

Purpose: To investigate the post-operative dosimetric impact of mixed activity I-125 LDR prostate brachytherapy using clinically realistic post-implant source distributions.

Methods: The plans and post-implant source distributions of 20 recent LDR prostate brachytherapy patients were randomly selected from the institutional database. Blinded to the outcome of the implant, two new mixed-activity plan variations were created to deliver a minimum peripheral dose of 144 Gy using sources of 0.6U and 0.9U, in addition to the standard activity of 0.424U. The specific aim was to attempt to improve coverage of the anterior superior quadrant (ASQ) of the prostate. In the first variation (V1), this was accomplished by substituting high activity seeds in this quadrant. In addition to this, the second variation (V2) reduced needle redundancy where appropriate to minimize trauma. Importantly, the needle depths and source positions used were subsets of those actually implanted. Consequently, after identifying the positions of the planned sources in the post-implant CT, the impact of the mixed-activity variations on post-operative dose metrics could be simulated by reassigning the activity of the appropriate seeds.

Results: The mean change in total activity due to the attempted boost was +5% (V1) and +2% (V2) over what was implanted clinically. Mean V100 increased by 3.5% and 1.7% respectively, while the mean V100 in the ASQ boost region rose by 14.4% and 12.0%. Mean D90 rose by 11.4 (V1) and 4.8 Gy (V2), but urethral V150 and rectal V100 were not impacted, varying less than <0.02cc on average, with negligible maximum increases of 0.35cc (V1) and 0.41cc (V2). Eliminating inefficient needles in V2 resulted in a mean reduction of 4.6 needles per case, and implants of 20% fewer seeds.

Conclusions: A mixed activity methodology may improve implant efficiency, reduce the impact of misplacement, and facilitate focal boosts without additional needles.

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