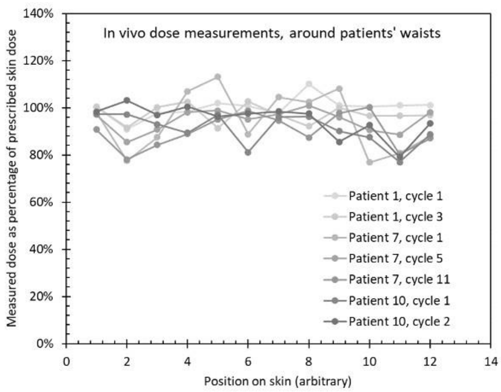

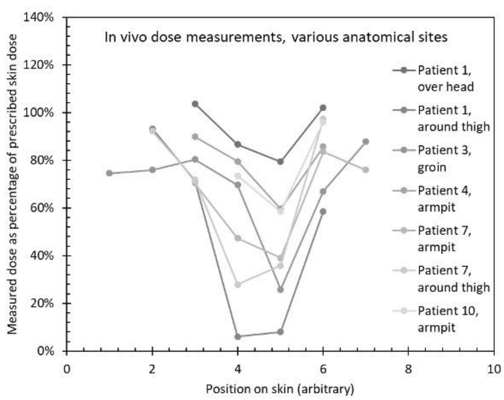

Conclusion

OSLDs can be used to obtain measurements of TSET dose with sufficient accuracy to justify treatment dose adjustments and indicate the need for additional shielding or boost treatments. The identification and consistent use of a specific set of measurement points would increase the value of future in vivo measurement data, as a local audit and quality improvement resource.

EP-1764 Portal dosimetry of the new O-ring system (Halcyon™): validation against a diode array

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Purpose or Objective

The new fully pre-configured system dedicated for the fast delivery of IMRT/VMAT, Varian Halcyon™, a 6MV-FFF linac mounted on an O-ring gantry was installed in our centers. The Anisotropic Analytical Algorithm v15.6 (AAA) has been pre-configured to allow the calculation of patient dosimetry. It is also used to predict the dose in EPID for patient pre-treatment quality assurance (QA) with IMRT technique. With this one it is not possible to customize the beam modeling.

The purpose is to validate the Varian Portal Dosimetry (VPD) system against the standard QA system (diode array 2D), in order to use it for routine QA.

Material and Methods

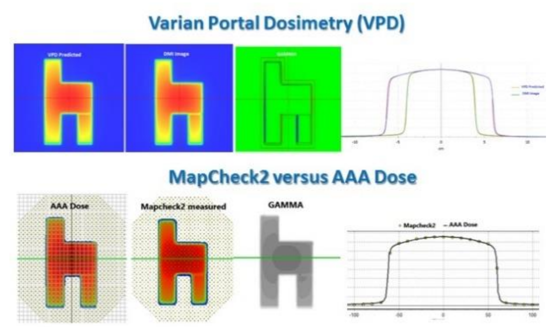
Dosimetric data were collected using the linac Varian Halcyon 2.0 with the 2D diode matrix Sun Nuclear MapCHECK2™ and the VPD with the AAA algorithm. Treatment Planning System (TPS) Eclipse™ version 15.6 was used to generate 26 alphabetical letters (A to Z) with the fluence brush tool (for example graph below for the letter h), 7 sweeping gaps (2, 4, 6, 10, 14, 16, 20mm) and 10 breasts cancers treatment with IMRT technique. The measured fluences with MapCHECK2™ were analyzed versus TPS dose water matrices (AAA V15.6) with the SNC software (V6.7.8) and predicted fluences with VPD (AAA V15.6).

Results

For alphabetical letters and sweeps gaps, the mean passing rates of the global gamma evaluation were 99.04±2.47% and 88.10±5.37% and the local gamma evaluation were 98.82±2.47% and 86.98±5.13%, for the 2%/2 mm and 1%/1 mm criteria, respectively, for MapCheck2.

