Purpose: To compare prostate radiation planning using four VMAT techniques and IMRT on plan quality and dose delivery efficiency.

Methods: The four VMAT techniques are: 1) Monaco VMAT (Version 2.03.01, CMS Inc., MO); 2) RapidArc (Eclipse Version 10.0, Varian Medical System Inc., CA); 3) SmartArc (Pinnacle Version 9.0, Philips Radiation Oncology Systems, WI) and 4) helical TomoTherapy (TomoTherapy Version 3, Accuray Inc., CA). The IMRT planning employed 7-field fixed gantry on Pinnacle. Single full-arc plan using each technique was generated for five prostate cases. All plans were prescribed to 70 Gy (2.5 Gy/fx) to 95% PTV using 6 MV photon beams to achieve same PTV coverage and similar OAR sparing. The quality of dosimetric plans was evaluated using metrics: target coverage, heterogeneity index (HI), target/organ mean/max/min doses, EUD, dose-volume histogram, etc.

Results: All VMAT plans are capable of delivering adequate target dose with equal or better OAR sparing than IMRT plans. The average mean PTV doses were 72.8, 73.1, 71.0 and 72.5 Gy with HIs of 1.10, 1.08, 1.03 and 1.05 for the Monaco, RadipArc, SmartArc and TomoTherapy plans respectively. In low dose range, TomoTherapy resulted in the highest V10 and V20 while V70 and V60 were generally lower compared to other plans. Generated on the same platform, the SmartArc plans were slightly more conformal (CI=1.04 vs 1.08) and less heterogeneous (HI=1.02 vs 1.04) with better OAR sparing compared to IMRT plans. The average required MUs were 817 (Monaco), 735 (RapidArc), 798 (SmartArc) and 4986 (TomoTherapy), compared to 876 MUs for the IMRT plans.

Conclusions: All single-arc VMAT techniques under study improve normal tissue sparing with more efficient dose delivery compared to prostate IMRT plans. RapidArc plans require least MUs while SmartArc provided most homogenous plans. All VMAT plans demonstrate significantly reduced MUs to achieve comparable dosimetric plans compared to Tomotherapy.