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Abstract

Dosimetric comparison of VMAT, MLC robotic radiosurgery, and Cone robotic radiosurgery in prostate SBRT

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Objectives: To compare the dosimetric efficacy of three different treatment techniques in stereotactic body radiation therapy (SBRT) of prostate cancer.

Methods: Prostate SBRT treatment planning was performed on eight prostate patients using three different treatment machines. VMAT planning was performed using a 5mm multileaf collimator (MLC) beam data of a clinically used conventional C-arm medical accelerator. Non-coplanar sequential treatment planning was performed on a TPS using ray-tracing dose algorithm based on the beam data sets corresponding to two different clinically used robotic stereotactic systems, one equipped with a 3mm MLC system and the other with cone collimators. For each patient, the same CT series and RT structure sets were used in all three plans. The prescription dose to the planning treatment volume (PTV) was 36.25 Gy (which ranged between 81.6-82.6% of the maximum dose). The planned dose was imported into independent 3rd party software to evaluation purpose. A set of dose-volume measurements, PTV conformity index (CI) and integral dose were measured. Student's t-test was used to look for statistically significant differences in collected data, defined by a p-value of less than 0.05.

Results: CI for cone and MLC robotic radiosurgery were 1.084±0.043 and 1.125±0.046, greater than the CI using VMAT (0.978±0.04, p=0.001). Rectum V36 Gy volume using cone robotic radiosurgery (0.469±0.34 cc, p=0.02) and MLC robotic radiosurgery (0.489±0.34 cc, p=0.04) were smaller than it was using VMAT (0.672±0.50 cc). Additionally, the rectum V18 Gy volume was smaller using the MLC-equipped robot (9.971±4.71 cc) than it was when using cone robot (16.27±6.19 cc, p=0.0002) and when using VMAT (13.517±3.750 cc, p=0.00024). No difference was found in bladder dose-volume measurements. Integral dose to body-minus-PTV volume based on V18 Gy dose-volume measurements was less when an MLC-equipped system was used: VMAT plans and MLC-equipped robot plan both had a smaller volume of (197.459±86.029 cc, p=0.00028) and (204.615±75.834 cc, p=0.00129) than cone robotic radiosurgery plans (316.528±135.127 cc).

Conclusions: MLC-equipped robotic radiosurgery may provide greater rectum tissue sparing during SBRT than both VMAT and cone-based robotic radiosurgery. Additionally, a non-concentric approach may provide a more conformal dose distribution. Finally, integral dose is

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reduced when either an MLC is employed to modulate the dose distribution.