EP-1571

Electron dosimetric characteristics of a dedicated linear accelerator for IOERT

M. Ghorbanpour Besheli[1,2], W. Budach[1], I. Simiantonakis[1,2]
[1]*University Hospital, Department of Radiotherapy and Radiation Oncology, Duesseldorf, Germany*
[2]*Heinrich-Heine University, Faculty of Physics/Medical Physics, Duesseldorf, Germany*

Purpose or Objective: Treatment planning systems for IORT (intraoperative radiation therapy) are able to predict the absorbed dose in the patient only when their algorithm precisely considered the dosimetric characteristics of electrons like energy fluence, angular distribution, etc. Hence, the main objective of the present work was to study the contribution of direct (electron component without interaction with the collimator) and scattered electrons to the energy fluence distribution, fluence and mean energy of total electrons.

Material and Methods: Different electron energies of 3, 5 (low energies), 7 and 9 MeV (high energies) at cylindrical field size of 40, 50 and 100 mm of a dedicated mobile IOERT linac NOVAC7 (SIT, Vicenza/Italy) were investigated. For analysis, the phase-space file generated by Monte Carlo code BEAMnrc including the LATCH variable, for specific energy and applicator, was used by the BEAMDP Monte Carlo user code. The LATCH variable is a 32-bit variable to track the history of particles. On the other hand, BEAMDP was used to obtain energy spectra, fluence and mean energy of the direct and scattered electrons at the phantom surface for different applicator diameters.

Results: It was in general observed that the energy fluence distribution of electrons did not change significantly with decreased applicator diameter. Furthermore, it was shown that the contribution of the direct and the scattered electrons on the total fluence changed depending on the applied energy moving from central axis toward the applicator wall. With respect to the fluence of direct electrons the contribution of the scattered component was much lower on the beam axis but increased significantly near the field edge. This is mainly due to the huge increase of interaction events occurred inside the therapeutic beam between electrons and applicator wall. It was also found that, the mean energy of scattered electrons increased intensely decreeing the applicator diameter up to about 28%. Due to the increased number of scattered electrons (higher fluence) and the larger energies of scattered component in the energy spectrum, the mean energy value of scattered electrons increased.

Conclusion: Significant results regarding the behavior of different electron components were found. It was shown that the fluence and mean energy of different electron components increase at larger energies and smaller applicators especially in the vicinity of the applicator wall. This could be useful to interpret dosimetric difficulties encountered working with such IOERT linacs. Furthermore, it is expected that the results discussed here support for accurate patient dose calculation in an IOERT treatment planning system. Moreover, these results can be employed to chamber simulation regarding the determination of perturbation correction factor.

EP-1572

Effective target spot size and grid size for acuros algorithm on penumbra and delivered dose

M.E. Erturk[1], S. Gurdalli[1]
[1]*MNT Saglik Hizmetleri, Medical Physics, Istanbul, Turkey*

Purpose or Objective: Purpose of the study is to analyze how penumbra and the delivered dose vary with the effective target spot size and grid size.

Material and Methods: Acuros beam model was configured for Varian TrueBeam 6 MV. 'Beam Data' section of 'Beam Configuration' of Eclipse 11 treatment planning system (TPS) was used at configuration of Acuros with different spot sizes (0, 1, 2 mm). Beam Analysis section was utilized to evaluate profiles of 4 fields (2x2, 3x3, 10x10 and 15x15 cm) at 5 depths (1.5, 5, 10, 20, 30) with 4 grid sizes (1.0, 1.5, 2.0, 2.5 mm). To perform analysis, penumbra of 80 profiles were calculated and compared with the measured profiles. A virtual water phantom and the same fields were prepared at TPS to calculate output factors at two different setups. The first has a Source Surface Distance (SSD) of 100 cm and depth is 1.5 cm. The second one's the depth is 5 cm while SSD is 95 cm. Profiles were measured at SSD of 100 cm with Edge detector while output factors measured with PTW pinpoint detector. Average of 4 fields of each spot size and grid size in units of percent was used to analyze the overall performance of the variables.

Results: All of the errors at each output are less than 1 %. Minimum average error in the first case was found to be 0.29 % when the grid size of 1 mm and the spot size of 2 mm were used. Furthermore, maximum average error was 0.51 % when the grid size of 2.5 mm and the spot size of 2 mm were used. In the second case, maximum average error was 0.31 % when the grid size of 2.5 mm and the spot size of 0 mm. Minimum average error was calculated to be 0.05 % when the spot size of 2 mm and the grid size of 2.5 mm were used. Noting that the profiles of 15x15 field cannot be calculated at 1 mm grid size due to the TPS' hardware requirements. Error in penumbra reaches as high as 6.6 mm. Maximum average penumbra error is nearly 2 mm. Change of average errors of the profiles and the maximum errors of each grid with the target spot size is given in table.

Conclusion: It is understood from the results that the output factors and the profiles can be analyzed separately as the variation of the outputs with the grid size and the spot size is negligible. Moreover, it is observed that penumbra of fields at different depths varies with the spot size and the grid size. Therefore, medical physicists have to take into account during the commissioning of the algorithm. The method defined in this study is quite precise, sensitive, easy and effective to analyze the spot size and the grid size.

EP-1573

Validation of a dedicated Intra-operative radiotherapy TPS: an innovative tool for image-guided IORT

A. Ciccotelli[1,2], S. Carpino[2], M. D'Andrea[2], G. Iaccarino[2], A. Soriani[2], G. Felici[1], M. Benassi[3], L. Strigari[2]
[1]*S.I.T. – Sordina IORT Technologies S.p.A., R&D Dept, Aprilia LT, Italy*
[2]*National Cancer Institute Regina Elena, Laboratory of Medical Physics and Expert Systems, Rome, Italy*
[3]*IRCCS Istituto Scientifico Romagnolo per lo Studio e la Cura dei Tumori IRST, Physics Department, Meldola FC, Italy*

Purpose or Objective: The Image Guided Intra-operative Radiotherapy (IGIORT) is a new methodology based on the planning optimization using intra-operative target images acquired after surgery. The dedicated Treatment Planning System (TPS) CSRAD+ has been developed in order to plan intra-operative radiotherapy treatments for patients with malignant diseases as clinically appropriate, using a dedicated mobile accelerator and an imaging device. The CSRAD+ performs IORT dose distribution calculation relying on pre-treatment and intra-operative DICOM_RT images. The aim of this work is to validate the dosimetric output and the performances of CSRAD+ before its introduction in clinical practice.

Material and Methods: The home-made CSRAD+ allows to calculate the dose distributions of a IORT dedicated mobile linac for each energy, applicator diameter and bevel angle in water using a cartesian grid with a 2 mm resolution, using Monte Carlo data stored in a database as look-up tables. Two dose calculation algorithms have been implemented both with and without inhomogeneity corrections. The DICOM images of the representative phantom test cases were acquired using a dedicated CT Scan. The calibration curves were loaded in both the CSRAD+ and in the EGSphant module