AbstractID: 11164 Title: Verification of Geometric Parameters in Volumetric Modulated Arc Therapy (VMAT)

Purpose: VMAT delivery involves simultaneous changes of multiple variables including gantry angle and rotation speed, MLC aperture shape, and dose rate. How to reliably verify the accuracy and functionality of the VMAT delivery presents a challenging problem to medical physicists. The purpose of this work is to describe an effective geometric quality assurance (QA) method for VMAT.

Method and Materials: A Varian RapidArc system was used for this study. The gantry angle and rotation speed were measured every 10 ms by a dynamic inclinometer. The positions and speeds of the MLC leaves at an arbitrary gantry angle (or time point) were obtained by using cine-mode MV imaging and a post-delivery image processing software. The geometric data so obtained were retrospectively synchronized and compared with the MLC Dynalog files, which record the gantry angle and leaf position every 50 ms during dose delivery. Three arc plans were generated using Eclipse planning system to test the system performance at different delivery situations. Each plan was delivered multiple times for error analysis.

Results: Our measurements show that the mean deviation of gantry angle over the course of delivery was 0.19˚-0.46˚ while the mean deviation of gantry rotation speed was 0.12-0.15˚/sec. The position and speed accuracy of individual MLC leaves measured by mean deviation were 0.5-1.0 mm (0.5-0.7 mm for bank A leaves; 0.8-1.0 mm for bank B) and 0.09-0.12 mm/sec, respectively. It was also noted that MLC positional accuracy had a sudden change when the gantry angle reached 180 degree, presumably due to the gravitational effect.

Conclusion: A clinically useful geometric QA procedure has been developed. Application of the procedure to the RapidArc delivery reveals that the planned arc sequence can generally be realized faithfully without major geometric error. Dosimetric tests should also be designed to ensure the dosimetric accuracy of VMAT delivery.