

AbstractID: 4871 Title: Tongue and groove effect in Direct Aperture Optimization IMRT plans

Purpose: Direct Aperture Optimization (DAO) is a promising new IMRT technique whereby the MLC leaves and relative weights of the apertures are simultaneously optimized. Due to the stochastic nature of the simulated annealing optimization algorithm, MLC leaves can have positions that are significantly different from their neighboring leaves. Opposed adjacent leaves with these positions can lead to a “ripple” in the dose distribution due to tongue-and-groove effect (TGE). In this work, we attempt to quantify the magnitude of the effect and commission the Pinnacle planning system to account for it.

Method and Materials: To quantify TGE, we generated a two-segment beam: one segment with every other leaf on one side extending well past the central axis and the other with every other opposed adjacent leaf extending well past the central axis. Jaws set to 20x20 bound both segments and both had equal monitor units. This beam was delivered to a flat phantom with a film placed at 10cm depth.

Newer versions of Pinnacle (7.4 or greater) take into account TGE. This is modeled in the physics tool with a tongue-and-groove step parameter. We systematically changed this parameter and compared the resulting dose distributions to the film measurement.

We imported DAO IMRT plans into the Pinnacle planning system and compared the dose distributions with and without TGE. These were also compared with verification measurements.

Results: The film displayed a 23% variation from minimum to maximum dose. The Pinnacle step parameter of 0.3cm reproduced the variation. If TGE is not accounted for in the planning, an underestimation of the absolute dose is observed for DAO IMRT plans. The magnitude of the underestimation is dependent upon the aperture shapes.

Conclusions: TGE affects the dose distribution for DAO plans. Limiting the distance adjacent leaves may travel can reduce the effect of TGE.