

(according to table given in Fig1.b) consists of 25 pixels. With the measurement resolution decreased to 0.5 mm (Fig.1.c), noise levels still increase with increased dose, but now the lowest noise is observed for 254 dpi scanning resolution, which again corresponds to ROI of 25 pixels in size.

Conclusion

Our preliminary results suggest that for high resolution dose measurements with EBT3 GafChromic™ film the optimal ROI pixel size is 25 (5 x 5) pixels. Despite the fact that as the sample size increases to 25 the Poisson distribution becomes the Gaussian one, more systematic studies are needed to confirm this observation. One challenge will be correlating lower than 127 dpi scanning resolution (established in imperial units) and metric ROI sizes.

PO-1319 Design of a phantom for verification of IORT treatments and in vivo dosimetry simulation.

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Purpose or Objective

A phantom was designed for verification of IORT treatments treated with low energy X-rays with the Axxent equipment (Xoft Inc.).

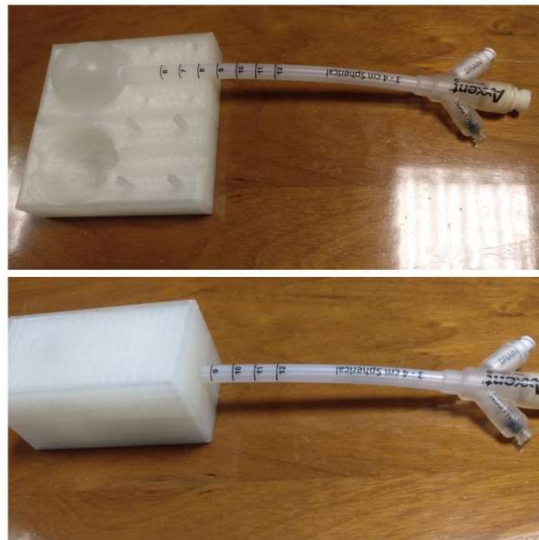
The goal is to estimate doses in risk organs such as heart and lung in which it is not possible to place a detector to perform proper in vivo dosimetry.

Material and Methods

It was designed with a 3D design software phantom suitable to accommodate the balloon-shaped applicator used in IORT breast treatments performed with Axxent. The balloon is housed in the area where the tumor is removed. Dosimetry measurements can be made in vivo in the prescription area (with the detector attached to the balloon in the case of radiochromic films) and in the skin area, but not in the heart (left breast) or lung. The phantom was designed (fig 1) in such a way that it can fit with the pieces of solid water (RW3) and be able to recreate the design to measure doses at the distances between the lung and the heart, as well as being able to add materials of different density to the complete design. Doses to the patient's lungs and heart were estimated from measurements of distances to these organs performed in a pre-treatment CT study.

The measurements were made with properly calibrated XR-RV3 radiochromic film scanning the films before and after irradiation following the triple channel method (radiochromic.com).

The phantom can accommodate balloons with a volume of 30 and 35 cc, which are the volumes most used in the treatment of patients (65% of cases), and for these cases were made the measures "pseudo in-vivo". The simulated patients correspond to treatments of the upper quadrant, both internal and external. The doses are estimated for the minimum distance at which the TPS tells us that the organ is located, so we would estimate the maximum dose to that organ.



Results

The results show the maximum doses calculated with radiochromic film for left lung and heart of 20 patients treated from the left breast measured retrospectively. The data shown correspond to the average of these measures separated by applicator volume and treatment location (breast quadrant), since depending on the location the distance to the risk organs is different.

Left Breast-3D Phantom measures			
External Upper Quadrant			
Volume: 30cc	Estimated Dose (Gy)	Volume: 35cc	Estimated Dose (Gy)
Left Lung		Left Lung	
Dmáx	2,1	Dmáx	2,6
Heart		Heart	
Dmáx	0,4	Dmáx	0,5
Internal Upper Quadrant			
Left Lung		Left Lung	
Volume: 30cc	Estimated Dose (Gy)	Volume: 35cc	Estimated Dose (Gy)
Dmáx	3,9	Dmáx	5,2
Heart		Heart	
Dmáx	0,9	Dmáx	1,1

Conclusion

3D printing is a very useful tool for simulating in vivo dosimetry situations that cannot otherwise be accessed. The control of the density of the materials and the adaptation of the design to our needs are turning this technique into a fundamental ally of the medical physicist. In this case was possible to measure and verify the doses in lung and heart for IORT treatments. With a CT study of the patient we could measure a priori the doses in these organs to recommend a particular type of treatment.

PO-1320 A machine QA tool to verify targeting accuracy of off-isocenter metastases

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Purpose or Objective

Stereotactic radiosurgery (SRS) procedures that use a single isocenter to target multiple metastases permit rapid therapy delivery to multiple metastases, thereby drastically reducing treatment time. Such procedures have gained significant attention in recent years; however, the hypofractionation of the delivery dose requires high conformity, necessitating the need to verify off-isocenter targeting accuracy. We present here a phantom and an analysis tool that are capable of measuring the off-isocenter targeting error as well as the off-isocenter positioning errors. Additionally, the analysis can distinguish the contributor to the targeting error between gantry, collimator, or table precession.

