AbstractID: 8143 Title: Dose Optimization of MammoSite Balloon Partial Breast Brachytherapy Treatment

DOSE OPTIMIZATION OF MAMMOSITE BALLOON PARTIAL BREAST BRACHYTHERAPY TREATMENT

Introduction: Limited information is available on whether adequate breast tissue is treated with the use of the MammoSite partial breast brachytherapy applicator. Though the MammoSite device has recently become popular, there are a limited amount of studies that address the long term clinical outcome of patients treated. In the present study, the objective was to determine the best optimization technique using MammoSite partial breast brachytherapy applicator for our regular clinical use by evaluating treatment plans of twenty patients with early stage breast cancer. A dosimetric comparison was performed of one point, four point and six point optimization techniques using single and multiple dwell positions.

Materials and Methods: The MammoSite device, which is described elsewhere, is composed of a silicon balloon connected to a shaft approximately 6 mm in diameter and 15 cm in length. The prescribed dose was 34 Gy in 10 fractions BID. CT images through the lumpectomy cavity from each patient were 2.5 mm slices. A 1 cm expanded volume from the balloon surface was designed with chest wall and skin as limiting structures. The volume of the inflated balloon was subtracted from the expanded volume to define the planning target volume (PTV).

Optimizations techniques attempt to reduce the effect of the anisotropy and possible ellipsoidal shape of the balloon by using multiple dwell positions (one, two or three) and optimization points (single, four and six). The dose is optimized to the PTV based on one, four, or six points that are located 1 cm from balloon surface. Three methods of optimization were used: one point, four point and six point. The one point method consisted of a single prescription point, the left lateral point, and was placed 1.0 cm from the balloon surface. The four point method consists of four points, in the plane transverse to the balloon axis perpendicular to the axis of the catheter 1 cm away from the balloon surface. The six point method involves the four point method plus two points along the axis of the catheter 1 cm superior and inferior to the balloon surface. Figure 1 shows the difference between one point and six point methods.

The percentage of volume receiving 90% (V_{90}), 100% (V_{100}), 150% (V_{150}) and 200% (V_{200}) of the prescription dose were calculated and compared among 3x3=9 treatment plans for each patient. The dose homogeneity index DHI = $(V_{100}-V_{150})/V_{100}$ that provides a quantitative analysis of dose distributions concerning homogeneity and conformality of the dose to the volume was also calculated and compared among 9 treatment plans for each patient. A high value of DHI is ideal because it implies that the dose is more uniformly distributed within the treatment volume.

Results: The balloon and the PTV volumes range from 31.12 to 80.18 cc and 76.55 to 127.73 cc, respectively. The mean V_{90} for six and four point with single dwell position was 94% compared to single point of 91%. The mean V_{100} was 87%, for six compared to 85% for four and 84% for single point prescription. The average dose homogeneity index was 0.66 with four points for one or two dwell positions, compared to 0.64 for six and

0.63 for single point prescription. 30% of the PTV gets 150% of the dose and 15.2 Gy is the average minimum dose to PTV plus 1 cm. Average maximum skin and heart doses were 68.5% and 43.8%, respectively of the prescription dose with less than 3.9% of average lung volume getting 17 Gy.

Conclusions: We conclude that optimized treatment plans with four point prescriptions and single dwell position are best for regular clinical use in our facility.

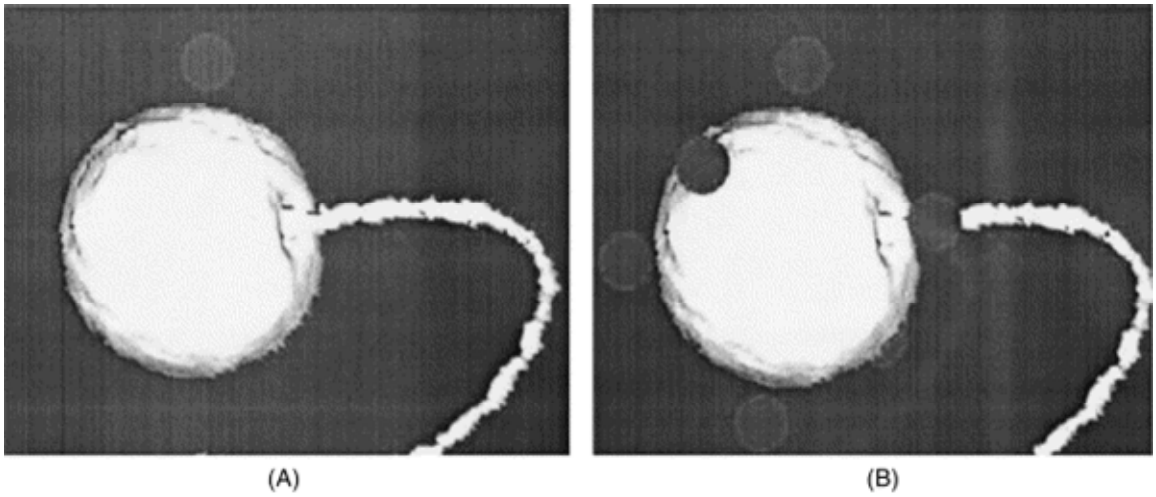

Fig. 1. Comparison of (A) single prescription point method and (B) six prescription point method