A Dosimetric Comparison Between a Knowledge-based Planning Model With and Without A Ring

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Purpose

Utilizing knowledge-based planning models (KBPM) can be useful for speeding up the treatment planning process and for providing a mechanism to control plan quality. The purpose of this study was to determine if adding a ring structure to a KBPM will result in a superior plan.

Methods and Materials

Using Varian's RapidPlan module in Eclipse version 13.6, a KBPM was created utilizing 25 clinical right sided SBRT lung plans. All 25 plans utilized VMAT with at least 2 half arcs. An identical KBPM was created with the same 25 treatment plans, with the same structures, except with the addition of a ring that was 2cm away from the PTV and 2cm thick. To compare the performance of the KBPM model with and without the ring structure, 10 clinically delivered plans that were not a part of the KBPM were re-optimized using both KBPM models with the same beam energy, geometry, prescription and settings. The ring optimization objective values and priorities were determined by the model. The 105% dose spill, CI100, CI50 and maximum dose 2cm away from the PTV was recorded for each plan. The percent difference was evaluated to see if there was a change in performance between the KBPM with and without the ring.

Results

The KBPM with the ring outperformed the KBPM without the ring in the 105% dose spill (-12%±33%), CI50 (-3%±3%), and maximum dose 2cm away from the PTV (-7%±4%). The CI100 was nearly identical for both models (-0%±1%).

Conclusion

Adding a ring structure to a KBPM can lower the 105% dose spill, CI50, and maximum dose 2cm away from the PTV in right sided SBRT lung plans. Additionally, the KBPM model with the ring generated different optimization priority levels for the OARs (Figure 4). Even though both models were created with the same 25 treatment plans, the priority levels change with the addition of the 'opti' ring structure. Further studies can be done to determine if other treatment sites can benefit from KBPMs with 'opti' structures and how the addition of those 'opti' structures affect the overall performance of the model.

% Difference Between KBPM With and Without a Ring

	105% Spill	PTV CI50%	PTV D2cm	PTV CI100%
1	0.26	0.00	-0.01	0.00
2	0.10	0.04	0.08	0.00
3	0.19	0.02	0.12	0.00
4	0.21	0.06	0.11	0.00
5	0.17	0.00	0.09	-0.01
6	0.17	0.02	0.08	0.01
7	0.75	0.02	0.02	0.00
8	-0.55	0.09	0.04	0.00
9	-0.19	0.00	0.07	0.00
10	0.03	0.01	0.09	0.00
AVG	0.12	0.03	0.07	0.00
STD DEV	0.33	0.03	0.04	0.01

Figure 1: The percent difference between the 105% dose spill, 50% isodose line conformity index, maximum dose 2cm away from the PTV, and 100% isodose line conformity index values for plans run with a KBPM with and without a ring structure. A positive value represents the KBPM with the ring outperforming the model without a ring. Green indicates the KBPM with the ring outperforming the model without a ring.

