AbstractID: 10918 Title: Analysis of the mechanical accuracy of volumetric modulated arc therapy (VMAT) deliveries and corresponding dosimetric effects

Purpose: Due to the continuous nature of VMAT deliveries, monitoring mechanical parameters and their effect on dosimetry is not straightforward. The purpose of this work is to present and evaluate a tool that compares real-time VMAT delivery parameters with expected values, and utilize the tool to evaluate the mechanical accuracy of VMAT plans and judge the effect of mechanical errors on dosimetric QA.

Method and Materials: An application was designed to record real-time VMAT delivery information such as gantry position, leaf positions, and dose rate. An analysis utility was created to compare the delivery data to the DICOM-RT plan data. Several example and clinical plans with and without simulated errors were delivered to a cylindrical QA phantom and analyzed.

Results: For test plans where a 2cm MLC gap oscillated during arc delivery at various speeds, mechanical accuracy was good. The leaf gap absolute error was 0.24+/-0.26mm at maximum speed. For four clinical plans, the average mean gantry/leaf errors were 0.18^{o}/–0.01mm and the average standard deviations were 0.35^{o}/0.52mm. The analysis program correctly reported simulated errors in both test and clinical plans, including a 2mm shift of one leaf, a missing control point, and gantry lag. Dosimetric results were not significantly affected by the simulated errors, but the phantom was sensitive enough to detect them.

Conclusion: Software tools that support monitoring and subsequent analysis of treatment machine parameters during VMAT compared to expected values have been developed. Clinical plans demonstrated good mechanical accuracy, and simulated errors were detected by the analysis software although dosimetric QA was relatively insensitive to them. These tools can complement VMAT dosimetric QA by helping determine the cause of dosimetric discrepancies, and routine use may also identify potential problems before they lead to dosimetric or other issues.

Conflict of Interest: Supported in part by Elekta