

DIBH with Partial Anterior Arc Therapy Improves Dose Distributions in Patients with Anterior Mediastinal Tumors: An Exploratory Analysis

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PURPOSE/OBJECTIVES

Anterior mediastinal tumors are challenging cases to treat given the combination of complex tumor motion and the numerous critical normal tissues abutting the target volume. The purpose of this study was to determine if deep inspiratory breath hold (DIBH) combined with volumetric arc therapy (VMAT) can improve dose distributions over currently used techniques.

MATERIALS and METHODS

DVH: Cyan=PTV; Red=Heart; Orange=Spinal Cord; Light green=Esophagus; Pink=Lung_R; Dark Blue=Lung_L

A single patient being treated to the mediastinum to 30.6Gy in 17 fractions was evaluated for this study. The patient was simulated in the supine position with an alpha cradle on a wing board (Figure 1). The patient was simulated with both a 4-dimensional (4D) and DIBH scan.

Contouring was performed by a single physician on both scans. For the 4D scan, a PTV was generated by expanding the ITV 1cm, excluding the area overlapping the heart. For the DIBH scan, a PTV was generated by expanding the CTV with 1cm margin.

Using Eclipse v.13.6, 3D, IMRT, and VMAT plans were created on the DIBH scan.

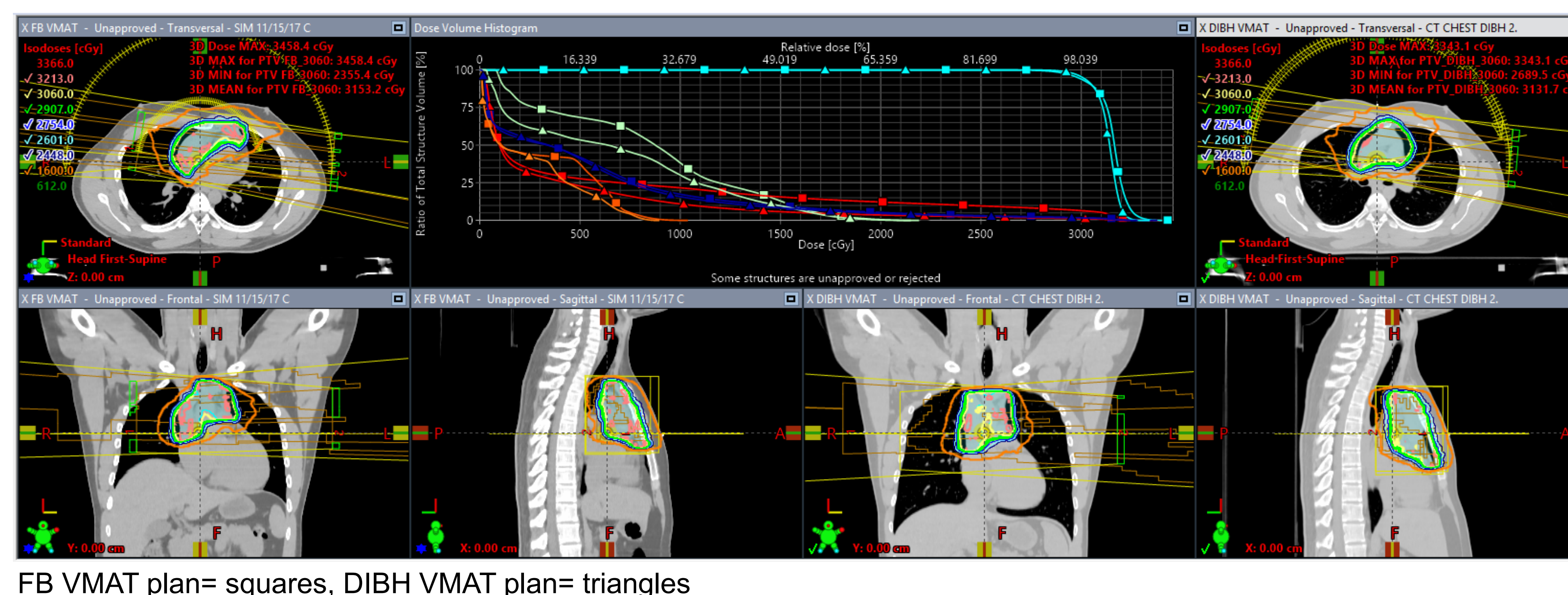
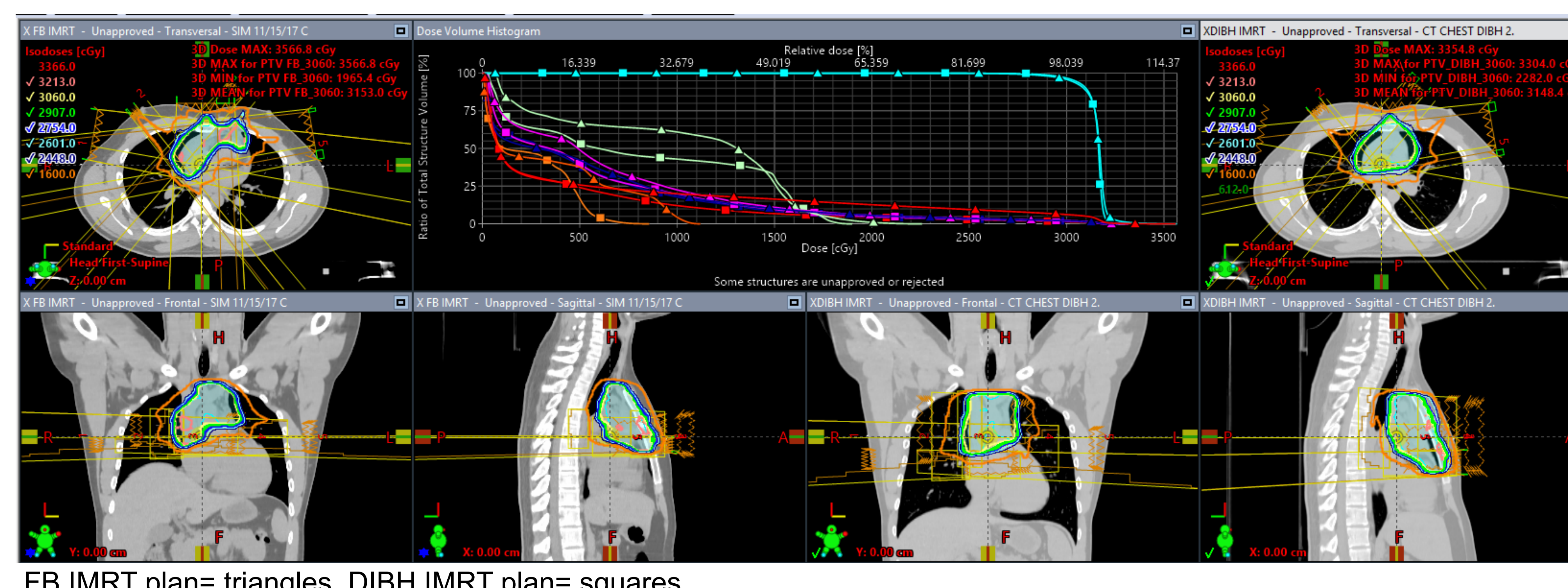
3D plan: 3 fields with wedges and 0.8cm MLC margin around PTV.

Static IMRT plan: 5 fields, gantry angles of 280, 320, 0, 40, and 80.

VMAT plan: 2 partial arcs, 280-80 and 95-265.

The IMRT and VMAT plans were optimized with constraints for the OARs.

For comparison, three identical plans were also created on the 4D FB scan. The dose to the PTV, heart, lungs, esophagus, and spinal cord were evaluated.



RESULTS

DVH analysis showed a reduction in dose to heart, esophagus, and spinal cord, with a smaller dose reduction to the lungs for plans on the DIBH scan compared to the 4D FB scan.

The largest reduction in normal tissue doses was seen with the combination of DIBH with VMAT planning.

The DIBH plan in combination with IMRT gave a slightly lower max dose to OARs

The DIBH plan in combination with 3D resulted in the lowest dose to the cord.

CONCLUSION

These results suggested that the partial arc VMAT technique would be a desirable method to treat mediastinal disease.

This treatment planning combination minimizes the size of the target volume and decreases the dose to OARs when compared to other planning techniques that were analyzed.

Further exploration of this treatment technique is needed and may improve clinical outcomes in patients with anterior mediastinal tumors including lymphomas, thymomas, teratomas, and thyroid cancers.



Figure 1

	V20 (%)	V5 (%)	V5 (%)	Mean (Gy)			Max Dose (Gy)	D90 (Gy)	D95 (Gy)
	Total lung		Heart	Total lung	Heart	Esophagus	Cord	PTV	
DIBH VMAT	4.77	40.83	22.9	5.43	3.69	6.68	8.73	30.53	30.07
DIBH IMRT	4.89	39.25	24.1	5.55	3.88	8.10	8.60	30.97	30.43
DIBH 3D	12.82	35.86	27.3	6.61	5.09	6.36	8.18	29.50	28.99
FB VMAT	5.53	46.69	27.7	6.13	6.03	8.33	10.42	30.49	29.79
FB IMRT	5.66	46.09	25.8	6.16	5.75	10.32	11.21	30.87	30.17
FB 3D	44.72	39.00	39.00	8.26	10.13	10.46	9.79	30.28	29.72

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