interstitial brachytherapy (BRT) in the anal canal based on RM guidance.

Materials and Methods: After a month from the end of the combined treatment RTCT, all the patients got a clinical examination, a PET-CT and an MRI. The prescribed brachytherapy target volume (TV) was individuated, supported by a radiologist, by MRI performed with vaginal applicator (MRI compatible) positioned in the anus. With a MUPIT applicator (Elekta©) in situ a CT simulation was performed. CT images were correlated with MRI by deformable co-registration (Velocity©). A treatment pre-plan was created in order to have information on the optimal position of the needles. Then the needles were positioned according to the indications of the pre-treatment plan. Afterward the patient underwent again a CT scan and the definitive treatment plan was created on Oncentra Brachy console.

Results: From February to June 2012, we treated 4 patients. 3 patients had histological diagnosis of squamous cell anal canal carcinoma (SCACC), instead 1 patient was a low rectum adenocarcinoma. The median age was 61,5 (range 49-78). There were: 2 patients cT2N0M0, 1 patient cT4N0M0 and 1 patient cT4N2M0. A patient didn’t ultimate the RT-CT combined treatment for toxicity. No complications were observed during and after the implant. The early follow up indicates no episodes of common complications at the first follow-up. Three patients had a complete response without tumor evidence and were alive without local recurrence or metastases. The patient that didn’t ultimate RT-CT treatment had a local persistence.

Conclusions: The integration of MRI guidance in BRT procedures seems to offer a better evaluation of the pelvis district adapting plan of treatment and of RT (TV). Patients had a compliance with scheduled episodes of complication for now. To evaluate the clinical results in terms of local control and survival we need a longer follow up and a more representative sample.

POSTER: IORT: BREAST CANCER

PO-0988
Comparison between linear accelerator and INTRABEAM® system for intraoperative radiotherapy of the breast.
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Purpose/Objective: The first treatments with INTRABEAM ® system (Carl Zeiss SAS) using low energy X-rays were performed in our institution in October 2011. Between 2004 and 2011 an electron linear accelerator was used for intraoperative irradiation of the breast for 82 patients.

Materials and Methods: Fifty-nine patients of mean age 71 years [59-87] have now been treated with INTRABEAM ®. For each, the radiation dose required was 20 Gy to the surface of the surgical margin in a single fraction. With the linear accelerator, 21 GY were prescribed to the 90% depth dose of the chosen energy. The system INTRABEAM ® produces low energy photons from a 50 kV and 40µA source while preceding irradiation technique used electrons energy of 6 or 9 MeV. The isotropy of the low energy photon beam and the dose rate were measured before each treatment with a specific system and a calibrated ionization chamber. During irradiation with electrons, we realize an ‘in vivo’ measurement with a semiconductor placed at the tumor bed by the surgeon and the radiotherapist during the positioning of the applicator. With the new technique, sterile applicators with variable diameters from 3 to 5 cm are selected to exactly fit the surgical cavity, thus allowing a homogeneous spherical irradiation. In our previous technique, the tumor bed flattened was systematically located 2 cm from the edge of the applicator (4 to 6 cm in diameter) to get a sufficient safety margin for processing.

Results: With INTRABEAM ®, the dose attenuation is rapid (5.4 Gy at 1 cm from the applicator surface), thereby reducing damage to surrounding healthy tissue. For treatment, mobile system is installed in one of two operating ambulances designed in accordance with radiation protection standards and does not require as before the immobilization of a radiotherapy bunker. The average time needed to deliver the dose was 27 minutes [20-53] for 59 patients using the low energy photon technique. This time had a good on-line of the applicator and is longer than the 11 minutes used before to deliver the prescribed dose with electrons. However, the total time needed for the room and the staff is not more important with INTRABEAM ® system as before.

Conclusions: The shift from breast intraoperative radiotherapy using a linear accelerator to INTRABEAM® was realized with no major problems in our institution. Using this new system has improved the workflow of radiotherapy and surgery, and thus increases the number of patients that can benefit from this technique.

