

Does Daily MRI-guided Online Re-Planning in Prostate SBRT Improve Dosimetry Compared to Isocenter Shift Adaptation?

M Ruschin^{1,2}, B Keller^{1,2}, J Detsky^{1,2}, A Loblaw^{1,2}, J Stewart¹, M Campbell^{1,2}, A Kim^{1,2}, K Wong^{1,2}, M Davidson^{1,2}, M Wronski^{1,2}, C McCann^{1,2}, and D Vesprini^{1,2}

¹ Odette Cancer Centre, Sunnybrook Health Sciences Centre, Toronto Ontario Canada

² Department of Radiation Oncology, University of Toronto, