Delivery Efficiency and Dosimetric Accuracy of Respiratory-gated VMAT Using an Elekta digital accelerator
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To characterize the performance of an Elekta digital accelerator in the delivery of respiratory-gated volumetric modulated arc therapy (VMAT) for lung stereotactic body radiation therapy (SBRT). The testing included an examination of delivery efficiency and dosimetric accuracy.

With a pre-clinical respiratory gating interface, the Response 2, developed by Elekta and a commercially available novel surface imaging system as the respiratory input, three lung SBRT treatment plans using gated VMAT were delivered with high dosimetric accuracy.

This work demonstrates that Elekta digital accelerators can accurately deliver gated radiotherapy even for complex delivery techniques such as VMAT. The results should offer a base-line reference for Elekta users around the world.

Methods & Materials

An Elekta Synergy digital accelerator was gated using the Elekta “Response 2” Gating Interface. This assembly breaks out the pulse repetition frequency (PRF) signal during the beam-off period. The gating signal was generated by the C-Rad Catalyst system (C-RAD AB, Uppsala, Sweden), a camera system that combines surface imaging with a non-rigid surface registration algorithm, and input into the Gating Switch Box via a USB connection.

The experimental setup and the Gating Interface are shown in Fig. 1.

Results

Table 1 below summarizes total delivery time, number of beam interruptions, and gamma-index passing rate for all three plans and all three delivery schemes, one un-gated and two gated. Results with the binned dose rate are listed side by side in the parenthesis with those with the CVDR.

Figure 2 shows an example (Patient 1) of the comparison of the measured and the planned coronal dose distributions with corresponding gamma-index analyses.

Conclusions

Our results demonstrated that for the first time, respiratory-gated VMAT can be delivered accurately and efficiently on an Elekta digital accelerator. For 3 lung-SBRT plans delivered with the CVDR, as compared with the binned dose rate, the delivery time was reduced by 28% and 16% on average with gated deliveries for gating windows 77% and 66%, respectively. High dosimetric accuracy was demonstrated for as many as 214 beam interruptions during a single 360-degree-arc delivery with gamma-index passing rates (3 mm/3% criteria) were no lower than 99.0% for all tests.