In the case of the portal dosimetry, the mean passing rates of the gamma evaluation were 99.18±3.73% and 90.75± 8.77% and the local gamma evaluation were 99.15±3.75% and 89.72± 8.77% for the 2%/2 mm and 1%/1 mm criteria respectively.

For breast IMRT treatments, the mean passing rates of local gamma evaluation were 99.9±0.28% and 99.9±1.68% for VPD and 99.56±0.65% and 97.49±1.86% for MapCheck2 for the 3%/3 mm and 2%/2mm criteria, respectively.



Example of h test results for mapcheck2 and VPD

Conclusion

The pre-configured portal dosimetry beam modeling gives a very good results and close to the 2D array detector. It seems enough robust to use for routine QA without any need to customize.

EP-1765 Adapted Delta4 phantom for EBT3 film based pre-treatment QA for lung SBRT VMAT: proof of concept

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Purpose or Objective

Implementation of Lung SBRT in clinical routine requires an extensive quality control program to assure patient safety. Patient-specific evaluation of the measured dose against the treatment planning calculated dose is essential in this context. While several commercial 3-D detector arrays are available, they do not provide alone sufficient information to analyze complex dose distribution of highly conformal radiotherapy. Given the high resolution of Gafchromic films, we developed a proof of concept for a pre-treatment QA procedure using EBT3 films placed inside the body of a commercial X-shaped 3-D detector arrays phantom.

Material and Methods

The Delta4 phantom has been modified by replacing the three detector plates (main board and wings) by EBT3 film placed in between 5mm thick PMMA slabs (Figure 1). Dose distribution of a three-arc VMAT (RayStation Version 6.0) plan for Lung SBRT (fraction dose of 15Gy, 6MV) was calculated on the homogeneous cylindrical body of the phantom and delivered using Elekta Synergy machine with Agility head. Calculated dose in the film planes (main plane 50° to the sagittal plane) was exported via a home-made script and compared to the measured film dose using FilmQAPro software (Ashland ISP, USA) three-channel dosimetry. All specific film handling precautions were followed [1,2]. For quantitative evaluation, the gamma index metric with 2%/2mm and 3%/3mm criteria was used in Film QA pro.

Results

Relative and absolute dose comparison was performed with 2%/2mm gamma analysis of 92, 85 and 86% for the main and the wing films respectively; increasing up to 98, 93 and 96% using conventional 3%/3mm criterion. Results are presented in Figure 2 with vertical and horizontal line profiles couple to an isodose map of the main film. Having high resolution data into two perpendicular planes in a cylindrical phantom is advantageous against the classical setup in a cubic slab phantom. It provides more information than a single film in a coronal plane and reflects a geometry closer to the anatomical region treated as recommended by the NCS report 28 [3].

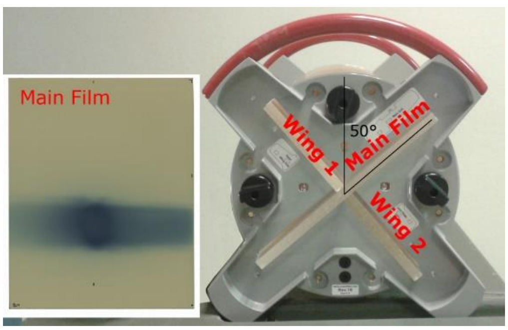

Figure 1. Adapted Delta4 phantom with film slabs. Left: Main film scanned image

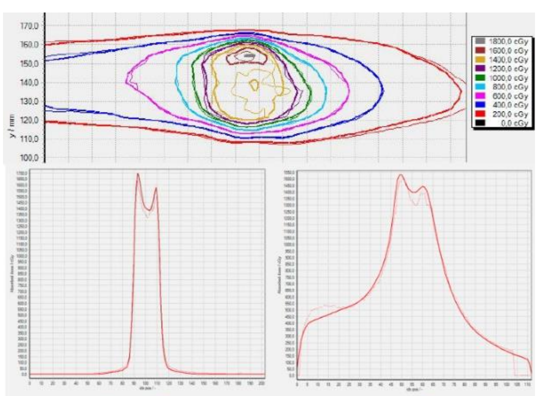

Figure 2. Film versus planned (solid line) isodose map and perpendicular dose profiles in the main plane

Conclusion

Pre-treatment QA for Lung SBRT VMAT based on EBT3 film inside the body of the Delta4 phantom is feasible. Advantages are high spatial resolution and two-plane dose information in a cylindrical phantom. Further evaluation for more cases and different prescription doses is necessary.

