procedure after BCT is whole breast irradiation with higher dose on tumor bed. The dose escalation may be proceeded by brachytherapy, intraoperative radiotherapy (IORT) and conformal radiotherapy (3D-CRT) from external beams.
The purpose of this paper was to report four years of IORT during breast-conserving surgery (BCS) as a tumor bed boost using high energy electrons.
Materials and Methods: Between May 2008 and November 2012 in 255 breast cancers treated IORT as a tumor bed boost was applied using electron accelerator Mobetron 1000 (IntraOp Medical, Inc.). IORT boost (10 Gy) was followed by whole-breast external beam radiotherapy (EBRT) – 25 fractions 2.0 Gy each or 15 fractions of 2.7 Gy each for patients registered in multi-center HIOB trial (Hypofractionated Whole-Breast Irradiation preceded by Intra-Operative Radiotherapy with Electrons as anticipated Boost).
150 patients were analyzed to evaluate the risk of local failure after BCT, IORT boost and EBRT with minimal observation period of 1 year. The clinical profile is presented in table.
After tumor excision, shielding plate was placed on a patient's chest wall, underneath breast tissues. Appropriate applicator size and tip bevel were chosen to cover whole tumor bed with specified IORT margins. Electron energy was precisely chosen to assure homogeneous dose distribution and to deliver 10 Gy to the 90% isodose, which reaches shielding plate surface, independently of tissue thickness. Acrylic bolus caps, if needed, were placed on the surface of tumor bed.

		Number of pts.	%
Tumor size	Tis	9	6.0
	T1mi	1	0.7
	T1a	1	0.7
	T1b	45	30.0
	T1c	79	52.7
	T2	15	10.0
	T3	0	0
	T4	0	0
Histopathology	ductal invasive	71	47.3
	lobular invasive	2	1.3
	ductal invasive+DCIS	52	34.7
	lobular invasive+LCIS	1	0.7
	DCIS	8	5.3
	LCIS	0	0
	mucinous, apocrinal, tubular	16	10.7

Results: There was no local failure in analyzed group of patients. Median age of treated women was 58 years (35 to 77). Patients were treated using all available electron beam energies: 6 MeV was used in 52% cases but also 9 MeV, 4 MeV and 12 MeV (33%, 13% and 2% cases respectively) were used for treatment. In 51% cases applicator size (which is related to the tumor bedsize) was 5 cm in diameter. The smallest used applicator was 4 cm in diameter(27% cases) and the largest one was 7 cm (1%). This results in average planning target volume - PTV (volume of tissue encompassed by the 90% isodose line) of35.31 cc ranging from 12.00 cc to 75.35 cc. In 56% cases no bolus was needed; 0.5 cm bolus was used in 83 cases (33%). In all treatment procedures aluminium-lead shielding plates were used, 82% of which were 0.5 cm thick. The thickness of irradiated breast gland was less than 1.5 cm in half of treated cases and between 1.5 cm and 2 cm in 40%. Breast gland thicker than 2.5 cm was irradiated only in 3% of all treated cases (figure).



Conclusions: Intraoperative radiotherapy as a tumor bed boost during breast-conserving surgery for breast cancer using high-energy electrons from a mobile linear accelerator is proved to be effective and perspective treatment procedure.

POSTER DISCUSSION: 12: PHYSICS: OPTIMISATION AND MODELLING

PD-0490

Universal method to ensure robustness of dose painting by numbers prescriptions against geometric uncertainties

E. Sterpin[1], S. Differding[1], G. Janssens[1], V. Grégoire[1], J.A. Lee[1]