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The Impact of Using Flattening Filter-Free Energies on Treatment Efficiency for Prostate SBRT

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Abstract : Purpose/Objective(s): The main purpose of this study is to analyze the planning of SBRT treatments for localized prostate cancer with 6FFF and 10FFF energies to see if there is a dosimetric difference between the two energies and how we can increase the plan efficiency and reduce its complexity. Also, to introduce a planning method in our department to treat prostate cancer by utilizing high energy photons without increasing patient toxicity and fulfilled all dosimetric constraints for OAR (an organ at risk). Then toevaluate the target 95% coverage PTV95, V5%, V2%, V1%, low dose volume for OAR (V1Gy, V2Gy, V5Gy), monitor unit (beam-on time), and estimate the values of homogeneity index HI, conformity index CI a Gradient index GI for each treatment plan.Materials/Methods: Two treatment plans were generated for15 patients with localized prostate cancer retrospectively using the CT planning image acquired for radiotherapy purposes. Each plan contains two/three complete arcs with two/three different collimator angle sets. The maximum dose rate available is 1400MU/min for the energy 6FFF and 2400MU/min for 10FFF. So in case, we need to avoid changing the gantry speed during the rotation, we tend to use the third arc in the plan with 6FFF to accommodate the high dose per fraction. The clinical target volume (CTV) consists of the entire prostate for organ-confined disease. The planning target volume (PTV) involves a margin of 5 mm. A 3-mm margin is favored posteriorly. Organs at risk identified and contoured include the rectum, bladder, penile bulb, femoral heads, and small bowel. The prescription dose is to deliver 35Gyin five fractions to the PTV and apply constraints for organ at risk (OAR) derived from those reported in references. Results: In terms of CI=0.99, HI=0.7, and GI= 4.1, it was observed that they are all thesame for both energies 6FFF and 10FFF with no differences, but the total delivered MUs are much less for the 10FFF plans (2907 for 6FFF vs.2468 for 10FFF) and the total delivery time is 124Sc for 6FFF vs. 61Sc for 10FFF beams. There were no dosimetric differences between 6FFF and 10FFF in terms of PTV coverage and mean doses; the mean doses for the bladder, rectum, femoral heads, penile bulb, and small bowel were collected, and they were in favor of the 10FFF. Also, we got lower V1Gy, V2Gy, and V5Gy doses for all OAR with 10FFF plans. Integral dosesID in (Gy. L) were recorded for all OAR, and they were lower with the 10FFF plans. Conclusion: High energy 10FFF has lower treatment time and lower delivered MUs; also, 10FFF showed lower integral and meant doses to organs at risk. In this study, we suggest usinga 10FFF beam for SBRTprostate treatment, which has the advantage of lowering the treatment time and that lead to lessplan complexity with respect to 6FFF beams.

Keywords : FFF beam, SBRT prostate, VMAT, prostate cancer
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