

Purpose: To determine whether alternative prostate brachytherapy needle patterns can result in similar or improved dose distributions while providing better access and reducing trauma in the treatment of HDR prostate brachytherapy. **Materials and Methods:** Standard prostate cancer HDR brachytherapy uses a regular grid of parallel needle positions to guide the catheter insertion. This geometry does not easily allow the physician to avoid piercing the penile bulb nor does it provide position flexibility in the case of pubic arch interference. In this study, CT datasets from 10 previously-treated patients were used and catheters were digitized by following three hypothetical catheter patterns: conical, bi-conical, and fireworks. The conical patterns were used to accommodate a robotic delivery using a single entry point. The bi-conical and fireworks patterns were specifically designed to avoid the bulb. For each catheter distribution, a plan was optimized with the inverse planning algorithm, IPSA, and compared with the plan used for treatment. Irrelevant of geometry, a plan must fulfill the RTOG-0321 dose criteria for target dose coverage ($V_{100} > 90\%$) and organ-at-risk dose sparing ($V_{75} < 1\text{cc}$ for the bladder and rectum, $V_{125} < 1\text{cc}$ for the urethra). **Results:** The three non-standard catheter patterns used 16 non-parallel, straight divergent catheters, with the focal point(s) in the perineum. 30 plans from 10 patients with prostate sizes ranging from 26 to 89 cc were optimized. All non-standard patterns fulfilled the RTOG criteria when the clinical plan did. In some cases, the dose distribution was improved by better sparing the organs-at-risk. **Conclusion:** Alternative needle patterns can provide the physician with additional ways to treat patients previously considered unsuited for brachytherapy treatment (pubic arch interference) and to improve patient quality of life (avoidance of penile bulb), while fulfilling the RTOG criteria. **Conflict of Interest:** Research sponsored by the Nucletron Corporation.