# Delivery Verification of HDR using a Multi-Channel Vaginal Cylinder Utilizing Rectal Sparing.

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## Introduction

Traditionally, vaginal cylinders have been used as a method of brachytherapy to deliver a uniform dose distribution for cervical and uterine cancers. However, when the region of interest is primarily anterior to the applicator, the cylinder over irradiates healthy tissue. The purpose of this experiment was to bias the dose distribution toward the anterior portion of the vaginal wall, minimizing dose to the rectum, by using a multi-channel vaginal cylinder. The desired dose distribution can be seen to the right in Figures 2 and 3.

## Materials and Methods

A multi-channel vaginal cylinder was wrapped in five layers of 0.5 cm bolus. A CT scan was taken of the cylinder apparatus and sent to Oncentra Treatment Planning System (TPS). 400 cGy was prescribed to the 100% isodose line 1cm from the cylinder surface for both plans. A tumor volume extending 1cm from the anterior surface was drawn, and a rectal contour was drawn starting 0.5 cm from the cylinder surface posterior of the tumor volume. Four of the channels were used on the anterior side for the multichannel plan, each having an active length of 4.5 cm (12 dwell points) and optimized graphically to ensure an approximately even dose 1cm from the cylinder surface. This process was then repeated using a single central channel vaginal cylinder plan. In order to achieve adequate coverage of the target, the active length was extended to 5.0 cm (13 dwell points) for the single channel plan. Optically stimulated luminescent dosimeters (OSLDs) were placed 1.0 cm away from the cylinder wall on both the anterior and posterior sides of the multi-channel cylinder to measure the dose in the tumor and rectum volumes The anterior OSLDs were placed to measure the amount of dose the target would receive; the posterior detectors monitored the dose to the rectum. The multichannel plan was then treated using a Iridium-192 source with an activity of 8.9 Ci. The results of these two methods are displayed in the dose volume histogram to the right (Fig. 1).

## Results

As seen in Table 1, the average dose delivered to the OSLDs on the anterior side of the multi-chamber cylinder was 410.5 cGy, ± 4.3, with the planned average dose of 401.7 cGy ± 0.9. The average OSLD reading on the posterior aspect of the multi-chamber cylinder was 209.1 cGy ± 9.0, with the planned average dose of 198.1 cGy ± 5.8. The average dose to the anterior and posterior portions of the traditional cylinder was calculated to be 393.3 cGy and 406.0 cGy respectively (shown in Table 2). The multi-chamber plan reduced the maximum rectal dose by 94%.

## Conclusion

A multichannel vaginal cylinder demonstrates a pronounced and measurable difference in rectal sparing for the treatment of some vaginal cancer treatments.

