Heterogeneity in Planning Target Margin Definition in Intact Prostate Cancer External Beam Radiotherapy: Results from a Large Statewide Consortium

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Purpose: The planning target volume (PTV) is an integral part of the planning process for prostate cancer (PCa) treated with external beam radiotherapy (EBRT) as it encompasses variation in patient position, organ motion, and other uncertainties. Given rapidly changing technologies and treatment techniques for PCa, current PTV practice patterns and associations with techniques are unknown. To address this need, we analyzed patients with intact PCa receiving EBRT within a large statewide multi-institutional consortium.

Methods: Prostate Radiation Technical Details (PRTDs) were collected including course details, plan details, and treatment delivery. This data is prospectively submitted by dosimetrists and physicists at each institution and audited annually. Univariate analyses were performed to evaluate the association between uniform target margin and the use of pre-treatment image guidance (IG) or placement procedures (fiducial markers or rectal spacer).

Results: A total of 475 patients with intact PCa received EBRT to the prostate gland (without pelvic lymph node irradiation) at 22 member sites, either as monotherapy or combined with brachytherapy, from 6/9/2020 to 12/20/2022. The number of patients enrolled by each site ranged from 1 to 102 (median=9). Six sites used exclusively non-uniform margins, 5 sites used only uniform margins, and 11 sites used both. The median uniform margin was 0.5 cm (range=0 – 1 cm). Of those using non-uniform margins, there was a smaller posterior margin (median=0.5 cm, range=0.1 – 0.8 cm) compared with other directions (median=0.7 cm, range=0 – 1.2 cm) (p-value<0.0001). The percentage of uniform margins varied markedly across sites (median=27%, range =0-100%). Daily volumetric imaging (p-value=0.019) and placement procedures (p-value=0.0375) were associated with uniform margins.

Conclusions: We observed a large inter-institution variance in PTVs for patients with PCa. Our work calls for further quantitative evaluation of the margins, stratified by IG technique, placement procedure, and fractionation scheme, to set evidence-based physics practice standards.

Supporting Information

Innovation and Impact: Reduction of target volume margins facilitates the reduction of normal tissue dose and target dose escalation. This is particularly relevant for prostate radiotherapy: previous studies have shown that appropriately designed margins reduced normal tissue toxicity and biochemical relapse[1], while inadequate margins led to worse outcomes[2]. From the perspective of patient-centered care, the optimal margin is a balance between the cost of advanced localization techniques and improved dosimetry. Currently, there is a lack of consensus guidelines on the optimal choice of margins given each technology setting[3]. Our work represents the first step in moving towards evidence-based quality guidelines for target margins.

Key Results

Figure 1. Use of uniform and non-uniform planning target margins at 22 MROQC member sites

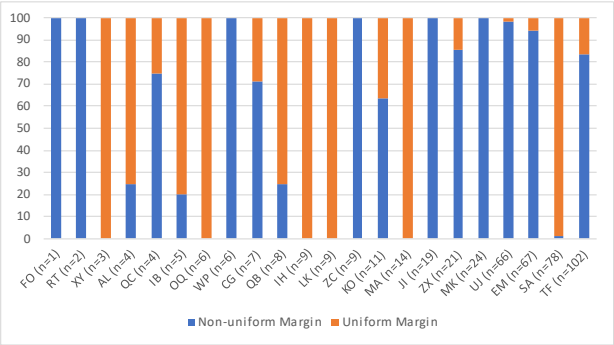

Table 1. Correlation between pre-treatment IG, placement procedure, and planning target margins. The reported *p*-values are from univariate analyses predicting the use of uniform margins.

Localization Technique		Planning Target Margin		*p*-value
		Non-uniform	Uniform	
IG	No or Infrequent Volumetric Imaging	61 (19.6%)	14 (8.6%)	0.0019
	Daily Volumetric Imaging	251 (80.4%)	149 (91.4%)	
Placement Procedure	None	110 (35.3%)	40 (24.5%)	0.0375
	Fiducial Marker & Spacer	159 (50.9%)	87 (53.4%)	
	Fiducial Marker Only	25 (8.0%)	21 (12.9%)	
	Spacer Only	18 (5.8%)	15 (9.2%)	

References

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3. Yartsev, S. & Bauman, G. *Br. J. Radiol.* **89**, 20160312.