

# A Novel Use of 3D-Printed Template in Vaginal HDR Brachytherapy

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## INTRODUCTION

High Dose Rate (HDR) brachytherapy using a vaginal cylinder is often used as adjuvant therapy for post-operative endometrial and cervical cancer patients. The initial treatment is typically designed using a CT simulation, while the subsequent treatments are often verified using a ruler and/or X-ray imaging. These existing methods either verify only one aspect of planning (e.g. insertion depth), or requires a complicated clinical setup and imposes additional dose to the patients (e.g. X-ray imaging).

## AIM

We propose the use of a patient specific 3D-printed template for reproducible vaginal cylinder insertion without imposing additional imaging radiation dose to patients.

## METHOD

- The CT images from the initial simulations were used to design the templates conforming to the patients' perineal region. It extends approximately 6 cm anterior and 4 cm posterior to the vaginal cylinder, and has a recessed area that fits snugly around the cylinder.
- Four patients are enrolled in the study with prescriptions of 6 Gy/fraction for 2-5 fractions (total 15 treatments). The first 1 – 2 treatments are delivered without the template and the rest with the templates. In addition to the initial CT simulation, cone beam CTs (CBCTs) were acquired to verify the cylinder placement for all treatments.



Figure 1. Side view of the 3D-printed template (red) with the cylinder (white).

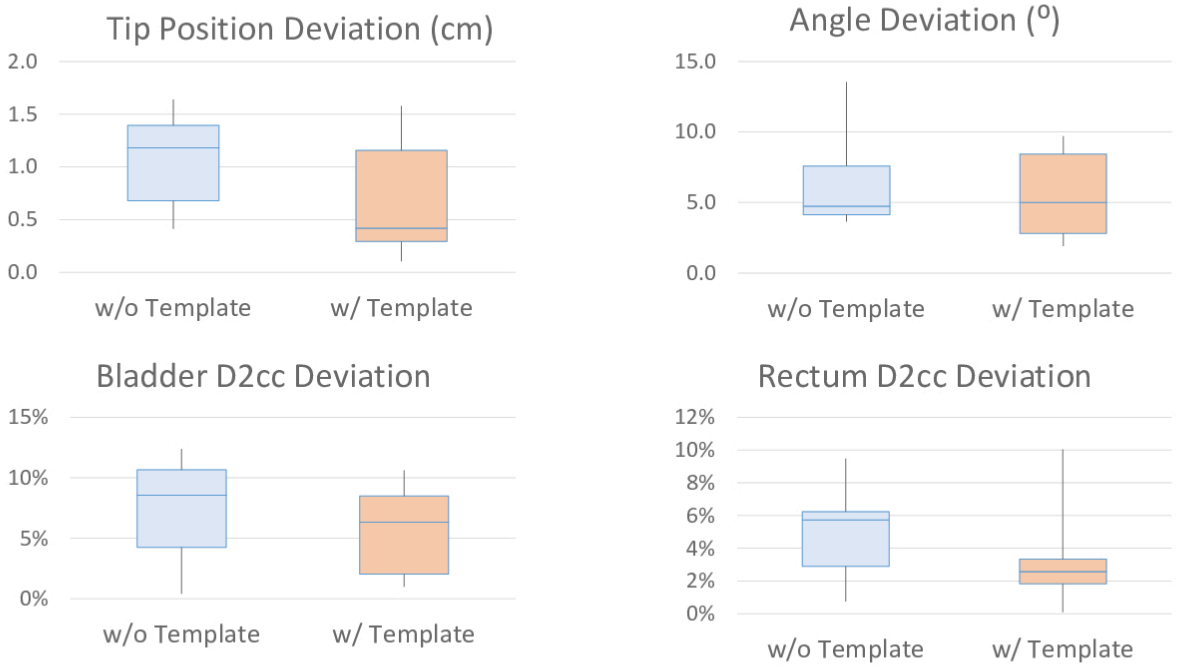


Figure 2. Comparison of the effect of using template on geometric deviation (tip position and angle) from the treatment plan as well as the dosimetric deviation (D2cc of bladder and rectum). Box plot shows the (maximum, upper quartile, median, lower quartile, and minimum). Improvement is observed in all instances.

## RESULTS

By using the templates:

- The accuracy of re-positioning improved from  $1.1 \pm 0.5$  cm to  $0.8 \pm 0.5$  cm.
- Angular reproducibility improved from  $6.5 \pm 3.8^\circ$  to  $4.8 \pm 3.1^\circ$ .

Dosimetrically:

- D2cc to bladder deviation from the plan reduced from  $7\% \pm 5\%$  to  $6\% \pm 4\%$
- D2cc to rectum deviation from the plan reduced from  $5\% \pm 3\%$  to  $4\% \pm 4\%$ .

## CONCLUSIONS

The implementation of individualized cylinder templates improves the geometrical and dosimetric reproducibility of cylinder treatments. Furthermore, this technique can be applied to multi-channel cylinder applicators, where the reproducibility of the cylinder placement is of even more importance.

## CONTACT INFORMATION

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