Purpose: To evaluate the impact of gantry acceleration on the VMAT arc therapy delivery.

Methods and Materials: The rapid delivery of VMAT arc therapy requires fast motion of the gantry around the patient. The difficulty is that the large inertia of the accelerator gantry limits rotation speed changes restricting the ability of the accelerator to arc as fast as possible without violating the integrity of the plan (plan delivery requires preserving mutual relations between gantry speed, MLC leaves speeds and beam dose rate). This work examines arc therapy deliveries for static and moving target in presence of acceleration limitation for gantry angular speed. We compute the shortest time of arc therapy delivery, provided different acceleration limitations are imposed. The problem of arc delivery to moving target is a complex optimal control due to dependence of motion constraints on the state of the evolution. As may be expected more stringent limits on the acceleration lead to longer delivery time and the successive decrease of the mechanical strain on the gantry rotation mechanism.

Results. The static prostate VMAT arc treatment investigated sets the acceleration limitations for gantry speed from 2deg/sec2 to 1.5deg/sec2 to 1.0deg/sec2 to 0.5deg /dsec2 to 0.0deg sec2. For subsequent deliveries the optimal time of therapy delivery increases appropriately from a just above 1 minute to above 3 minutes.

Conclusions. The ultimate limitation imposed on the acceleration of the gantry (constant gantry speed delivery) leads to approximately threefold increase in most efficient delivery times for the example. This time increase is accompanied, by complete removal of mechanical stress on the system of the gantry motion. The constant gantry angular speed delivery is not realistically achievable for moving target when the motion is measured in real time if the planned dose delivery integrity is to be preserved.