

Mi-Hwa Kim, Hae-Jin Park, Jina Kim

Ajo University School of Medicine, Department of Radiation Oncology, Suwon, Korea, Republic of

INTRODUCTION

We evaluated the dosimetric characteristics and feasibility of the Halcyon system for lung Stereotactic Body Radiation Therapy (SBRT) by comparing multiple-arc VMAT plans on Halcyon with clinical plans generated on the TrueBeam STx.

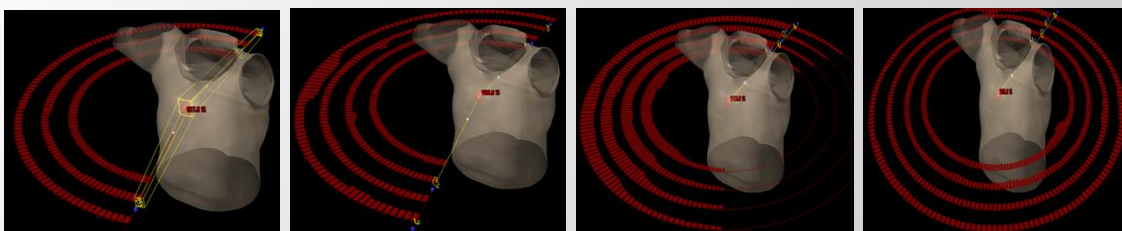
METHODS

Five lung SBRT patients (48 Gy in 4 fractions; PTV 6–16 cm³) treated using a Partial Arc technique (no avoidance sector) on TrueBeam STx(TB) were replanned on the Halcyon system(HC). Halcyon plans utilized 3 to 5 arcs, employing both Partial Arc (with and without avoidance sectors) and Full Arc(358° rotation) techniques.

All plans were calculated using the Acuros XB algorithm (Eclipse v18).

Plans were normalized such that 95% of the PTV received the prescribed dose, adhering to RTOG 0915 constraints.

Analyzed indices included Conformity Index (CI), Homogeneity Index (HI), high-dose spillage ($V_{105\%}$), low-dose spillage (D_{2cm} and $R_{50\%}$) and Lung V_{20Gy} .



(a)TB Partial arcs (b)HC_Partial (c)HC_Partial_avoidance (d)HC_Full

Figure 1.(a)TrueBeam Partial arcs without avoidance sectors, (b)Halcyon Partial arcs without avoidance sectors using the same rotation range with TrueBeam Partial arcs, (c)Halcyon Partial arcs with avoidance sectors, (d)Halcyon Full arcs

RESULTS

The CI for Halcyon plans (range:0.98–1.1) using 3~5 arcs was comparable to that of TrueBeam STx. Depending on arc configuration, HI on Halcyon was similar to TrueBeam STx or showed a trend of being up to 16% higher. High-dose spillage($V_{105\%}$) remained $\leq 2\%$, and intermediate-dose spillage(D_{2cm} and $R_{50\%}$) met RTOG 0915 criteria (no or minor deviation). Notably, depending on PTV size, the 3-arc Partial technique tended toward higher high-dose spillage compared to other techniques. There was no significant difference in Lung V_{20Gy} between the two systems. Monitor Units (MU) were generally 10~30% higher for Full Arc technique compared to Partial Arc technique and MU of Partial arcs with avoidance sectors were similar to TrueBeam STx.

		Halcyon_3Arcs			Halcyon_4Arcs			Halcyon_5Arcs			TrueBeam_3Arcs
		Partial	Full	Partial_avoidance	Partial	Full	Partial_avoidance	Partial	Full	Partial_avoidance	Partial
CI_RT0G	Ave.	1.03	1.01	1.03	1.01	1.00	1.02	1.02	1.01	1.02	1.01
	std	0.05	0.03	0.02	0.03	0.03	0.03	0.04	0.03	0.04	0.03
HI_RT0G	Ave.	1.10	1.10	1.12	1.09	1.10	1.12	1.10	1.10	1.11	1.06
	std	0.04	0.04	0.04	0.03	0.04	0.04	0.03	0.04	0.05	0.02
D2cm(%)	Ave.	50.92	44.28	48.20	49.66	43.28	51.40	50.34	44.92	50.72	46.26
	std	8.31	3.74	5.60	4.84	4.24	2.94	4.56	3.95	2.41	5.90
R50%	Ave.	5.56	5.41	5.52	5.57	5.45	5.69	5.68	5.48	5.80	5.53
	std	0.62	0.66	0.55	0.68	0.68	0.77	0.78	0.66	0.81	1.06
Lung V20(%)	Ave.	1.88	1.80	1.82	1.82	1.82	1.86	1.82	1.82	1.88	1.80
	std	0.84	0.64	0.71	0.76	0.64	0.71	0.76	0.70	0.73	0.71
MU (rel.)	Ave.	1.11	1.21	0.98	1.11	1.22	1.03	1.08	1.25	1.06	1.00
	std	0.05	0.12	0.15	0.14	0.20	0.20	0.26	0.20	0.20	0.00

Table 1. Average values of dosimetric indices among 5 lung SBRT patients, comparing partial arc (with and without avoidance sectors) and full arc techniques on Halcyon and TrueBeam

CONCLUSION

The Halcyon system is capable of delivering highly conformal lung SBRT that meets RTOG 0915 dosimetric criteria. While C-arm type linacs (e.g., TrueBeam STx) may face rotation range limitations depending on PTV location, Halcyon offers fewer constraints on arc rotation. By utilizing adequate multiple arcs and optimized rotation ranges, the Halcyon system is useful for managing dose spillage, dose homogeneity and MUs while maintaining high conformality.