

Dosimetric Dependence on the Collimator Angle in Prostate Volumetric Modulated Arc Therapy

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Abstract : Purpose: This study investigates the dose-volume variations in planning target volume (PTV) and organs-at-risk (OARs) using different collimator angles for smart arc prostate volumetric modulated arc therapy (VMAT). Awareness of the collimator angle for PTV and OARs sparing is essential for the planner because optimization contains numerous treatment constraints producing a complex, unstable and computationally challenging problem throughout its examination of an optimal plan in a rational time. Materials and Methods: Single arc VMAT plans at different collimator angles varied systematically (0° - 90°) were performed on a Harold phantom and a new treatment plan is optimized for each collimator angle. We analyzed the conformity index (CI), homogeneity index (HI), gradient index (GI), monitor units (MUs), dose-volume histogram, mean and maximum doses to PTV. We also explored OARs (e.g. bladder, rectum and femoral heads), dose-volume criteria in the treatment plan (e.g. D30%, D50%, V30Gy and V38Gy of bladder and rectum; D5%, V14Gy and V22Gy of femoral heads), dose-volume histogram, mean and maximum doses for smart arc VMAT at different collimator angles. Results: There was no significance difference found in VMAT optimization at all studied collimator angles. However, if 0.5% accuracy is concerned then collimator angle = 45° provides higher CI and lower HI. Collimator angle = 15° also provides lower HI values like collimator angle 45° . It is seen that collimator angle = 75° is established as a good for rectum and right femur sparing. Collimator angle = 90° and collimator angle = 30° were found good for rectum and left femur sparing respectively. The PTV dose coverage statistics for each plan are comparatively independent of the collimator angles. Conclusion: It is concluded that this study will help the planner to have freedom to choose any collimator angle from (0° - 90°) for PTV coverage and select a suitable collimator angle to spare OARs.

Keywords : VMAT, dose-volume histogram, collimator angle, organs-at-risk

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