

# Comparison of 3DRT and VMAT Treatment Techniques on Vaginal Doses in Female Anal Cancer Patients With and Without the Use of Vaginal Cylinders

## Introduction

Female anal cancer patients often report vaginal discomfort, dryness, itching, and shrinkage during radiation therapy and post-treatment. These effects observed from external beam radiation may result in sexual dysfunction and negatively affect quality of life, which have traditionally been accepted as unavoidable outcomes of treatment (Bruheim et al., 2010).

The insertion of a vaginal cylinder during simulation and throughout radiation therapy treatment has been proposed as a possible option for female anal cancer patients. A vaginal cylinder may offer better delineation of isodense tissues in the female pelvis, displace the anterior vaginal wall further from the target, and aid in more accurate target volumes. There is the potential for this technique to significantly reduce the mean vaginal dose, and therefore possibly spare some degree of sexual functioning.

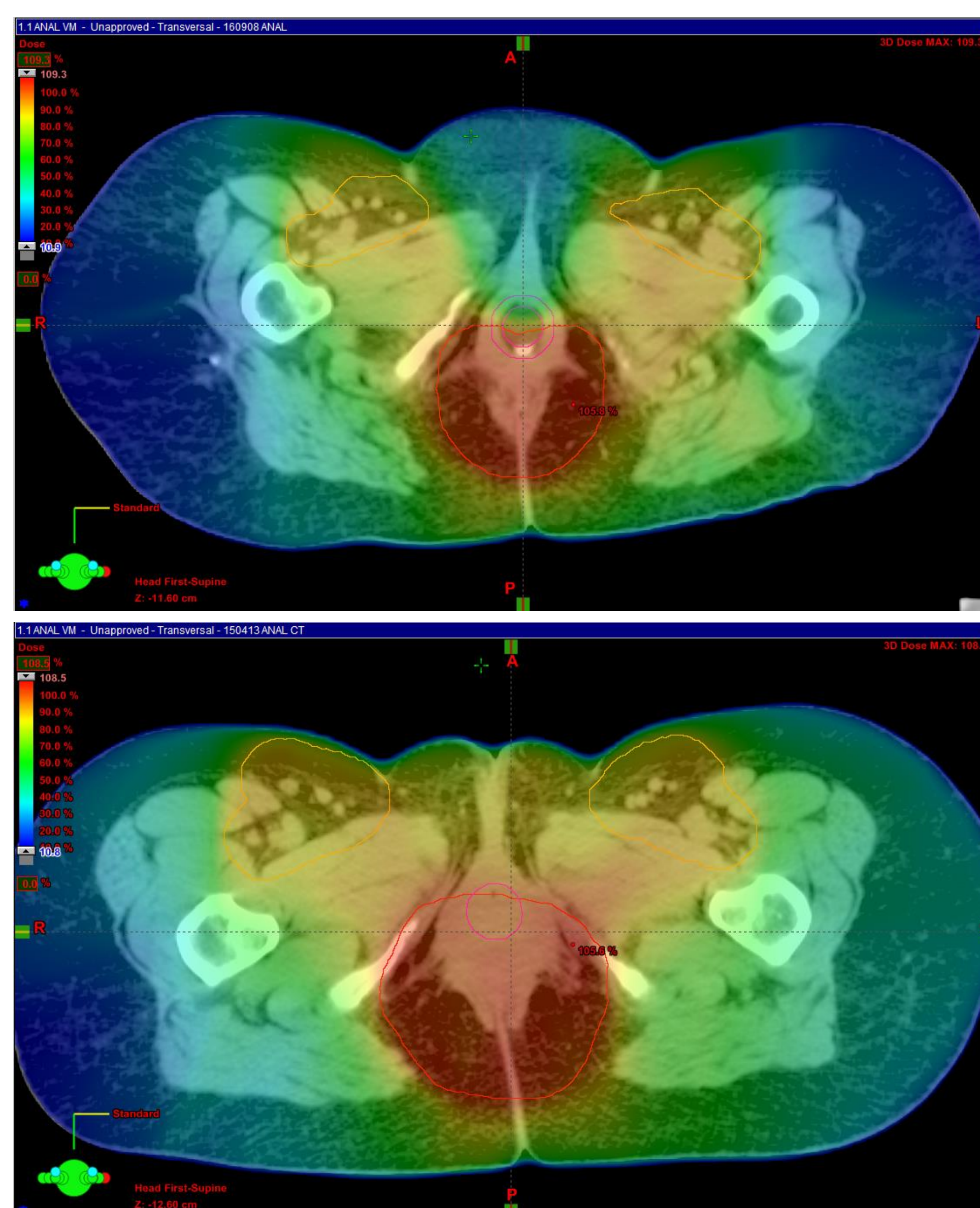
