AbstractID: 12689 Title: Retrospective dose reconstruction for respiration-gated VMAT

Purpose: The Varian Trilogy MX linac allows respiration-gated volumetric modulated arc therapy (VMAT). The aim of this work is to develop a technique to reconstruct the actual dose delivered in gated-VMAT treatment using on-treatment 4D cone-beam CT (CBCT) that supplies the most updated anatomy and dynamic log-files which record the actual leaf positions, gantry angles, and cumulative monitor units (MUs) during the delivery.

Method and Materials: 4D CBCT was acquired before the dose delivery and systematic log-files were retrieved after the gated-VMAT delivery. Actual delivery at a control point including MLC leaf positions, gantry angles and cumulative monitor units (MUs) were recorded in the log-files and the information was extracted using an in-house software. The extracted information was then embedded into the original DICOM-radiotherapy (RT) plan file to replace the original control point parameters. The reconstituted DICOM-RT file was imported into the treatment planning system (TPS) and dose was computed on the treatment phase of the 4D CBCT. A series of 4D phantom experiments was performed to show the feasibility and efficacy of this dose reconstruction technique.

Results: A dose reconstruction procedure has been established for respiration-gated VMAT. The studies indicate that 4D CBCT-based VMAT dose reconstruction is achievable and provides a valuable tool for monitoring the dose actually delivered to the tumor target as well as the sensitive structures. In the ideal situation where the 4D phantom is set up identically in planning CT and on-treatment CBCT, the reconstructed dose distributions on 4D CBCT show no significant difference (<3%) from the planned. It is also elucidated that the proposed method is capable of revealing the dosimetric changes in the presence of setup errors and irregular motion during the treatment.

Conclusion: The proposed methodology affords an objective means for dosimetric evaluation of newly available respiration-gated VMAT.