AbstractID: 12573 Title: Comparison of Source Dwell Position Configuration in Single Catheter Balloon Partial Breast Brachytherapy

Comparison of Source Dwell Position Configuration in Single Catheter Balloon Partial Breast Brachytherapy

Introduction: The intracavitary balloon catheter treatment device, originally comprised of a single catheter located centrally within a balloon, placed and inflated in the lumpectomy cavity is currently being used in the accelerated partial breast irradiation techniques to improve the reproducibility of the dosimetric coverage of the target volume. Although most data presented so far have employed the single central dwell position method using Mammosite technique with HDR Iridium-192 (Ir-192) source, the use of multiple dwell positions to enhance the conformality of the isodose distribution has also been advocated. Studies have shown that optimizing multiple dwell positions can improve coverage and other dosimetric challenges. However, this improvement is generally at some cost, whether over or under dosing some breast and other normal tissues. The recent electronic brachytherapy (eBx) technique requires the utilization of multiple dwell positions but to our best knowledge no study has yet been done to compare the dosimetric effect of utilizing a single dwell position or various multiple dwell positions. The objective of the present study has been to determine an optimal source dwell position configuration for accelerated partial breast irradiation in a single catheter system utilizing either electronic or Ir-192 HDR sources.

Materials and Methods: Treatment plans for 11 patients (7 had tumor in the left breast) were used in this study. Anatomic structures heart, ipsilateral lung, ipsilateral breast, planning treatment volume (PTV) and treatment balloon were contoured and five different treatment plans were created for each patient using the Nucletron PLATO treatment planning system. The Ir-192 and eBx multiple dwell position (MDP) plans had dwell positions at spacing of 2.5 mm covering the full balloon diameter. The Ir-192 and eBx five dwell position (FDP) plans had 5 dwell positions with 1 cm spacing that required no dwell position outside the balloon; and single dwell position (SDP) plan with the Ir-192 source placed at the center of the balloon. The source anisotropy of the eBx prevented an unbiased analysis of a plan at a single dwell position. The prescription dose was 3.4 Gy per fraction for 10 fractions at 1 cm beyond the balloon surface. From the dose volume histograms, PTV volumes covered by 95% (V_{95}), 100% (V_{100}), 150% (V_{150}) and 200% (V_{200}) of the prescription dose were extracted for each plan and patient. Also extracted were the volumes of heart covered by 5% (V_5), volumes of lung covered by 30% (V_{30}), and volumes of uninvolved ipsilateral breast covered by 50% (V_{50}) of the prescription dose and maximum skin and rib doses.

Results: The PTV coverage was very similar for all plans. There were no statistical differences in mean PTV $V_{100.}$ The mean percent of the PTV in the high dose region (V_{150} and V_{200}) was considerably higher with both eBx plans compared to the three Ir-192 plans as shown in Table 1. Pair wise comparison between either of the eBx plans against any of the Ir-192 plans shows significant differences ($p<0.001$). However, no significant differences were observed from comparison between eBx plans and among Ir-192 plans. The mean maximum skin dose was generally about 10% less with the eBx plans compared to Ir-192 plans. The mean maximum rib doses did not change much among the

plans. The doses to lung, heart and breast were dramatically lower in the eBx treatment plans compared to Ir-192 plans as shown in Table 1.

Conclusion: The eBx plans were found to have increased PTV dose and decreased heart, breast, and lung dose indicating dosimetric advantage.

Table 1. PTV and Normal Tissue Dose Comparison among plans

		eBx MDP	eBx FDP	Ir-192 MDP	Ir-192 FDP	Ir-192 SDP
PTV - V150	Mean %	44.58	43.02	29.94	27.12	29.93
	Std. Dev.	5.59	5.27	6.17	6.79	6.08
PTV - V200	Mean %	19.65	18.37	2.72	1.47	2.78
	Std. Dev.	3.74	4.45	3.57	3.09	3.19
Heart V5	Mean %	28.31	26.89	81.89	80.63	82.47
	Std. Dev.	17.85	16.96	26.42	28.00	29.41
Lung V30	Mean %	1.07	1.07	2.71	2.83	2.95
	Std. Dev.	1.04	1.01	2.50	2.42	2.77
Uncomplicated Breast V50	Mean %	12.16	11.53	21.55	19.96	22.25
	Std. Dev.	3.14	2.35	4.21	3.88	4.66