Dosimetric Comparison Between Pinnacle^3 Auto-Planning and Manual Planning for Lung SBRT Treatments

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Introduction

Stereotactic body radiation therapy (SBRT) has become an effective treatment option for early stage and small metastatic lung tumors. Due to plan complexity with SBRT, traditional, inverse optimized IMRT planning may be time consuming and the quality of plans is likely to vary with the skill and experience of the planner. Auto-Planning, a new functionality developed by Pinnacle^3, has been made commercially available with Version 9.10. Auto-Planning is a tool that automates and facilitates inverse optimization of treatment plans. Benefits of Auto-Planning are based on planning efficiency improvements and standardization of plan quality. The aim of this study is to dosimetrically compare the treatment plan quality of Auto-Planning against previously approved clinical plans.

Methods and Materials

- Twenty (n=20) lung SBRT patients previously treated using a non-coplanar, 6 MV fix-field IMRT technique with a 120 HDMLC Novalis Tx were replanned in Pinnacle^3 (v9.10) with Auto-Planning.
- Patient plans were normalized to 5000 cGy in 5 fractions such that at least 98% of the PTV received 100% of the prescription dose, and the same beam geometries were used for Auto-Planning as the clinical plan.
- Metrics used for comparison were the dose fall-off ($R_X = V_{X\%}/V_{ptv}$) at the 70%, 50%, and 30% isodose lines, conformation number (CN), and homogeneity index ($HI = D_{0.2cc} / D_{98\%}$).
- Statistical differences were evaluated using a paired sample Wilcoxon signed rank test with significance level of 0.05.

Results

- For the dose fall-off of parameters, a mean percentage increase of 6.5%, 6.1% and 0.2% was found for the R_{70}, R_{50} and R_{30}, respectively, using Auto-Planning—however no statistically significant difference was noted.
- The CN showed a mean percentage difference of 1.7% ($p<.0.05$) decrease for Auto-Planning.
- The HI showed a mean percentage difference of 3.9% ($p<0.05$) improvement for Auto-Planning
- Auto-Planning did show an increase of 4.6% ($p<0.05$)in total monitor units but a 17.7% ($p<0.05$) decrease in the total number of control points.

Conclusion

Auto-Planning appears to generate SBRT treatment plans for lung lesions of similar treatment plan quality to the manually optimized, clinical plans. No statistically significant differences were noted for the dose fall-off parameters. Since it provided comparable plans, it can be used as a starting point to standardize plan quality and can be further improved manual optimization. With further experience, the Auto-Planning templet can be refined to produce better treatment plans.

Figure 1: (*left*) Cumulative, normalized dose volume histogram (DVH) for a sample lung SBRT patient using both manual and Auto-Planning techniques. (*right*) 3D rendering of the patient and beam geometry for a sample patient.

