Development of Simulation-Omitted Prostate (SO-PRO) Radiotherapy Workflow for MR-Linac

Yesenia Gonzalez, PhD, Tsuicheng D. Chiu, PhD, Christopher Kabat, PhD, Weiguo Lu, PhD, Aurelie Garant, MD, Xingzhe Li, MD, MPH, Andrew Wang, MD, Neil Desai, MD, Raquibul Hannan, MD, PhD, Steve B. Jiang, PhD, Mu-Han Lin, PhD
UT Southwestern Medical Center, Dallas, TX, USA

2026 JULY 19–22 VANCOUVER, BC
JOINT AAPM | COMP MEETING

UT Southwestern Simmons Cancer Center
Radiation Oncology

INTRODUCTION

Simulation-omitted prostate SBRT (SO-PRO) has potential to reduce treatment delays and expand access to care but presents unique challenges for SBRT workflows that require careful management of target and organ-at-risk (OAR) dose. A major barrier is diagnostic MRI—preferred for patient-specific anatomical information—does not include rectal spacer, resulting in substantial anatomical mismatch for spacer-affected organs and limiting reliability of deformed reference contours. This study evaluates the development of an MR-Linac–based SO-PRO workflow, integrating AI-assisted contouring to enable safe, efficient online adaptation.

METHODS AND MATERIALS

A SO-PRO workflow was implemented where physicians identified candidate prostate SBRT patients for simulation-omitted treatment. Two MRI datasets were used for initial testing: pre-spacer diagnostic MRI to generate primary SO-PRO plan, and post-spacer MRI simulation as backup reference.

Plans were created using identical prescription and constraints (45/40 Gy SIB in 5 fractions). To mitigate anatomical discrepancies introduced by the absence of spacer on diagnostic MRI, AI-based rectum and bladder contouring was integrated. During treatment, SO-PRO plans followed the standard MR-Linac online adaptive workflow with physician review and approval prior to delivery.

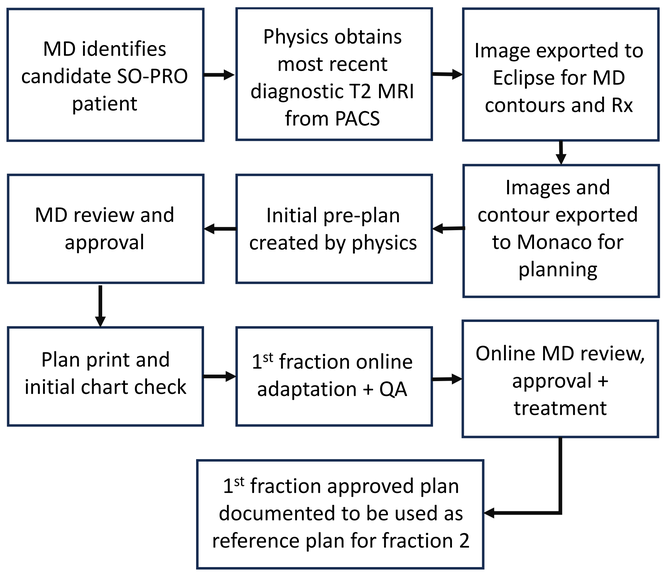

Figure 1. SO-PRO workflow

RESULTS

Four patients were treated using SO-PRO, all successfully delivered using plans generated from diagnostic MRI. All adaptive plans met target coverage and OAR constraints without workflow failure.

AI-generated contours demonstrated improved agreement for spacer-affected organs compared with deformed reference contours, with Dice similarity coefficients of 0.94 for rectum and 0.95 for bladder. Total on-couch time for patients was within one-hour, with extended sessions attributable to bladder filling and repeat adaptation rather than limitations of SO-PRO workflow.

