Purpose:

The beamlet-based IMRT-SBRT has two widely-recognized deficiencies: an elevated MU and a reduced MU-to-cGy coefficient. To address these issues, we developed our own version of VMAT. A thorough literature search indicates that this is the first non-commercial VMAT in the United States. Our objectives are 1) to minimize MU; 2) to maximize delivery efficiency and 3) to provide IMRT-SBRT-comparable plans.

Methods:

All VMAT-SBRT plans consisted of a single arc of 180 equally spaced beams. Our VMAT was designed to simultaneously optimize both MLC apertures and aperture MU weights. A novel feature of our VMAT planning system was the inclusion of a normal tissue objective (NTO) function into the total dose-volume based quadratic objective function. Five VMAT-SBRT plans were computed and compared with corresponding IMRT-SBRT plans. Our VMAT-SBRT plans were delivered in RapidArc mode on a RapidArc-enabled Varian Trilogy machine.

Results:

We found that the mean MU for the VMAT-SBRT plans was 2052±108, while that for the IMRT-SBRT plans was 3790±63. The MU-to-cGy ratio was 1.15±0.06 for the VMAT-SBRT plans, while the MU-to-cGy ratio was 2.11±0.04 for the IMRT-SBRT plans. The mean delivery time for the IMRT-SBRT plans was 6.32±1.06 min (600 MU/min), while that for the VMAT-SBRT plans was only 1.25 min. The mean target dose homogeneity index HI for the IMRT-SBRT plans was 0.0535±0.0001, while that for the VMAT-SBRT plans was 0.0366±0.0028. The mean PTV dose conformity PIPTV for the VMAT-SBRT plans was 1.421±0.0311, while that for the IMRT-SBRT plans was 1.466±0.0028.

Conclusions:

Based on our preliminary results, we conclude that our own version of VMAT-SBRT can significantly increase plan delivery efficiency, enhance energy use efficiency, and improve target dose homogeneity and conformity. It is a viable and safe substitute for IMRT-SBRT.

Funding Support, Disclosures, and Conflict of Interest: