AbstractID: 13796 Title: Optimization Platform Based on Monte Carlo Dose Calculation

Purpose : Dosimetry and planning for brachytherapy relies on the TG43 formula. This formalism, like any homogeneous dose calculation method, neglects the various effect of heterogeneities such as tissue composition, air, applicators and shielding. This study aims to incorporate Monte Carlo (MC) dose calculation within an inverse planning algorithm in order to improve the dose conformity, thus increasing the quality of the treatment.

Material an Methods : Dose calculation and optimization is based on pre-calculated Dose Distribution Kernel (DK). A DK represent the dose distribution produced by the irradiation of a single source located at one dwell position. The DKs are calculated using an automated CT based Monte Carlo software using the Geant4 toolkit. A research version of the inverse planning software IPSA was modified in order to read the set of DKs and use these dosimetric informations instead of the TG43 formula to generate the plan. This method was tested for two HDR brachytherapy sources : the microSelectron 192Ir source and the Axxent electronic source at 50 kVp.

Results : The impact of the water approximation is found to depend on photon energy, with higher dose attenuation for the lower energies of the Axxent source in comparison with ^{192}Ir with an underdosage of 5.4 % versus 2 % on the CTV V_{100}. Incorporating Monte Carlo DK into the planning is found to correct the dose coverage for both energies.

Conclusion: A new method to optimize high dose rate (HDR) brachytherapy plans that uses MC dosimetric information was developed. Including CT-based information in MC dosimetry in the inverse planning process is shown to take into account the full range of scatter and heterogeneity conditions. This method can therefore predict and improve the dose coverage and homogeneity of clinical cases.