Purpose: MLC tumor tracking is a promising method for rigid motion management in radiation therapy. The purpose of this work is to develop an MLC control algorithm capable of delivering VMAT to the tumors that are undergoing rigid motion.

Method: The motion of the target is assumed to be known prior to the treatment. This assumption is made for simplicity but the algorithm is readily adaptable for real time. The motion of the target divided into two components from the MLC plane of reference: one along the x-axis (parallel to the MLC leaf motion) and the other along the y-axis (perpendicular to the MLC leaf motion direction) as the gantry rotates around the patient. Target motion along the y-axis is tracked by appropriately shifting the positions of all MLC leaves. To demonstrate the optimal delivery for a moving target, the interdependence of the delivery parameters (gantry speed, MLC velocity and dose rate) are investigated and the machine constrains are applied for the delivery of several VMAT plans.

Results: We have found that, for a real-time tracking for the VMAT delivery, the leaf acceleration is much less than the physical acceleration limit. However, the most efficient delivery requires large gantry acceleration or deceleration for the motion tracking, which may not be acceptable and causes dosimetric error. Comparisons are made for the VMAT plans with segments spaced at 2° and 4°. It has been shown that larger spaced gantry intervals with slightly longer delivery time will significantly reduce the gantry acceleration or deceleration.

Conclusion: The algorithm for tracking the target motion is proposed and makes it possible to compensate for dose error due to the target motion in real-time. Our results, specifically, machine constrains including gantry acceleration, are important for the practical VMAT deliveries for moving targets.