AbstractID: 14014 Title: Investigation of a novel algorithm for true 4D VMAT planning and delivery

Purpose: To quantify the ability of our 4D VMAT planning algorithm to generate deliverable plans over a range of target motions.

Method and Materials: Our 4D VMAT planning algorithm is an extension of the 3D algorithm by Otto (Med Phys **35** 2008, 310-317) and fully incorporates target and organ motion during optimization. Delivery of each MLC aperture is synchronized to a specific phase of the target motion. The magnitude of motion between each phase is 2.5 or 5 mm. Using a phantom consisting of a cylindrical target nested within a half-ring avoidance structure, treatment plans for a range of uniform target motions (0.5 – 4 cm) and periods (2.5 – 5.5 s) were generated. Dose prescription was 60 Gy. DVHs from the 4D VMAT plans were compared against the 3D VMAT DVH as well as 3D motion degraded DVHs.

Results: 4D VMAT plans were similar in quality or superior to the 3D plan. For motion ranges of 1.5 cm and 4 cm, the volume of the avoidance structure receiving more than 20 Gy was decreased by 10.4% and 28.6% respectively while the target volume receiving greater than 58 Gy increased by 6.5% and 16.5%. Total treatment time ranged from 141 - 181 minutes to deliver the full 60 Gy prescription or 4.7 – 6.1 minutes for a 2 Gy fraction assuming maximum dose rate is 600 MU/min. Motion of 1 cm can cause noticeable degradation of the 3D DVH.

Conclusion: Our 4D VMAT planning algorithm can create plans equal to or superior to 3D plans. Future work will investigate whether these benefits can be extended to actual 4D clinical patient data.

Conflict of Interest (only if applicable):