Difference in Isodose Distributions

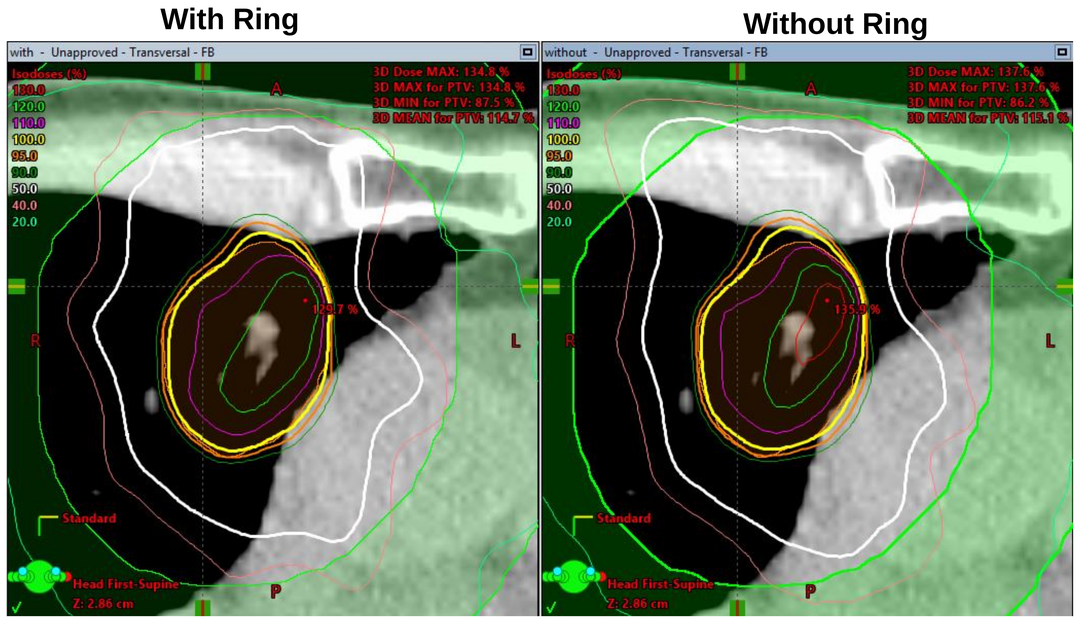

Figure 2: Isodose distributions for the plans optimized using the KBPM with a ring and the KBPM without a ring for patient 3. Note the spillage of the 100% and 50% isodose lines on the "without ring" plan.

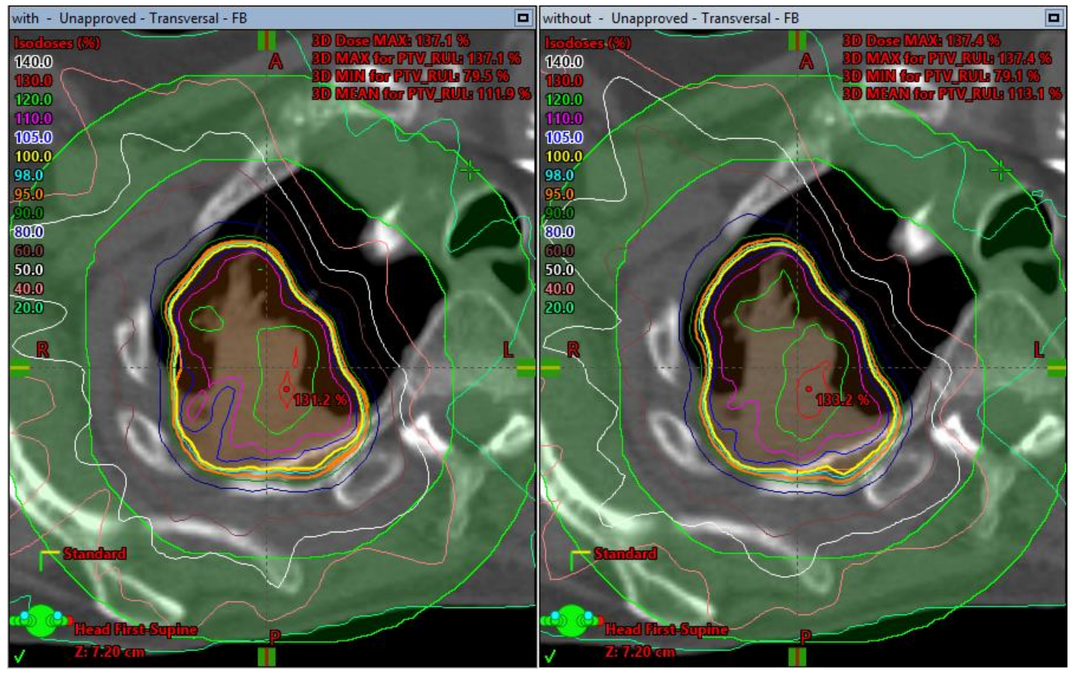

Figure 3: Isodose distributions for the plans optimized using the KBPM with a ring and the KBPM without a ring for patient 4.

Figure 4: KBPM generated objectives and priorities for patient 4 using the model with the ring (left) and the model without the ring (right). Note that the generated priority numbers are different between the two models.