Establishing margins from clinical to planning target volume for low-risk prostate cancer radiotherapy: a multi institutional study

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1. Purpose

The aim of this multi institutional study was to determine the appropriate margins from clinical target volume (CTV) to planning target volume (PTV) in low risk prostate cancer irradiation, in relation to the image guided radiotherapy (IGRT) protocol used, derived from data from three radiotherapy (RT) centers.

2. Methods

Twenty patients with localized low risk prostate cancer were selected from each RT center for retrospective review. Prescribed dose of 78 Gy in 39 fractions was delivered with volumetric modulated arc therapy (VMAT) in supine position. Localized low-risk prostate cancer2 includes patients with TNM stage T1-T2a disease, PSA <10 ng/ml or Gleason score ≤6. Pretreatment preparation was applied in accordance with Affidea’s institutional protocol (full bladder-empty rectum). CTV included prostate only (Figure 1).

Cone beam computed tomography (CBCT) was daily co-registered with planning Computed Tomography (CT), using two registration protocols: bone match and soft tissue (prostate) match (Figure 2). Based on this data, set up errors and inter-fracton prostate motion were calculated in all three CT centers. Literature data for delineation errors and intra-fracton motion3 were used to determine CTV-PTV margins for different imaging protocols (online 2D/2D bone match and online CBCT match).

3. Results

Systematic, random, setup and intra-fractal-organ motion errors (Σsystematic, Σorganmotion, Σsetup and Σorganmotion), calculated data for all three RT centers is presented in Table 1.


depending on the IGRT protocol, the calculated CTV-PTV margins of longitudinal (Long), lateral (Lat) and vertical (Vert) directions are presented in Table 2.

4. Conclusion

If no setup correction protocol is used, CTV-PTV margins less than 10 mm cannot be used due to increased risk of missing the CTV. Treating patients for low risk prostate cancer with daily online IGRT protocol allows smaller PTV-CTV margins (5-7 mm) to be used and may lead to better local control and lower toxicity rates. Calculated margins exclude rotational errors and shape deviations and therefore should be considered when defining the PTV4.

5. References

(2) European Association of Urology. Oncology Guidelines, 2018