Purpose:

To investigate dosimetry improvement in prostate brachytherapy by conforming needles to urethral and prostate shape using an electromagnetic tracking device.

Methods:

We have reported a needle tracking system using an electromagnetic sensor embedded inside the tip of the needle to improve needle reconstruction accuracy and efficiency in conventional prostate HDR brachytherapy. Utilizing the same system, we propose to guide needle insertion following pre-optimized tracks based on the target shape. In this study, we investigate possible dosimetry improvement and needle number reduction by comparing plans using the conventional implant method and the proposed method. Twelve prostate brachytherapy patients were selected and studied retrospectively. New virtual plans were created using the proposed method and conforming needle tracks to the urethral and prostate shapes. Same optimization constraints were applied to both the conventional and the new plans. DVH parameters and total needles used have been analyzed to quantify dosimetry improvement and potential toxicity sparing due to reduction in implant needles.

Results:

Prostate volumes are 41.16±13.27 cc. Number of needles used for the conventional plan is 16.6±1.2, vs. 13 for all the new plans. The prostate volume receiving 100% (V100), 125% (V125), and 150% (V150) of the prescription dose in conventional plans vs. those in the new plans are 99.48%±0.21% vs. 99.53%±0.20%, 53.90%±5.61% vs. 50.30%±5.23%, and 25.37%±4.91% vs. 20.96%±3.41%, respectively. The corresponding urethra V100 and V110 are 90.96%±3.10% vs. 85.78%±7.76% and 2.06%±1.23 vs. 0.46%±0.28%.

Conclusions:

The needle numbers and the urethral V110 in the new plans are significantly lower than those in conventional plans (p<0.001 and p=0.004, respectively), with no significant changes in doses to the prostate. Conformal needle implant following pre-optimized tracks with electromagnetic guidance may significantly reduce acute and late toxicities in prostate brachytherapy by reducing the number of needles and the urethral doses.