An Abstract of

Quantitative Assessment of Radiation Dosimetry from a MammoSite Balloon, FSD Applicator and a Newly Designed HDR Applicator for Treatment of GYN Cancers Using Monte Carlo Simulations

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This abstract contains three parts: 1) Computation of three dimensional attenuation presented by Mammosite Balloon in dosimetry of Partial Breast Irradiation. Current treatment planning systems (TPSs) for partial breast irradiation using this applicator often neglects the effect of inhomogeneity, leading to potential inaccuracies in dose distributions. Previous publications either have studied only a planar dose perturbation along the bisector of the source or have paid little attention to the anisotropy effect of the system. In this study, we investigated the attenuation-corrected radial dose and anisotropy functions in a form parallel to the updated American Association of Physicists in Medicine TG-

43 formalism. This work quantitatively delineates the inaccuracies in dose distributions in three-dimensional space. Monte Carlo N-particle transport code simulations in coupled photon–electron transport were used to quantify the changes in dose deposition and distribution caused by the increased attenuation coefficient of iodine-based contrast solution. The corrected radial dose function has a predominant influence on dose reduction, but the corrected anisotropy functions explain only the effect at the MammoSite system poles. By applying the corrected radial dose and anisotropy functions to TPSs, the attenuation effect can be reduced to the minimum.

2) Three dimensional computation of attenuation presented by the material of Fletcher Suite Device (FSD) applicator in HDR treatment of cervical and endometrial cancer. Current intracavitary therapy planning system for brachytherapy treatment of cervical and endometrial cancers using the FSD usually neglects the attenuation effect from stainless steel (SS) tube. This could lead to potential inaccuracies in computing dwell times and dose distribution. A more accurate analysis quantifying the level of attenuation for Ir-192 source used in HDR is presented through Monte Carlo Simulation verified by measurement.

3) Design of a new disposable non-metallic applicator system for three dimensional target based patient specific dosimetry and retiring of the Manchester point based dosimetry system. A new HDR applicator system has been designed in our department to treat endometrial and cervical cancer. This new applicator has several advantages as compared to a conventional FSD system. Firstly, it provides

the ability to do volumetric image based patient specific dosimetry calculation instead of the current Manchester based point dose through input of planar images. Secondly, through CT/MR imaging with applicator in place, the critical and surrounding structures can be delineated and better protected. Finally, implementation of this applicator allows target based treatment planning where one can take advantage of all established dosimetric parameters such as GTV(gross tumor volume), CTV(clinical target volume), PTV(planning target volume), inverse planning, and employ the already well developed three dimensional evaluation tools used in external beam radiotherapy. This in turn results in retiring of the old Manchester point dose calculation. It is expected that this new applicator system will provide all the functionalities of a Fletcher-Suit Delclos (FSD) device and has more versatility in treatment of these cancers.