AbstractID: 9104 Title: A new approach for afterloading brachtherapy inverse planned dose optimization based on the accurate Monte Carlo method.

Purpose:

In brachytherapy, considering the perturbations from the heterogeneities in the planning system will give a better dose conformity for specific sites. The goal of this work is to demonstrate the feasibility of replacing the TG43 analytical approach by a Monte Carlo (MC) dose calculation engine in the optimization process.

Method and Materials:

The novel method is based on pre-computed 3D dose kernels. The CT clinical images and the dwell positions (DWP) are loaded from the DICOM-RT files to create a voxel based simulation of the treatment. MC dose calculation is used to create the dose kernel specific for each possible DWP. Density and tissue compositions are fully taken into account in MC. The Inverse Planning Simulated Annealing (IPSA) algorithm is used for the optimization process. IPSA reads and analyzes the MC dose kernels before the beginning of the optimization process; it replaces the TG43 parameterization. A breast interstitial HDR plan is used to demonstrate the approach.

Results:

Computation of precise 3D-kernels is the most time consuming portion and is proportional to the number of DWP. However, the optimization process itself takes the same amount of time as a standard (TG43) optimization. The breast, TG43/MC plan shows an underdosage in the CTV relative to the TG43/TG43 plan by 4.3 % on D90 and 3.2 % on D50. For the surgical bed, the difference is 4.2 % and 3.5 % for D90 and D50 respectively. This was corrected in the MC/MC plan, with a minimal dose increase of the skin.

Conclusion:

MC optimization improved the dose conformity. The method presented is straightforward and can be applied to any site and any afterloading process (HDR or PDR) using various type of sources, from Ir-192 to micro-XRay devices, as long as a precise MC model is made.

Conflict of Interest (only if applicable):