

AbstractID: 9482 Title: A Systematic Analysis of Errors and Uncertainties in Partial Breast Irradiation using the MammoSite Balloon Catheter

Purpose:

The objective of this study was to evaluate systematic and random errors associated with HDR brachytherapy treatment delivery of partial breast irradiation with a MammoSite Balloon. The impact of these errors on the actual delivered dose was studied.

Method and Materials:

The effect of respiratory motion, balloon contrast concentration and intra-observer variability on accuracy of applicator delineation were investigated. Additionally, the consequence of variability of target delineation and dose matrix voxel size was considered in relationship to target coverage. Lastly, an analysis of 15 patients treated with the MammoSite was performed to simulate the effect of allowed source position uncertainty for each fraction.

Results:

Respiratory motion resulted in an under-estimation of the balloon volume of 8% and 18% for computed tomography and cone-beam computed tomography, respectively. The coverage was assessed based on the volume of the target receiving 95% of the prescribed dose (V_{95}). On average, balloon volume underestimation combined with the daily ± 1.0 mm source position uncertainty degraded the coverage from an initial 96.3% to 91.7% over the course of 10 fractions. Additionally, a 3mm difference between the true tip of the applicator and its delineated position resulted in a decrease in coverage from 96.3% to 92.6% and from 98.7% to 79.3%, for a small and a large balloon, respectively.

Conclusion:

Current treatment protocols require that 90% of the target volume receives 90% of the prescription dose. Our findings suggest that significantly higher dosimetric coverage goals are necessary to compensate for the identified errors inherent in balloon based brachytherapy dose delivery. This will insure that the expected degradation of the actual dose delivered from the planned dose, as a consequence of random and systematic uncertainties, does not fall below an acceptable threshold.