Purpose: To quantify biological consequences of MLC calibration errors in prostate IMRT and relate those biological consequences to IMRT QA action levels.

Methods: Ten consecutive prostate cancer patients treated with a 5-field IMRT (Varian iX with Millenium 120 leaf MLC) were selected. All cases were treated with a prescription dose of 74 Gy. An in-house program was used to introduce systematic MLC offsets. Combinations of X1 and X2 offsets in the range from -2 to +2mm were explored. Modified files were imported into the treatment planning system (TPS) to recalculate dose for each modified plan. DVHs were exported from the TPS and generalized equivalent uniform doses (gEUD) were calculated for the rectum (n=0.09) and PTV (a=-10). Each plan was also recalculated on a CT scan of a cylindrical phantom with a contoured ion camber. Dose distributions were exported for 3D gamma analysis with dose and distance to agreement set to 3% and 3 mm, respectively. Pass criteria were: at least 95% of voxels have to pass and dose to chamber has to be within 2% of the reference dose.

Results: Plans with offsets of 2 mm, single leaf bank or combined, have not passed gamma QA, however 30% of plans passed chamber dose QA. For 1.5 mm offsets 20% and 70% of plans passed gamma and chamber dose QA, respectively. Change in gEUD for PTV and rectum was of the order of 2% for plans passing both QA methods and larger than 3% for those which failed QA.

Conclusions: With currently used methods and criteria for prostate IMRT QA, we can only detect changes in gEUD greater than 3% that are resultant from MLC calibration errors. This is important because it provides a lower limit on the ability of current IMRT QA to estimate a biological impact for machine errors.