

Clinical Implementation of Gated RapidArc for SBRT

E. C. Mok, K. Kielar, L. Wang, A. Hsu

Stanford University Medical Center, Stanford, CA

Purpose/Objective(s): The newly acquired Varian TrueBeamSTx linac is capable of delivering volumetric modulated arc therapy (RapidArc) under respiratory-gated conditions. When operating under flattening-filter free (FFF) mode, dose rate of up to 2400 MU/min. is achievable. This has made gated RapidArc a suitable choice for Stereotactic Body Radiotherapy (SBRT) for sites with respiratory motion, such as lung and pancreas. This study describes the implementation process.

Materials/Methods: RapidArc was commissioned using method recommended by C. Ling, et al.,¹. Prior to clinical use, the accuracy of gated RapidArc was tested and evaluated. Simple static fields and RapidArc plans for target sizes from 10 cm to 1 cm diameters were delivered on a Respiratory Gating Platform (Standard Imaging) with a plastic water phantom. Isodose distribution of these plans were measured using Kodak EDR2 film and compared with dose distribution calculated by Varian Eclipse V8.9, using grid spacing 1.0 and 2.5 mm. The result was analyzed with RIT113V5.2 software. Before treatment, fiducial markers that had been implanted prior to simulation were contoured on 4D-CT scans. MLCs were used to project a 2-mm margin of aperture on the kV setup fields. A six-dot marker block placed on the patient allows for the monitoring of the patient's breathing pattern using the respiratory gating system. For each treatment, the patient was first aligned to their bony anatomy using kV imaging and CBCT. The kV fluoroscopy was then used to adjust the gating window such that the implanted fiducial were within the 2 mm aperture when the MV treatment beam would be turned on. The accuracy of the delivery was further assessed by taking intra-fraction kV images just before the MV beam-on at every breathing cycle.

Results: For square fields the distance of agreement (DTA) was found to be less than 0.8 mm between the measured and calculated isodose distribution. For RapidArc plans, the comparison had a gamma index better than 95%. The average DTA was found to be 2.65 mm. When analyzing the infrafraction kV images of patients, the fiducial marker was found to be within 2 mm of the aperture. Since November 2010, 21 patients have been treated with gated RapidArc in a 5 month period for various sites affected by respiratory motion including lung (10 cases), liver and pancreas. Overall the actual beam-on time was between 5 to 15 minutes, depending on the breathing pattern of the patient.

Conclusions: Gated RapidArc for SBRT treatment have been successfully implemented in our center. The developed QA methodology shows that plans could be delivered with precision and accuracy to a target volume in motion. With the available high dose rate of the FFF mode, gated RapidArc become the treatment of choice for SBRT.

Reference:

1. *Commissioning and Quality Assurance of RapidArc Radiotherapy Delivery System. IJROBP 72:575-81.*