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Dosimetric Comparison of 5-, 7-, and 9-Field SIB-IMRT Plans in Prostate Cancer Using 100% Isodose-Based Target Evaluation

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Dosimetric Comparison of 5-, 7-, and 9-Field SIB-IMRT Plans in Prostate Cancer Using 100% Isodose-Based Target Evaluation

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Introduction: High-risk prostate cancer requires a multimodality approach to therapy. Several randomized trials have shown excellent long-term biochemical outcomes with higher radiation doses. Evidence from multiple retrospective and prospective series of patients with localized prostate cancer confirmed the theoretical benefits of dose escalation. However, dose escalation with conventional fractionated EBRT results in more hospital visits for patients, a resource burden on the treatment facilities, and a high cost for society. Based on the α/β model for prostate cancer, a hypofractionated course of EBRT with larger fraction sizes and fewer treatments would potentially increase therapeutic benefits without increasing toxicity in the bladder and rectum. The use of intra-fractional monitoring and correction of prostate position with the Image Guided Radio Therapy (IGRT) system can increase the spatial accuracy of dose delivery. Aim was to compare the dosimetric performance of 5-, 7-, and 9-field Simultaneous Integrated Boost (SIB) Intensity - Modulated Radio-therapy (IMRT) plans for prostate cancer using an institutional protocol in which both PTV68 (68 Gy) and PTV45 (45 Gy) are fully covered by their 100% isodose lines, while 97–99% of the CTV is encompassed by the 100% isodose, with focus on rectum and rectoprostatic interface sparing.

Methodology: Ten prostate cancer patients treated at the Sindh Institute of Urology and Transplantation (SIUT) were retrospectively planned using SIB-IMRT (68 Gy/45 Gy in 25 fractions). Three IMRT plans per patient were created using 5-, 7-, and 9-field beam arrangements. All plans were normalized to ensure full prescription coverage of PTVs and ≥97% CTV inclusion within the 100% isodose. Dose-volume parameters, conformity index (CI), homogeneity index (HI), and OAR doses were analyzed. Daily CBCT verification confirmed treatment reproducibility.

Results: All plans achieved acceptable coverage per SIUT criteria. The 7 - field configuration demonstrated the most balanced performance with

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optimal target coverage and OAR protection. Mean CTV coverage was 97.2 ± 0.6%. CI averaged 0.78 (5-field), 0.86 (7-field), and 0.91 (9-field), while HI improved from 0.12 → 0.09 → 0.08 across increasing field numbers. The 7-field plan achieved lowest rectal and bladder doses (rectal V60 < 20%, bladder V65 < 25%) with moderate delivery efficiency (~950 to 1050 MUs).

Conclusion: Prostate SIB-IMRT using 100% isodose-based evaluation ensures precise target coverage with excellent rectoprostatic sparing. The 7-field technique offers the optimal balance between conformity (CI ≈ 0.86), homogeneity (HI ≈ 0.09), and treatment efficiency, aligning with 2026 radiotherapy standards emphasizing precision, reproducibility, and reduced toxicity.

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