

Introduction: Different CT modalities with varying image quality are being used to correct for interfractional variations in patient setup and anatomy changes, thereby reducing CTV-to-PTV margins, for prostate radiotherapy (RT). We explore how CT image quality affects patient repositioning and CTV-to-PTV margin.

Methods and material: Three CT-based IGRT modalities routinely used in our institute for prostate RT are considered in this study: MV fan beam CT (Tomotherapy), MV cone beam CT (MVision, Siemens) and kV fan beam CT (CTVision, Siemens). Daily shifts are determined by manual registration to achieve the best soft tissue agreement. Effect of image quality on patient repositioning was determined by statistical analysis of daily shifts for 65 prostate cancer patients (34 Tomotherapy, 21 CTVision, 10 MVision) treated in our clinics. The impact of soft tissue contrast on organ interface identification was evaluated by analyzing contours drawn by 7 users on the scans from each imaging modality. In addition, variability of soft tissue registration between 10 users was evaluated based on the registration of representative scan for each CT modality with its corresponding planning scan. CTV-to-PTV margin was defined as 1.96σ .

Results: Inferior image quality with MV CT based IGRT leads to increased variations in daily shifts (3, 4, 5 mm for CTVision, Tomotherapy and MVision) and in prostate delineation (6, 3, 10 mm for CTVision, Tomotherapy and MVision). Superior image quality with the kV CT results in reduced variation between 10 users in soft tissue registration. Uniform margin introduced to account for the uncertainty in the identification of prostate edge are determined to be 2, 6 and 5 mm for CTVision, Tomotherapy and MVision.

Conclusion: Image quality adversely affects the reproducibility of the manual registration for IGRT and necessitates a margin of 2 mm for kV CT and 6 mm for MV CT to ensure adequate coverage.