

# Short-course preoperative pencil beam proton therapy for rectal cancer: a pilot study

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## Introduction

Pencil beam that is a new deliver technique of proton therapy has been developed for at least 10 years. However, except for head and neck cancer, there are limited clinical data for this technique. As the second proton center in Taiwan, we have an obligation and responsibility to publish clinical data for the common cancers in Taiwan.

There are no formal studies about pre-operative proton beam therapy for rectal cancer. We hypothesize proton beam significantly decrease small bowel, bone marrow, and sexual function impairment without compromising local control and survival compared with conventional photon radiotherapy. Therefore, we conduct a piolt study before integrated project for clinical trial .

## Material and Method

From October 2018 to January 2019, 2 male patients with MRI-diagnosed Stage III (cT3-4 or cN1-2) adenocarcinoma of rectum planned by short-course preoperative radiotherapy were included in this study. The dose of radiotherapy was 25 CGE/5 fractions. Pencil beam proton therapy system (Sumitomo Heavy Industries) using single-field uniform dose (SFUD) was delivered through 2 posterior oblique fields (135 and 215 degree).

Image-guided cone beam CT was used before each treatment. Doses of pelvic bone marrow, small bowel, and penile bulb were calculated and compared with VMAT using RayStation 6.0 planning system. Acute toxicities of radiotherapy will be evaluated by common toxicity criteria (CTC) version 4. Surgery was performed within 1 week after completion of proton therapy.

## Results

No Grade 1 or greater leukopenia, dermatitis and diarrhea were noted before or after operation.

OAR	Photon	Proton	Constraint
<b>Pelvic marrow (%)</b>			
V2.5	85.6±9.1	45.9±12.0	<80%
V5	79.6±9.8	40.4±10.5	<50%
V7.5	75.7±10.3	35.8±8.6	<40%
V10	62.8±7.9	29.7±4.9	<35%
<b>Small bowel (mL)</b>			
V10	142.9±94.0	58.6±39.3	<90 mL
V15	73.9±37.4	50.3±34.3	<75 mL
V20	47.3±30.6	41.5±28.4	<60 mL
<b>Penile bulb (CGE)</b>			
D90	20.6±0.1	14.3±3.9	<17 CGE
<b>Mean dose</b>	<b>12.1±1.3</b>	<b>6.4±1.7</b>	

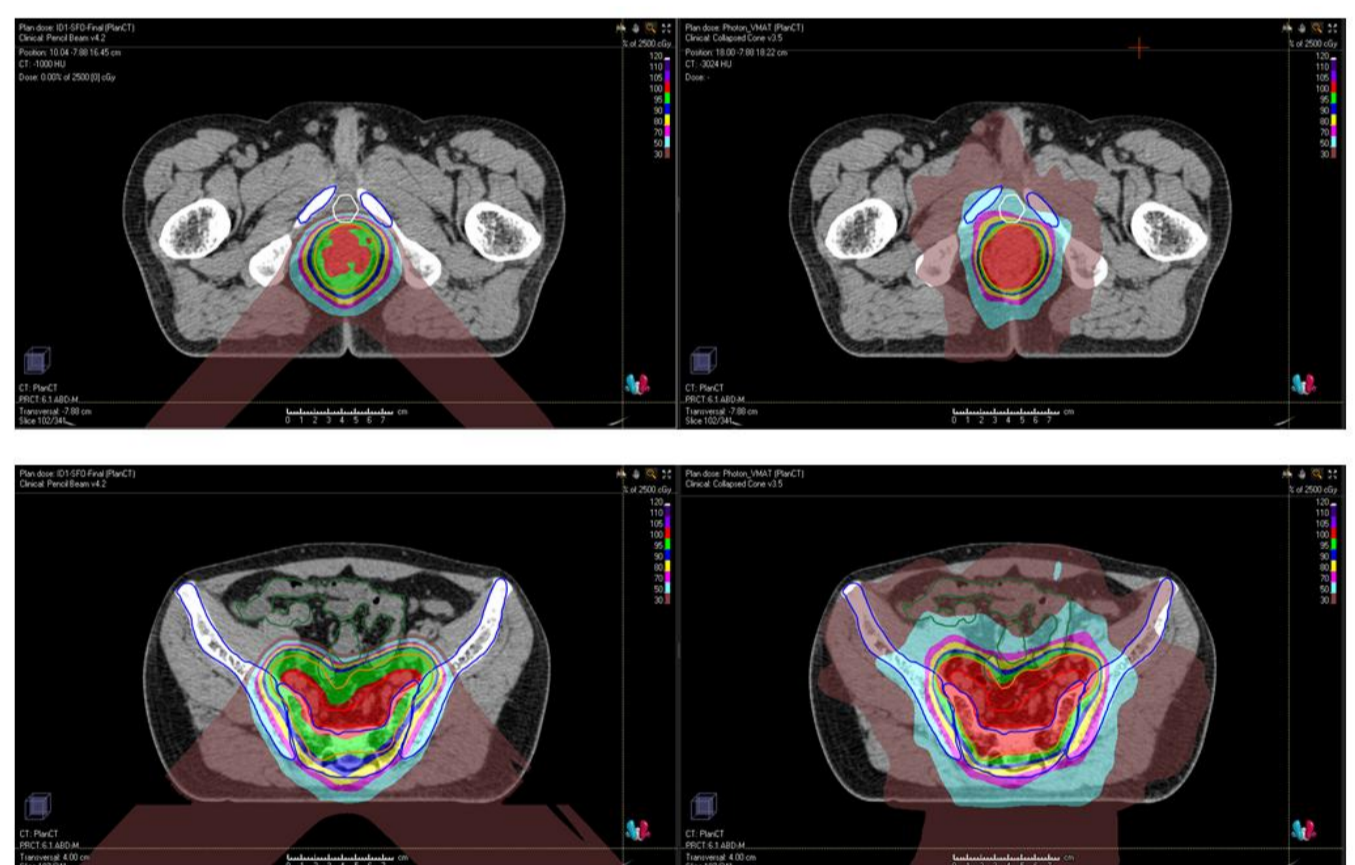


Figure 1. Comparison of dose distribution between proton (left) and VMAT (right) plan.

## Conclusion

Short-course preoperative pencil beam proton therapy for rectal cancer is feasible because of better dosimetries of pelvic bone marrow, small bowel, and penile bulb. Further prospective study is considered for short-term and long-term outcomes.