AbstractID: 11046 Title: A Hybrid Strategy of Offline Adaptive Planning and Online Image Guidance for Prostate Cancer Radiotherapy

Purpose: In online image-guided radiotherapy of prostate cancer, the setup error and inter-fractional motion is eliminated through pre-treatment imaging and couch correction at each fraction. However, the rotation and deformation is not corrected and only accounted for in planning margin. In this study, we propose a hybrid of online and offline adaptive image-guidance strategy for both low risk patients (LRP, CTV=prostate) and intermediate risk patients (IRP, CTV=prostate+seminal vesicles). The benefit of margin reduction is evaluated geometrically.

Method and Materials: Planning and treatment helical CT images from 25 patients over 412 fractions were used. Online image-guidance was simulated by matching the center of mass of CTV in treatment CT to planning CT. Offline replanning was performed by constructing the internal target volume (ITV) from the union of position-corrected CTVs from the first 5 treatment CTs. The volume overlap index (OI) of ITV and CTVs of the remaining fractions were compared with the OIs between PTV from planning CT and the treatment CTVs. Margins from 0 to 10 mm were investigated.

Results: The mean ITV volumes are 62.5 and 90.1 cm^3 for LRP and IRP, respectively, equivalent to 0.8 and 1.0 mm uniform margin to CTV_0 (mean volumes of 55.7 and 78.0 cm^3). The margins needed for 99% OI for ITV ($V_{99\%}$ = 67.9 and 105.5 cm^3) are 1.7 mm and 2.6 mm less than those for the planning CTV ($V_{99\%}$ = 84.5 and 144.7 cm^3) for LRP and IRP, respectively.

Conclusion: The hybrid of online and offline adaptive radiotherapy protocol can effectively account for the patient-specific interfraction organ motion and setup errors for prostate cancer patients. The planning margin can be reduced further using the hybrid strategy compared with online image guidance alone. Reduced irradiated volume will also lead to decreased toxicity in critical organs.

Conflict of Interest: None.