AbstractID: 11253 Title: Investigating Thermal Properties of a Thermobrachytherapy Radioactive Seed for Concurrent Brachytherapy and Hyperthermia Treatments: Design Considerations

Purpose: Hyperthermia has been demonstrated to be one of the most effective radiation sensitizers. It offers significant improvement in both tumor control and survival rate after radiation therapy without considerable increase in side effects. Previous studies show that the time interval between administrations of both modalities has to be rather short, preferably, within an hour. We propose a new Thermobrachytherapy radioactive seed model, serving as a heat source for concurrent administration of brachytherapy and hyperthermia.

Method and Materials: A new combination seed is based on the BEST Model 2301-I^{125}, where tungsten marker core is replaced with a ferromagnetic material, capable of producing heat when subjected to external alternating electro-magnetic field. Such a replacement does not noticeably change the dose rate distribution, and has only minor effect on the radiographic properties of the seed. A finite-element partial differential equation solver package "COMSOL Multiphysics" was used to evaluate thermal distribution of the heat induced in the ferromagnetic core.

Results: The induction heat source has relatively low efficiency due to losses associated with a considerable distance between the ferromagnetic core and induction coil. However, the temperature distribution is tunable based on the number of seeds used during the treatment, their locations, coil diameter, and the frequency of the electro-magnetic field. A model with a solid radiographic marker is preferable for the proposed application since it offers the highest heat output. We found that the implementation of the proposed seed will require only small changes in the internal structure of a standard commercial model, and will not affect significantly the dose rate and other TG43 factors characterizing radiation distribution.

Conclusion: We will present the radiation and thermal properties of the new seed model which has high potential for implementation of concurrent brachytherapy and hyperthermia.