## Methods

The aim of this study was to retrospectively compare traditional 3D Conformal RT and VMAT optimized plans on female anal cancer patients both with and without the use of vaginal cylinder to assess differences in mean vaginal dose. In patients simulated with a vaginal cylinder, the vaginal contour was created as a 5mm ring structure around the inserted cylinder. Both the control group and test group were composed of six patients.

3DRT plans were composed of a 4-field box technique to the Primary & Nodal PTV's, with a 6-field boost technique to the Primary PTV. VMAT plans were composed of 3 full arcs. Planning was completed with the Eclipse Treatment Planning System 11.0 for a Varian TrueBeam Treatment Machine (Varian Medical Systems, Inc., Pal Alto, California).

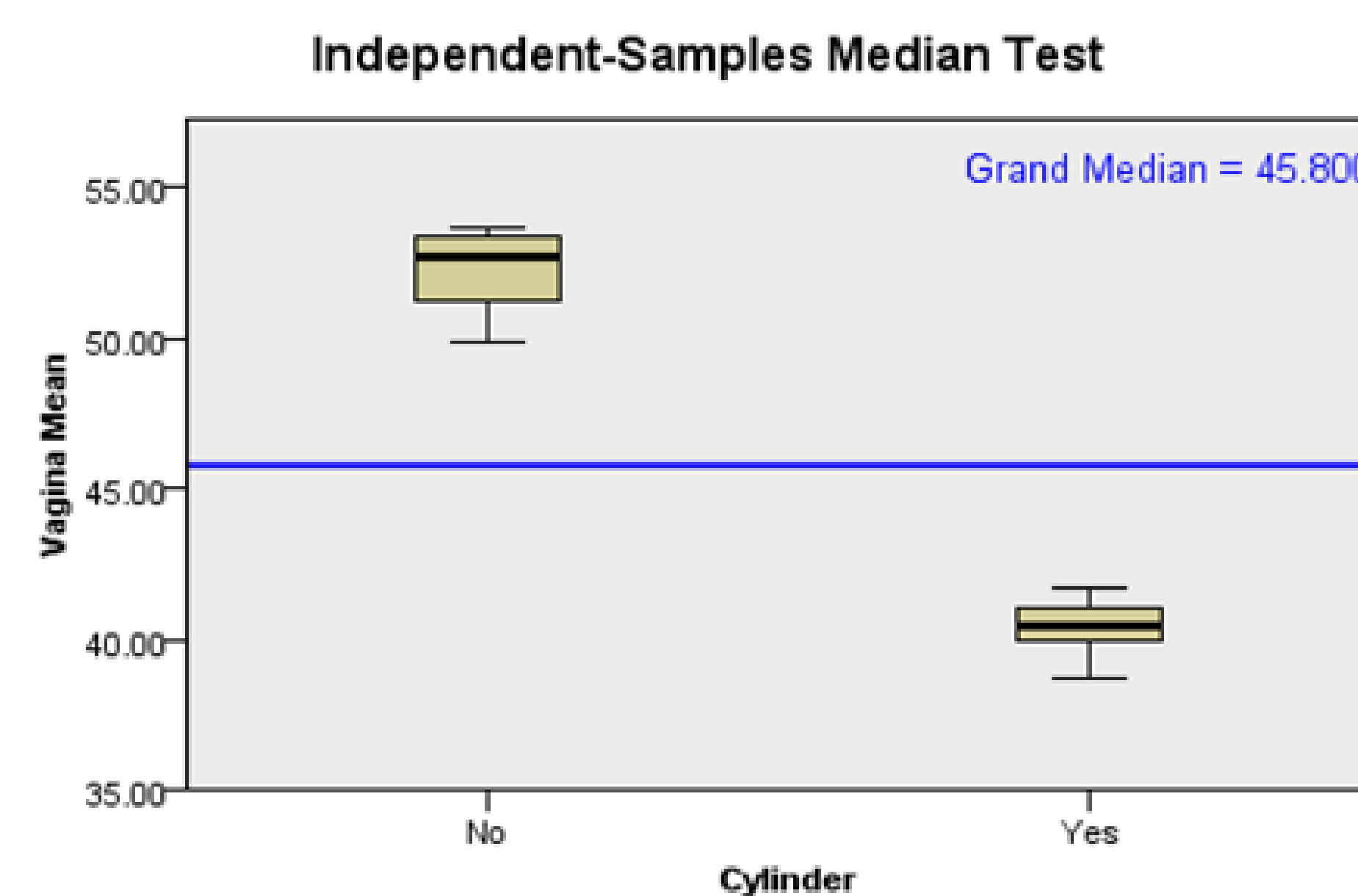
A standard prescription of 54 Gy to the primary tumor and 45 Gy to involved lymph nodes was used. All OAR dose limits for VMAT plans are taken from RTOG Protocol 0529 which focuses on IMRT for Anal Cancer, while QUANTEC dose limits were observed for 3DRT plans. PTV objectives were 95% of the prescription dose to cover at least 95% of the PTV.