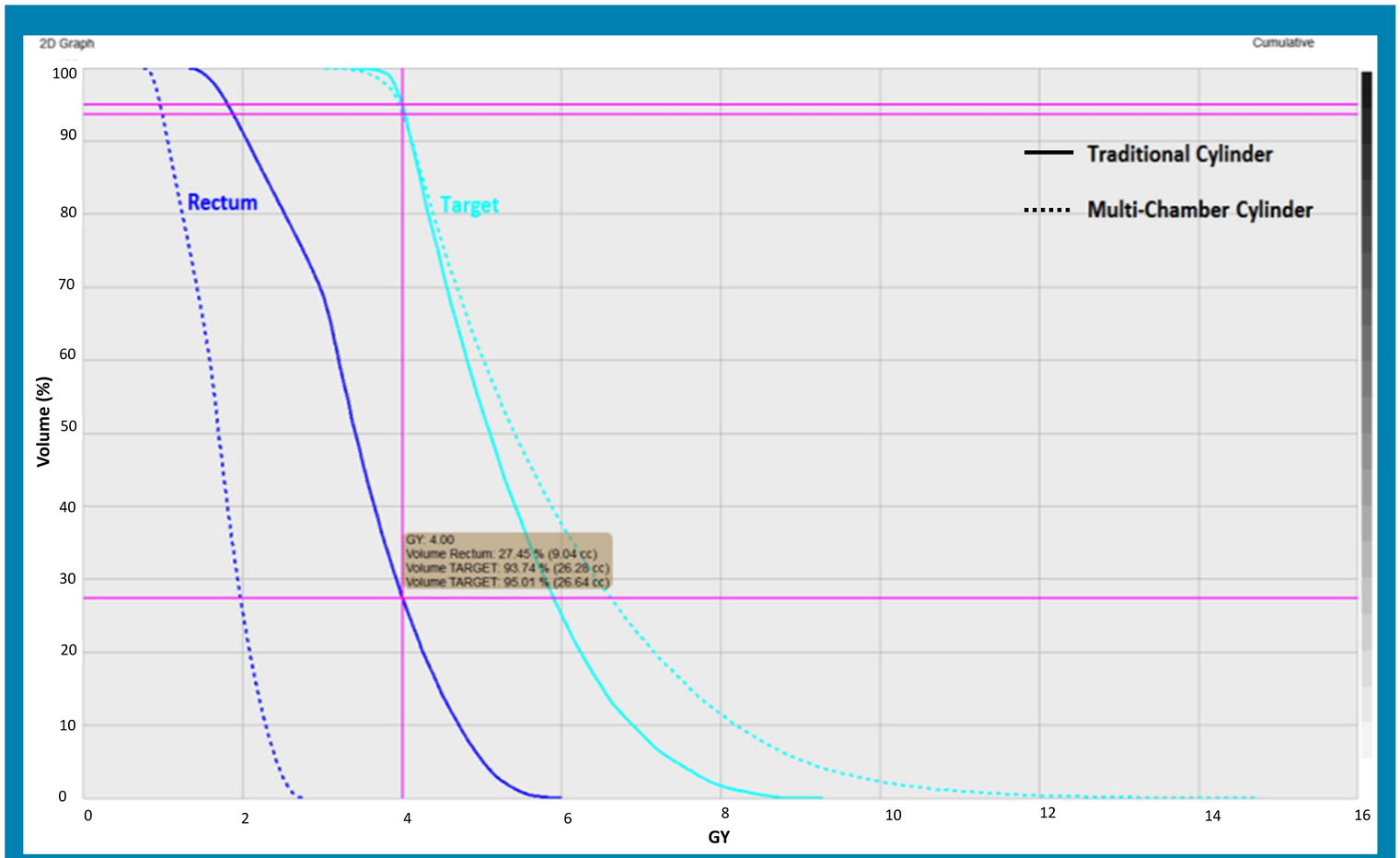


***Figure 1:*** *Dose Volume Histogram displaying the difference in dose to the target and the rectum using a traditional and a multi-chambered vaginal cylinder.*

| *Multi-Chamber Cylinder* | *Planned* | *Delivered* | *Planned* | *Delivered* |
|---|---|---|---|---|
| *OSDLs* | *Anterior Dose (cGy)* | *Anterior Dose (cGy)* | *Posterior Dose (cGy)* | *Posterior Dose (cGy)* |
| 1 | 403.06 | 404.76 | 190.90 | 202.49 |
| 2 | 401.42 | 415.11 | 205.03 | 221.93 |
| 3 | 400.82 | 411.78 | 198.10 | 203.01 |
| ***Average Dose (cGy)*** | ***401.77 ± 0.94*** | ***410.55 ± 4.31*** | ***198.10 ± 5.77*** | ***209.14 ± 9.04*** |
| **% Difference** | **2.19%** | | **6.08%** | |

***Table 1:*** *Comparing planned and delivered doses in a multi-chamber vaginal cylinder*

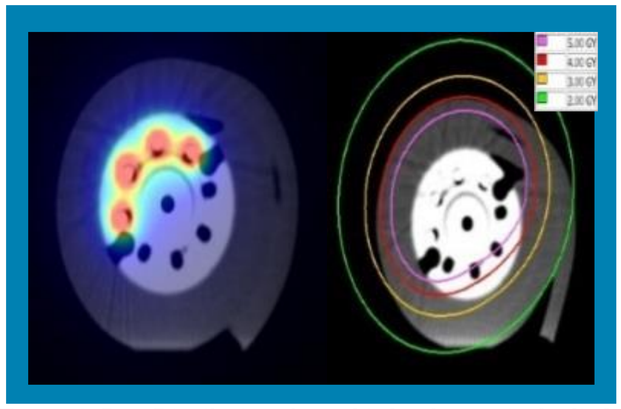

***Figure 2:*** *Dose Distribution of a multi-chambers vaginal cylinder*

| | *Anterior Dose (cGy)* | *Posterior Dose (cGy)* |
|---|---|---|
| ***Multi-Chamber Cylinder*** | *410.55 ± 4.31* | *209.14 ± 9.04* |
| ***Traditional Cylinder*** | *393.34 ± 0.60* | *406.03 ± 9.57* |
| **% Difference** | **4.19%** | **94.14%** |

***Table 2:*** *Comparing anterior and posterior doses using a multi-chambered vaginal cylinder and a traditional cylinder*

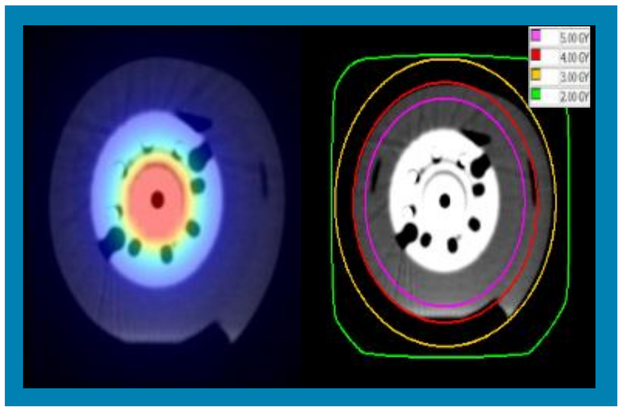

***Figure 3:*** *Dose Distribution of a traditional vaginal cylinder*