PO-0989
Management of breast cancer: the multidisciplinary approaches in IORT procedure at Città di Castello Hospital
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Purpose/Objective: In the last ten years, intraoperative radiotherapy has been used extensively in the clinical setting as the exclusive mode of partial breast irradiation or as tumor bed boost during BCS. A careful diagnostic evaluation is essential for the choice of the most appropriate treatment. Most international guidelines recommend a multidisciplinary approach for patients with breast cancer. The multidisciplinary team provide to establish quality standards in the multiple aspects of the treatment and may be particularly important for a procedure as IORT in which different professionals must work together for the successful implementation of the treatment.

Materials and Methods: In our center, since February 2005 we treated about 500 cases of breast cancer with IORT and since January 2011, all the patients were evaluated by the multidisciplinary team made up of surgeon, radiologist, radiation oncologist, medical oncologist, pathologist, radiographers and nurses. The selection of patients to be able to be submitted to IORT exclusively takes place, in agreement with the surgeon, on the basis of the ASTRO guidelines, all other patients are treated with EBRT and intraoperative boost. One of the main limitations in the use of IORT is the absence of pathology information; in our center all patients received core-biopsy with the evaluation of predictive parameters (histology, grading, Her2, ER, PgR, Ki67) and before the surgery, an external or on-site external examination is performed to evaluate the surgical margins and the sentinel lymph node.

Results: Since January 2011 to October 2012 in our hospital 152 patients were treated with BCS and IORT. All patients were evaluated by the multidisciplinary team before and after surgery. 37 patients, had a biopsy compliant with the ASTRO criteria and received IORT exclusively, 115 received anticipated boost. Histologically, three patients treated with IORT exclusive, were not fully compliant with the ASTRO criteria: in one case there was evidence of neoplastic thrombus in the sentinel node, in the other case the grading was 3 and in the last case it was a lobular form.

Conclusions: An integrated, multidisciplinary approach is desirable to treat all patients. We consider IORT a safe procedure, with good cosmetic results, allowing more women to have access to breast conserving therapy; a careful selection of patients who may benefit from a partial breast irradiation is needed. We believe that the core-biopsy examination can be very predictive and therefore mandatory before an exclusive treatment. The close and constant collaboration with the surgeon and the pathologist has been essential in the improvement of the entire procedure.

POSTER: IORT TRACK: PHYSICS AND IMAGING

PO-0990
Software for calculating the dose distribution in the low-energy X depending on the angle of incidence
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Purpose/Objective: The use of low energy X-ray radiotherapy is not always done in ideal conditions with the beam perpendicular to the surface. It is therefore important to know what will be the impact of the angle made by the applicator on the dose distribution. For this we have developed a software based on a Monte Carlo code.

Materials and Methods: We use a papillon50 emitting 50 kV X-rays with applicators of different diameters (22, 25 and 30 mm). The apparatus and applicators were modeled with the Monte Carlo code PENELOPE. The validation of this model was made by comparing calculations and measurements by ionization chamber and films gafchromics EBT2. It
was then possible to develop software for calculating the dose distribution at any angle made of the applicator with the surface.

**Results:** The software calculates the dose distribution by varying the angle and the depth to which you want to know. The variation of homogeneity is very important. For an angle of 25°, the inhomogeneity in the surface plane is between 100 and 40%.

**Conclusions:** A software has been developed, based on the computation code PENELLOPE to know the dose distribution at any depth as a function of angle applicator with the surface.

**PO-0991**
A noval approach of superficial intraoperative radiotherapy (IORT) using a 50kV x-ray source

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**Purpose/Objective:** IORT is becoming an increasingly popular approach for cancer treatment. Especially patients with very close or positive margins after resection or recurrent cancer benefit from IORT. For situations where a flat area (up to 6cm in diameter) has to be treated intraoperatively, new applicators for superficial treatment with a miniature x-ray source (INTRABEAM® System, Carl Zeiss Surgical GmbH, Oberkochen, Germany) were developed. They were evaluated using ionization chamber and film dosimetry.

**Materials and Methods:** Each of the so called FLAT (1 - 6cm diameter) and SURFACE Applicators (1cm - 4cm diameter) consists of a radiation protective metal tube and a flattening filter, which converts the spherical dose distribution of the x-ray source into a flat one. The homogeneity of each dose distribution and depth dose measurements were evaluated using a film dosimetry (Gafchromic EBT2 films, ISP, New Jersey, USA) in a solid water phantom (Gammex 457, Gammex Inc., Middleton, WI, USA) and a soft x-ray ionization chamber (Type 34013, PTW, Freiburg, Germany) in a water tank (Carl Zeiss Surgical GmbH, Oberkochen, Germany).