## Results



**Fig. 1 & 2**  
Figure 1 (above) shows CT Axial slice of dose color wash with a vaginal cylinder inserted, while Figure 2 (below) is without a vaginal cylinder at the same level of the inferior ischium, including Primary PTV (red), Nodal PTV (orange), and Vagina (magenta) contours.

|             | Vagina Mean | Vagina Max | PTV Tumor | PTV Nodes |
|-------------|-------------|------------|-----------|-----------|
| <b>3DRT</b> |             |            |           |           |
| No Cylinder | 54.53       | 56.74      | 54.03     | 43.69     |
| Cylinder    | 49.03       | 55.48      | 54.32     | 44.41     |
| <b>VMAT</b> |             |            |           |           |
| No Cylinder | 52.26       | 54.82      | 52.47     | 43.62     |
| Cylinder    | 40.43       | 54.19      | 52.99     | 44.20     |



**Tables 1 & 2**  
Table 1 (above) shows Average Vagina Mean, average Vagina Maximum, average Tumor PTV 95% coverage, and average Nodal PTV 95% coverage for the control group treated without the vaginal cylinder, and the test group with the vaginal cylinder for both 3DRT and VMAT treatment plans. Table 2 (below) boxplot illustrates mean vaginal doses with and without a cylinder for VMAT plans.

## Conclusion

The mean vaginal dose for 3D Conformal RT techniques is slightly lower with the use of the vaginal cylinder, however is not significantly beneficial. Due to 3DRT techniques essentially treating the majority of the pelvis, the addition of a vaginal cylinder does not aid in lowering the mean vaginal dose or the maximum dose.

A comparison of VMAT planning on patients with and without a vaginal cylinder shows a significant decrease in overall mean dose to the vagina with a p-value of 0.001 with the use of the cylinder. This average decrease in mean dose is 22.6% lower in patients treated with the cylinder. While long term affect on patient sexual function and quality of life with a lower mean vaginal dose is not yet known, any decrease in dose to an OAR without decreasing PTV coverage should be considered as a clinically relevant option.

## Limitations

Due to the relative rarity of female anal cancer (5,250 cases per year in U.S.), this study had a small number of subjects. As a retrospective study, patient CT scans with and without a cylinder were not available, therefore the control and test group CT scans are composed of entirely different patients.

## References

- Bruheim, K., Tveit, K. M., Skovlund, E., Balteskard, L., Carlsen, E., Fosså, S. D., & Guren, M. G. (2010). Sexual function in females after radiotherapy for rectal cancer. *Acta Oncologica*, 49(6), 826-832.
- RTOG Protocol 0529. (2016). A Phase II Evaluation of Dose-Painted IMRT in Combination with 5-Fluorouracil and Mitomycin-C for Reduction of Acute Morbidity in Carcinoma of the Anal Canal. *Radiation Therapy Oncology Group*.

## Acknowledgements

- Daniel Tatro, CMD, RT(T), Clinical Preceptor
- Scott Green, M.S., CMD, RT(T), Research Project Advisor
- Kristen Vu, M.S., CMD, RT(T), Clinical Professor
- Martha Matuszak, Ph.D
- Dr. Annette Kretzler & Dr. Kyle Cuneo, Advising Physicians
- GVSU Statistical Consulting Center