

AbstractID: 2045 Title: Investigations into the use of multi-species seeds in interstitial prostate implant brachytherapy using the 3-D treatment optimization program based upon the region of interest adjoint functions and greedy heuristic algorithm

This investigation studied the application of region of interest (ROI) adjoint functions and a greedy heuristic (GH) for use with multi-species radioactive sources in permanent prostate implants. The goals include delivery of the target dose in a uniform manner, sparing sensitive structures, and minimizing the number of needles and sources. The motivation for the use of multi-specie sources is that a more uniform dose could be obtained using fewer sources and needles by mixing Ir-192 with I-125 than the latter alone (as per Glasgow). The algorithm utilizes an "adjoint ratio," which provides a means of ranking source positions and acts as the objective function for the GH. Three cases were compared, each using 0.4mCi I-125 seeds: I-125 alone, 0.12mCi Ir-192 seeds mixed with I-125, and 0.25mCi Ir-192 mixed with I-125. The scheme followed to incorporate multi-species seeds in the GH program was placing the Ir-192 seeds at the first few positions selected by the GH. The GH searches for an optimum value of the isodose surface constraints based on the individual Ir-192 and I-125 source dose distributions and the final termination criteria of approximately 98% coverage of the tumor by the prescribed dose. The multi-species cases spare the urethra to a greater extent than the I-125 base case. The exposure to rectum and normal tissue increases, but for the lower strength multi-species combination, both are within tolerance. The number of needles used varies by one and there is an overall decrease in the total number of seeds used for treatment.