**Results:** The FLAT Applicators show the best homogeneity, with a maximum standard deviation of 2.66%, in certain depths. In 1mm depth SURFACE Applicators show a lower field edge dose (compared to the central axis dose) of up to 31%, which corresponds to a geometrical error of 2mm. They also show a higher dose rate (0.53 - 1.78Gy/min in 5mm depth) and a steeper dose gradient compared to the FLAT Applicators (0.17 - 1.24Gy/min in 5mm depth). This results in a treatment time of 1.0 - 6.5min in an instance of a prescription of 10Gy to the surface of the SURFACE Applicators, respectively 9.5 - 61min in case of a prescription of 10Gy in 5mm depth from the surface of the FLAT Applicators.

**Conclusions:** Generating flat dose distributions in a certain depth using the INTRABEAM® System and novel applicators result in an inhomogeneity at the surface of these applicators. To evaluate the exact extent of homogeneity there, further research based on Monte Carlo simulation is needed. But the results show that it is possible to perform a superficial localized IORT with shielding of the surrounding tissue and with minimum radiation protection requirements.

**PO-0992**
In vivo dosimetry and shielding disk alignment verification in breast IORT treatment

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**Purpose/Objective:** A new method for in vivo dosimetry (IVD) during breast intraoperative radiation therapy (IORT) was carried out to improve information on the dose actually delivered to the target and for optimizing the shielding disk. With this method it is possible to acquire two bi-dimensional dose distributions: one just below the target and the other beyond the shielding disk.

**Materials and Methods:** Breast IORT requires the protection of the tissues underneath the target volume. This is achieved by the surgeon positioning a shielding disk between the residual breast and the pectoralis fascia. The position of the disk is a very suitable location for performing IVD. In our experience we prepared two layers of radiochromic films. Radiochromic EBT3 of the same size of the shielding disk, we fixed them by sterile tape to both sides of the disk, which was then delivered to the surgeon for subsequent placement. The radiochromic films were calibrated in dose for the two energy (6 and 9 MeV) usually employed in breast cancer treatment to provide a bi-dimensional distribution in term of absolute dose. After each treatment the radiochromic films were read by a CCD scanner producing two digital images suitable for subsequent analysis.

**Results:** The Department of Radiotherapy of Trieste has recently implemented a IORT dedicated electron-beam accelerator, the IntraOp® Mobetron. The first patients were treated immediately after conservative surgery for breast carcinoma, and two in vivo dose maps were acquired for all of them. The image related to the film positioned on top of the disk allowed us to evaluate the mean absolute dose in a central area of the exposed field to compare with the prescribed dose. In all cases we obtained excellent agreement. The uniformity of the exposed area was also evaluated (Fig.1).

**PO-0993**
Intraoperative radiotherapy for prostate cancer: preliminary midterm results of a mono institutional study.

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**Purpose/Objective:** To evaluate the local control and early late toxicity of IORT for localized prostate cancer.

**Materials and Methods:** Between December 2009 and September 2010, 8 patients with locally advanced prostate cancer or high/low systemic relapse risk were selected. We enrolled patients with ≤ 70 years age, without clinical nodal disease, and at least two of following characteristics: pre-operative PSA >10 ng/ml and <20ng/ml; Gleason score ≥ 7; cT1c; or at least one of following characteristics: apical gland involved; pre-operative PSA >20mg/ml and <50ng/ml; Gleason score ≥8; cT3c. Before the surgery the Ethical Board validated informed consent for adjuvant IORT was obtained. The surgery included radical prostatectomy with iliac-obturators lymphadenectomy and extemporaneous histological examination for nodal metastasis research. After prostate removal the patients were irradiated with IORT receiving a radical dose of 20 Gv in single fraction by 10 MeV electron beam. The IORT procedure was performed after bladder-urethral anastomosis and confirmation of pathological negativity of

**Fig.1 - Images of the EBT3 Gafchromic® film located on the upper face of the shielding disk. a) Original image (green channel); b) Representation enhancing the dishomogeneities of the target.**