

Dosimetric Assessment of the Impact of OAR Hydrogel Rectal Spacers in the Treatment of Prostate Cancer with SBRT

Jillian Hauck¹, Michael Greenberg¹, Anand Mahadevan², Fiori Alite¹

1. Radiation Oncology, Geisinger Medical Center 2. Radiation Oncology, Geisinger Cancer Institute, Danville, USA

✉ **Corresponding author:** Jillian Hauck, jehauck@geisinger.edu

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Abstract

Objectives: To compare defined dose volume histogram specifications on the rectum and bladder, planned with and without the placement of a rectal organ at risk spacer.

Methods: This study was limited to 43 patients with low grade prostate cancer (T1c, T2a or T2b), who were treated at Geisinger either primarily with prostate SBRT, or retreated with SBRT after previous brachytherapy and external beam failure. All patients had fiducials placed at time of spaceOAR placement and were treated by the same radiation oncologist. They had bowel preparations and full bladders prior to simulation, and a urethrogram was performed at the time of simulation for enhanced urethral visualization. All patients were planned on a 3T MRI scanner using either T2 fat saturated sequences or an ADC map. Patients received either 36.25 Gy in 5 fractions or 40 Gy over 5 fractions. After planning was complete, data was collected pertaining to the V36, V29, and V18 of the rectum, V37, V32, and V18 of the bladder, and D-max and D-mean for the penile bulb.

Results: This study showed marked improvement in the delivered dose to the rectum for all dose volume parameters studied, including V18 ($P < 0.001$), V29 ($P < 0.001$), and V36 ($P < 0.002$) for patients with spacers compared to patients without spacers. The bladder was less affected by the addition of the rectal spacers, with insignificant and variable dose outcomes ($P = 0.62$ (V18), 0.59 (V32), 0.97 (V37)). The maximum and mean doses delivered to the penile bulb were also significant, with p values of 0.0068 and 0.019 respectively.

Conclusions: Using hydrogel OAR spacers resulted in significantly lower rectal and penile bulb doses for patients that were treated with SBRT for prostate cancer. In the future we plan to prospectively use rectal spacers in all prostate patients and to continue to record DVH outcomes. Data regarding clinical outcomes including acute and chronic toxicity and patient reported quality of life metrics will also be collected and correlated with the respective dosimetric endpoints.

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Jillian Hauck MS, Michael Greenberg MD, Anand Mahadevan MD, Fiori Alite MD, Chad Lee PhD
Geisinger Medical Center, Danville, PA

Geisinger

Abstract

OBJECTIVE: To compare defined DVH specifications on the rectum and bladder, planned with and without the placement of a rectal OAR spacer

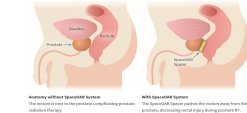
METHODS: This study was limited to patients with low grade prostate cancer (T1c, T2a or T2b), who were treated at Geisinger either primarily with prostate SBRT, or retreated with SBRT after previous brachytherapy and external beam failure. Patients were prescribed either 36.25 Gy in 5 fractions or 40 Gy over 5 fractions, and were treated using VMAT external beam on a linear accelerator.

RESULTS: This study showed marked improvement in the delivered dose to the rectum for all dose volume parameters studied, including V18 ($P < 0.001$), V29 ($P < 0.001$), and V36 ($P < 0.002$) for patients with spacers compared to patients without spacers. The bladder was less affected by the addition of the rectal spacers, with insignificant and variable dose outcomes ($P = 0.62$ (V18), 0.59 (V32), 0.97 (V37)). The maximum and mean doses delivered to the penile bulb were also significant, with p values of 0.0068 and 0.019 respectively.

CONCLUSION: Using hydrogel OAR spacers resulted in significantly lower rectal doses for patients that were treated with SBRT for prostate cancer.

Introduction

- Prostate cancer is among the most common cancers in men worldwide
- For prostate cancer confined to the prostate, standard management options include radical prostatectomy, radiation therapy, and active surveillance
- Goal of SBRT: deliver highly conformal, therapeutic dose of radiation to the tumor while minimizing radiation to surrounding normal tissues, with steep dose fall off
- Proximity of the prostate to the rectum, urethra, bladder, and penile bulb makes it inherently vulnerable for radiation induced toxicity
- Implanted rectum spacers are used to separate the anterior rectal wall from the prostate to prevent rectal toxicity associated with high doses of radiation



- Here we report the dosimetric advantages of the hydrogel SpaceOAR in the treatment of prostate cancer with SBRT on a consecutive series of patients and analyze their dose volume parameters of interest in the rectum, bladder, and penile bulb

Methods

- Study was limited to patients with low grade prostate cancer (T1c, T2a, T2b), who were treated at Geisinger with SBRT
- Each patient underwent a bowel prep prior to each phase of treatment
- Patients were imaged on a 3T MRI scanner using either T2 fat saturated sequences or an ADC map, and on our CT Simulator
- Dose Prescription: 36.25 Gy or 40 Gy spread over 5 fractions
- All were treated using VMAT external beam on a linear accelerator
- Patients were instructed to repeat the bowel prep and come to treatment with a full bladder to allow for more accurate reproducibility of setup
- Cone beam CT was used before and during treatment to verify positioning

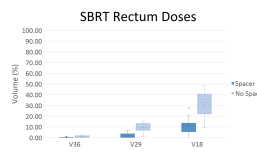


Figure 1: Variation in Rectum Doses with and without SpaceOAR

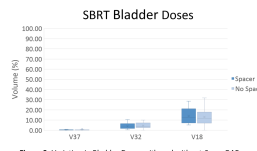


Figure 2: Variation in Bladder Doses with and without SpaceOAR

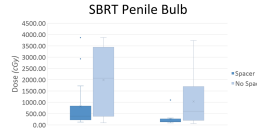


Figure 3: Variation in Penile Bulb Doses with and without SpaceOAR

Results

- After planning was complete, data was collected pertaining to the V36, V29, and V18 of the rectum, V37, V32, and V18 of the bladder, and D-max and D-mean for the penile bulb of the 43 patients in this study
- Less dose was delivered to the rectum with the use of SpaceOAR for all dose parameters studied
- The bladder was less affected by the addition of the SpaceOAR, with insignificant and variable dose outcomes
- The dose delivered to the penile bulb was varied, but the results were still significant for the maximum and mean doses

Table 1: Significance of Decrease in OAR doses with Use of SpaceOAR, Calculated with 2-Tailed Analysis

	SpaceOAR	No SpaceOAR	p-value (2-tail)
RECTUM (cc)			
V36	0.29	1.07	0.0015
V29	1.23	9.43	0.00000039
V18	9.27	31.3	0.00000073
BLADDER (cc)			
V37	0.27	0.26	0.97
V32	3.97	4.49	0.59
V18	14.66	13.18	0.62
PENILE BULB (Gy)			
D _{max}	817.14	1989.78	0.0068
D _{mean}	360.76	1012.39	0.019

Conclusions

- Using hydrogel OAR spacers resulted in significantly lower rectal and penile bulb doses for patients that were treated with SBRT for prostate cancer
- In the future we plan to prospectively use rectal spacers in all prostate patients and to continue to record DVH outcomes
- Data regarding clinical outcomes including acute and chronic toxicity and patient reported quality of life metrics will also be collected and correlated with the respective dosimetric endpoints

Contact

Jillian Hauck, MS
Medical Physics Resident
Geisinger Medical Center
jhauck@geisinger.edu