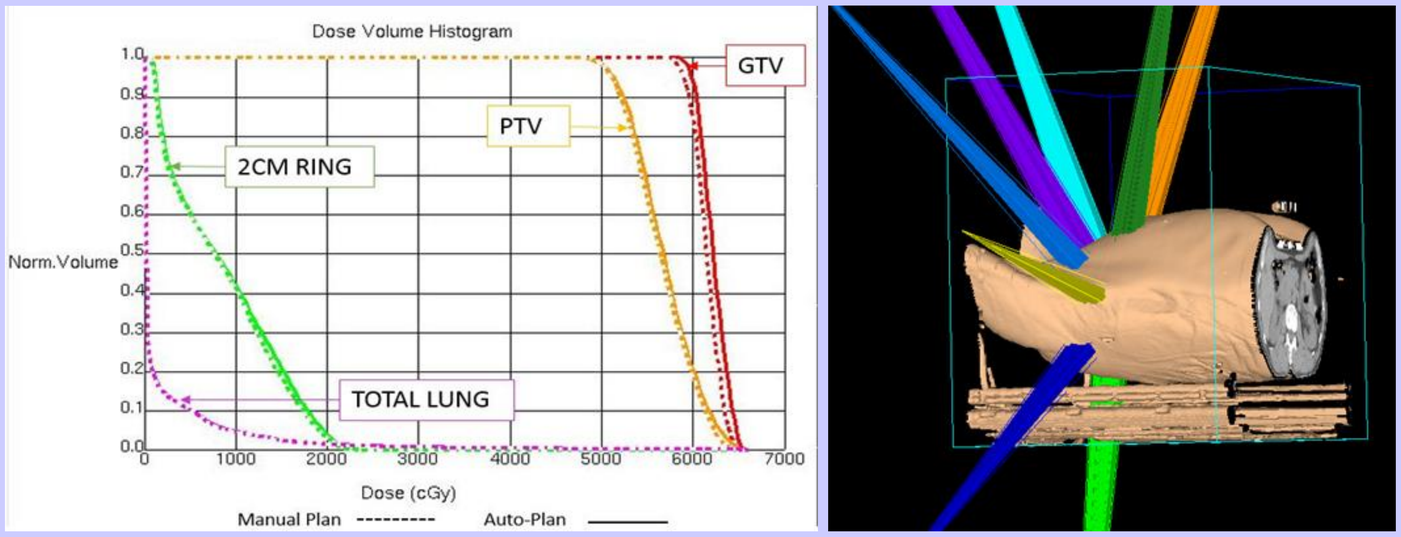

Figure 2: Axial simulation CT slice of a sample lung SBRT patient. (*left*) Dose distribution for manual treatment planning (*right*) Dose distribution for the Auto-Planning.

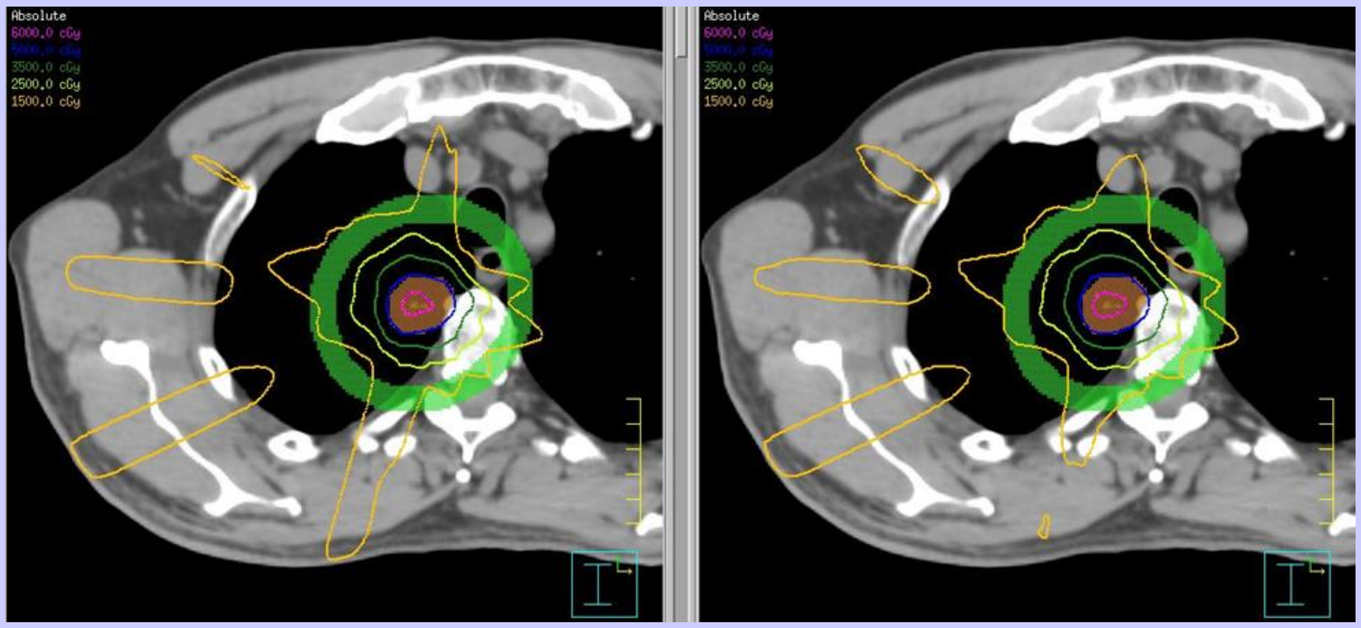

Table 1: Table shows the mean PTV parameter for conformity, dose fall off, dose heterogeneity, and total treatment plan Mus for all patients using Auto-Planning and manual planning.

	Manual Plan				Auto-Plan			
	Mean	Std	Min	Max	Mean	Std	Min	Max
HI	1.41	0.08	1.29	1.58	1.32	0.07	1.15	1.41
CN	0.92	0.04	0.84	0.97	0.90	0.03	0.83	0.94
R70	2.48	0.35	1.99	3.21	2.51	0.36	1.89	3.11
R50	4.64	0.76	3.61	5.92	4.67	0.83	3.58	6.14
R30	16.86	6.35	10.33	32.21	17.66	6.05	11.37	30.19
MU	2619	327	2021	3084	2731	447	1801	3605