

## AbstractID: 8606 Title: Improved critical structure sparing with biologically-based treatment planning systems

**Purpose:** To compare commercially-available biologically-based and physically-based IMRT treatment planning systems.

**Method and Materials:** For representative cases of various anatomic sites, four IMRT plans were generated for each case. Two plans used physical optimization only (pIMRT): CMS Xio and Philips Pinnacle physical optimization (Pinn\_Phy). Two other plans included biological optimization (bIMRT): CMS Monaco and Pinnacle's combined biological optimization (Pinn\_bio). For a given case, the same CT images and structures were used for all four plans. The numbers of beams and beam orientations were the same. The dose-volume-histogram (DVH), mean dose, minimum and maximum doses,  $V_x$  (the percent volume receiving at least x dose), heterogeneity index (HI), equivalent uniform doses (EUD), and an EUD-based plan ranking index (fEUD) were used to compare these IMRT plans. The greater *fEUD* values suggest superior plans.

**Results:** For all the cases studied, the four IMRT plans had acceptable target coverage and organs-at-risk (OAR) sparing. The bIMRT plans, however, led to improved OAR sparing as indicated by DVHs and EUDs. For a prostate case, the mean rectum doses for the four plans were 29.6 Gy (Xio), 24.1 Gy (Monaco), 27.9 Gy (Pinn\_phy), 25.0 Gy (Pinn\_bio), while the target coverage was consistent within 3.4% (ranged from 96.1% for Xio to 99.5% for Pinn\_phy), the target EUDs were comparable (within 2.5%, between 76.1 Gy for Xio to 78.0 Gy for Monaco). The fEUDs were calculated to be 0.26 (Xio), 0.31 (Monaco), 0.27 (Pinn\_phy), 0.29 (Pinn\_bio), indicating that bIMRTs are generally better than the pIMRTs.

**Conclusion:** Unlike physical optimization, biological optimization utilizes biological quantities that can work in the entire dose range in non-linear proportional fashion. The biological optimization can generate plans with equivalent target coverage but with improved critical structure sparing as compared to the physical optimization.

**Conflict of Interest (only if applicable):**