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Improving SBRT Lung Plans by the Addition of Oblique Beams; a Clinical Experience

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INTRODUCTION

The change in accuracy from AAA to Acuros has made it more difficult to achieve the same reported plan quality as AAA. In our clinic, we had been able to achieve acceptable plans using conformal arcs with AAA. However, the transition to Acuros caused lower doses at the inferior and superior regions of the PTV and made the protocol constraints for D2cm and V50 harder to meet. The cold regions were addressed by increasing the inferior/superior MLC margins, but this made it even more challenging to meet the other criteria, especially for island-type PTVs. Therefore, we have implemented a new beam arrangement using static oblique beams in addition to the conformal arcs. This beam arrangement has helped significantly in planning while keeping the difficulty and time of treatment relatively unchanged. This planning technique is a good compromise between conformal arcs and plans requiring multiple couch kicks, especially for patients who are not eligible for VMAT treatments.

AIM

Previously, at our institution SBRT lung patients were being treated using modulated conformal arc beams calculated in AAA. When Acuros XB (AXB) was adopted, the more accurate modeling of radiation transport of Acuros made it more challenging to meet protocol guidelines, especially in heterogeneous regions. To combat this issue we increased the MLC block margins and needed to add static oblique beams to the conformal arcs to help achieve better results. The purpose of this study is to quantify the resulting improvement in dosimetric plan quality.

METHOD

A cohort of 25 patients treated with the new beam arrangement was retrospectively analyzed. These patients were planned initially using only modulated conformal arcs and up to 3 additional static beams were added to improve the plan. The plans without the added beams were compared to those with the added static beams. A subgroup of 12 patients with island-type tumors were analyzed separately. The plans were evaluated using the RTOG 0813 guidelines.

RESULTS

A total of 25 patients were studied, with 12 having island-type PTVs. All plans were normalized to 95% dose covering the entire PTV. Table 1 shows the typical oblique beams added for right and left sided PTVs. The exact angles were adjusted, if needed, based on the patient geometry, such as entering through the arm. The extra beams were added only as needed to achieve reasonable plans and were not kept if they did not help improve the plan enough, at the dosimetrists' discretion. Patients had 1-3 static beams added, with an average of 1.55 additional beams. As seen in Table 1, the additional beams, required less than 1% more MU to treat, but improved the plan quality for almost all plan metrics. There was a slight increase in Dmax and V105, but these increases were still well within the RTOG 0813 guidelines being used to evaluate the plans. The dose conformality index (CI), D2cm, and V50, decreased appreciably. The total number of deviations due to CI and D2cm fell from 21 to 5 for all sites and 12 to 4 for island type tumors. While the total number of deviations due to V50 remained relatively unchanged, there was a small shift from major deviations to minor.

On average 1.5 static beams were added per plan. The addition of the static beams lead to a small increase in maximum dose and V105 spillage, while staying within protocol guidelines. There was a significant decrease in deviations related to the conformity index (V100) and D2cm. V50 also improved in minor and major deviations. The total MU from the different approaches increased by less than 1%. In general, the island type PTVs were more challenging to make meet planning constraints, but saw similar improvements when static beams were added.

Table 2: Treatment technique comparison. 25 total and 12 island-type patients were used. V100, V90, Dmin, and Dmax are percent of prescribed dose. V105, CI, D2cm, and V50 are percent of PTV volume. "Minor" and "Major" refer to deviations from RTOG 0813 protocol guidelines.

Site	Technique	Dmin (PTV)	Dmax (Body)	V105 (Body)	CI (%PTV)	D2CM (%PTV)	V50 (%PTV)	CI Minor	D2CM Minor	V50 Minor	V50 Major	MU
All	Arcs and SB	90.3%	124.6%	8.1%	114.4%	97.1%	518.8%	1 (4%)	4 (16%)	16 (64%)	5 (20%)	2181.7
	Arcs Only	90.3%	123.6%	7.5%	115.4%	101.5%	529.9%	6 (24%)	15 (60%)	15 (60%)	7 (28%)	2167.4
Island	Arcs and SB	90.1%	128.0%	7.0%	113.0%	97.5%	544.7%	1 (8%)	3 (25%)	7 (58%)	4 (33%)	2402.5
	Arcs Only	90.2%	127.1%	7.3%	114.5%	103.5%	562.0%	3 (25%)	9 (75%)	5 (42%)	6 (50%)	2379.3

Table 1: Typical static oblique beams added to help achieve protocol guidelines. Beams were added, as needed and removed if they yielded no benefit.

Beam (R/L)	Gantry (R/L) (deg)	Couch (R/L) (deg)
1 – RIO/LIO	270/90	20/340
2 – RSO/LSO	270/90	340/20
3 – RAO/LAO	330/30	0

CONCLUSIONS

The addition of static oblique beams helps improve planning for SBRT lung lesions with the biggest benefit seen in the conformality index and D2cm. While total MU remained relatively unchanged, the added beams will increase total treatment time and therefore should be used only as needed. An average of 1.5 added beams, as found in this study, strikes a good balance of adding significant dosimetric benefits without creating an overly complicated plan to create or deliver. It is also worth noting that some cases studied did not need or were not aided by the extra static beams and it is recommended to only add them if needed to improve the treatment plan

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