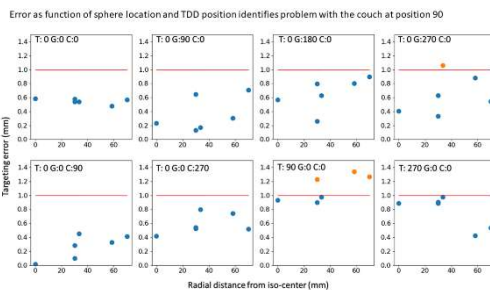
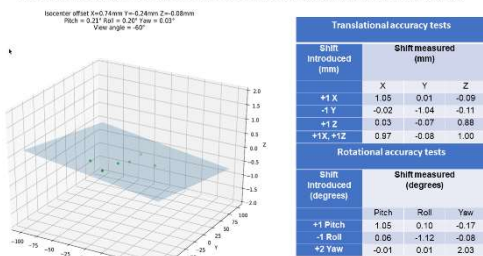
Material and Methods

A rigid phantom was developed consisting of 6 coplanar, 5 mm diameter tungsten carbide spherical targets of which 4 are colinear. The maximum center-to-center distance between targets is 100 mm. The Winston-Lutz (WL) analysis framework was extended to encompass off-isocenter targets in order to calculate their 3D locations in the IEC 61217 fixed coordinate system. Applying a best-fit line and best-fit plane to the calculated 3D locations of the 6 targets enables the estimation the pitch, roll, and yaw of the phantom relative to the radiation isocenter. An analysis tool was developed and applied on data acquired on a Varian TrueBeam® equipped with Millennium multi-leaf collimators and on a Varian Edge® equipped with high-definition multi-leaf collimators.

Results

Optimized delivery plans were developed, which allow data acquisition to be completed within 10 minutes on either the Edge or TrueBeam. By introducing positioning errors of known magnitude, we demonstrated the ability of the tool to identify translational positioning errors to ± 0.1 mm and rotational positioning errors (pitch, roll, and yaw) ± 0.2 degrees. Correcting the positioning error allowed to quantify the targeting errors with the accuracy of ± 0.1 mm. We will present data demonstrating this tool's ability identify targeting error due to couch and collimator. On a well-calibrated treatment delivery system, the targeting error was demonstrated to be less than 1 mm for off-center targets 7 cm off-isocenter.

Calculating 3D locations of the 6 targets enables the estimation the pitch, roll, and yaw of the phantom.



Conclusion

The MultiMet-WL QA phantom and the MultiMet-WL Analysis tool are a readily useable off-the-shelf solution and a clinically useful tool for daily or pre-treatment machine QA. Integration of the MultiMet-WL QA phantom with the StereoPHAN end-to-end phantom makes it an effective tool for end-to-end testing.

PO-1321 Assessment of depth uncertainty and its influence on dose measurement in water phantoms

Abstract withdrawn

PO-1322 Advanced Marcus chamber in high dose-per-pulse electron beams. k_{pol} and k_{sat} inter-chamber dependence

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Purpose or Objective

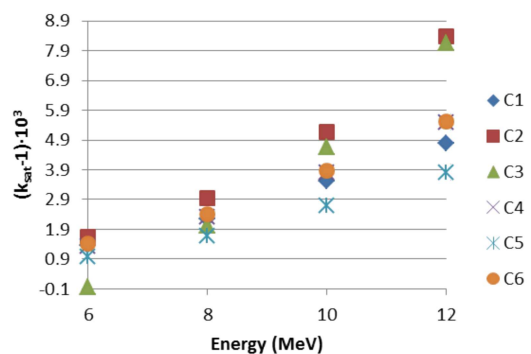
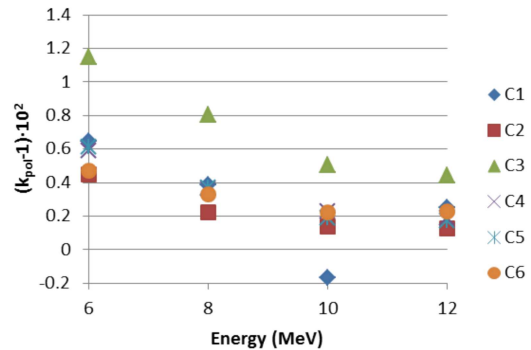
The Advanced Marcus parallel plate chamber (PTW Germany) is one of the preferred chambers for measurements in electron high dose-per-pulse irradiations since its low inter-electrode distance (1 mm) produces a low saturation correction factor (k_{sat}). The objective of this study was to evaluate the inter-chamber dependence of the polarization correction factor (k_{pol}) and the saturation correction factor (k_{sat}) for the Advanced Marcus when irradiated with highly dose-per-pulse electron beams.

Material and Methods

Six Advanced Marcus chambers embedded in a phantom attached to the mobile linac LIAC HWL (SIT, Sordina IORT Technologies, Vicenza, Italy) were irradiated with different energies (6, 8, 10 and 12 MeV) and, as a consequence, with a range of dose per pulse between 8.5 mGy/pulse and 40 mGy/pulse. At least three measurements were performed for voltages 100 V, 400 V and - 400 V. k_{pol} was estimated according to TRS-398 and k_{sat} according to Laitano *et al* (Phys. Med. Biol 51, 2006). The final value of k_{pol} and k_{sat} for each chamber and each energy was obtained as the average and standard deviation of the three groups of measurements.

Results

Type A uncertainty ($k=1$) of k_{sat} was on average $7 \cdot 10^{-5}$, $5 \cdot 10^{-5}$, $7 \cdot 10^{-5}$ and 10^{-4} for 6, 8, 10 and 12 MeV, while dispersion between chambers was about one order of magnitude higher. In the case of k_{pol} , uncertainty on average was $4 \cdot 10^{-4}$, $2 \cdot 10^{-4}$, $2 \cdot 10^{-4}$, 10^{-3} while again the dispersion between chambers was about one order of magnitude higher. Type B uncertainties were not analyzed.



Conclusion

Dispersion between chambers for both k_{pol} and k_{sat} was higher than the associated uncertainty due to charge measurement (Type A). For this reason, individual evaluation of k_{pol} and k_{sat} for the Advanced Marcus chamber could be adequate when used for measurements on high dose-per-pulse electron beams. The maximum deviation