[1] Borca VC, Pasquino M, Russo G, et al. Dosimetric characterization and use of GAFCHROMIC EBT3 film for IMRT dose verification. Journal of Applied Clinical Medical Physics. 2013;14:158-71.

[2] Paelinck L, De Neve W, De Wagter C. Precautions and strategies in using a commercial flatbed scanner for radiochromic film dosimetry. Phys. Med. Biol. 2007;52:231-242

[3] NCS Report 28-National Audit of Quality Assurance for Intensity Modulated Radiotherapy and Volumetric Modulated Arc Therapy- 2018

EP-1766 Application of Extended CT Scale and Metal Artefact Reduction Methods on Radiotherapy Planning

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Purpose or Objective

The main purpose was to investigate the effects of extended computed tomography (ECT) scale and single energy metal artifact reduction (SEMAR) algorithm on dose distribution during the use of metal implants in radiotherapy treatments using 3D-printed individualized phantoms.

Material and Methods

In this study, measurement was performed for both mandible and spinal titanium alloy implants. To evaluate the effect of these implants on real treatment case, three individualized phantoms were printed using MakerBot Replicator Z18 3D printer. In the first case, mandible implant was fixed to sawbone mandible model and it was placed inside of the individualized phantom. In the second and third case, two different spinal implants for C1-C3 and C4-C7 vertebra were instrumented to bone equivalent sawbone cervical vertebra model and these model were placed into the 3D-printed phantoms. CT scans of these phantoms were performed in two different step, with and without SEMAR methods, using Toshiba Aquilion LB CT simulator. In the treatment planning Varian Eclipse Version 7.1.3 TPS was used and measurement was performed on Varian Clinac DHX High Performance linear accelerator In the first case, IMRT plans were created for both standard CT Scale (from -1024 HU to 3071 HU) and ECT scale (from -1024 HU to 64.511 HU). In the second and third case, in addition to CT scale comparisons for 3D-CRT and IMRT techniques, effect of SEMAR methods on dose distribution were analyzed for 3D-CRT treatment plans. Measurements were performed with EBT3 gafchromic film and 5mm DTA/%5 DD criteria was used for gamma analysis criteria.

Results

In the first case, significant difference was not observed for SEMAR +/-, ECTS +/- since the implant used in the mandible phantom was thin and small so that it did not create dominant artifacts in the CT image. However, in C1-C3 and C4-C7 scenarios, it was observed that the ECT scale results were generally better (2-16% better) than SCT scale. When analyzing the gamma analysis data obtained for the planning of vertebral phantoms, no significant difference could be obtained from SEMAR +/- conditions.

Conclusion

in case of significant metal artefact, use of ECT scale can improve the dosimetric accuracy of treatment planning. However, in mandible implant dosimetrical differences were not found, since thin and small implants were prefferd in clinical use.

EP-1767 Validation and clinical use of a commercial Monte Carlo algorithm for Cyberknife patient-specific QA

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Purpose or Objective

To ensure safe dose delivery in radiotherapy, uncertainties and errors have to be minimized by an extended quality assurance (QA) protocol. An established part of this chain is pre-treatment verification of monitor units, which can be performed by an independent dose re-calculation. Especially for complex non-isocentric treatment plans as delivered by the Cyberknife with multi-leaf collimator (MLC), the traditional point-based MU verification does not suffice and a 3D dose recalculation is preferred for plan QA. The purpose of this work was to commission the first commercially available 3D Monte