AbstractID: 9607 Title: Initialization strategy and concurrent imaging for single 360 degree arc intensity modulated treatment delivery

Purpose: Single 360 degree arc treatment with variable MU per degree and changing MLC apertures provides an efficient means for delivering highly conformal radiation therapy. Additionally, the treatment geometry is amenable to CT image acquisition during the delivery enabling verification of patient position. The challenge with the technique is finding the optimal set of apertures over the arc. Aperture based optimization (MLC leaf positions) is the natural approach, but suffers for complex targets if the initial starting condition is simply the fields exposing the target around the arc. The problem occurs when the optimal solution would have the MLC closing off a larger portion of the target requiring large positional changes from the initial condition to the optimal position. In this case gradient based optimizations fall short in that the derivative of the dose distribution with respect to the leaf position is flat for locations further from the leaf tip. In order to remedy this problem, improved initialization of the initial MLC positions around the arc based on the target geometry are proposed.

Materials & Methods: A research version of the Pinnacle3 RTPS was used to plan the single arc delivery. The approach uses 36 equispaced beams over a 360 degree arc, and optimizes the plan using a single MLC aperture for each beam and the direct machine parameter optimization (DMPO) technique in the system. The Elekta Synergy linear accelerator was used to deliver the treatment and for cone beam CT acquisition.

Results: Initial results show dose conformality similar to that of traditional intensity modulated radiotherapy with the 360 degree delivery using geometry based pre-initialization of the apertures. Additionally, kilovolt image acquisition during delivery was possible. Scattered radiation and the interplay between image acquisition frequency and the pulse rate of the treatment beam influence the image quality but not significantly.