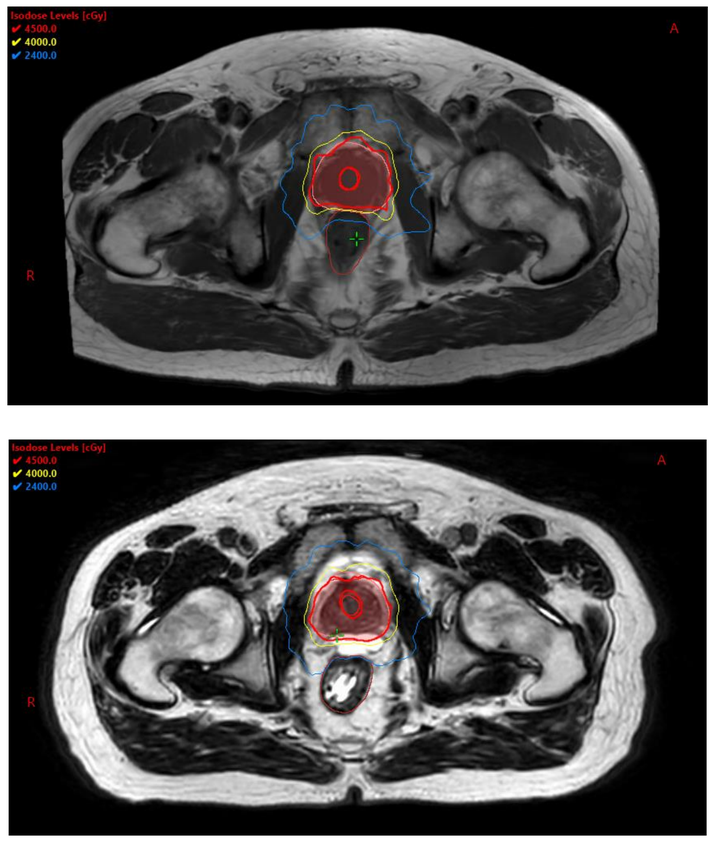

Figure 2. (Top) Reference SO-PRO plan, created on the diagnostic MRI and acquired prior to spacer. (Bottom) 1st fraction adaption, using the SO-PRO plan (above) as the reference plan. Note the inclusion of the spacer, visible on the T2 sequence. PTV is displayed in a solid pink color, isodose lines displayed are as follows: 45Gy (red), 40Gy (yellow), 24Gy (blue).

Structure	Cost Function	Delete	Enabled	St...	Reference Dose (cGy)
Urethra	Quadratic Overdose		☑	On	4150.0
BladderWall	Quadratic Overdose		☑	On	4100.0
	Parallel		☑	On	1830.0
PTV_SIBDIL_4500_5	Target Penalty		☑	On	
	Target Penalty		☑	On	
	Quadratic Overdose		☑	On	5100.0
PTVprosSV4000_5	Target Penalty		☑	On	
	Target Penalty		☑	On	
	Quadratic Overdose		☑	On	4700.0
NeurovascBundle	Quadratic Overdose		☑	On	4700.0
PenileBulb	Quadratic Overdose		☑	On	2950.0
Rectum	Quadratic Overdose		☑	On	4250.0
	Parallel		☑	On	3900.0
	Parallel		☑	On	2400.0
BODY	Quadratic Overdose		☑	On	4500.0
	Quadratic Overdose		☑	On	4000.0
	Quadratic Overdose		☑	On	2250.0

Figure 3. All plans were created following a standard prostate template with fixed constraints and ordering within Monaco

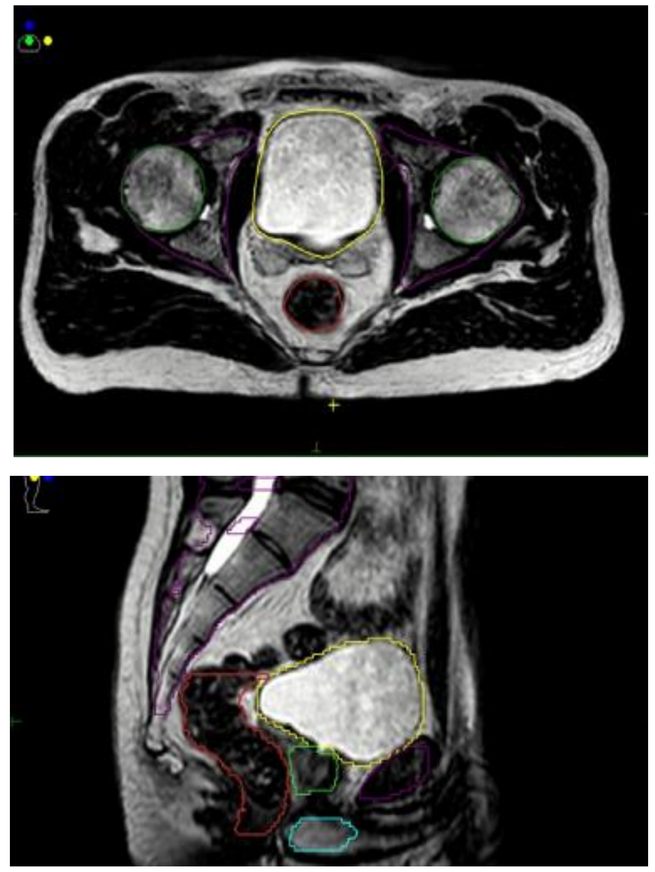

Figure 4. AI generated contours for a prostate SBRT treatment shown on axial (left) and sagittal (right) views. Rectum is displayed in brown, and bladder is shown in yellow.

DISCUSSION & CONCLUSIONS

A SO-PRO SBRT workflow incorporating diagnostic MRI and AI-assisted contouring is operationally feasible on MR-Linac while maintaining plan quality and adaptive efficiency. This framework is scalable to future patient-specific focal boost strategies, positioning SO-PRO as a foundation for personalized prostate SBRT and broader simulation-omitted adaptive workflows.

Additionally, further work has been completed on the SO-PRO workflow to not require the use of any patient-specific diagnostic images to start the treatment planning process. The SO-PRO workflow now utilizes templated patient planning images and planning templates. With adaptation, plans are updated online according to patient-specific anatomy.

CONTACT

Yesenia Gonzalez, PhD

yeseniaa.gonzalez@utsouthwestern.edu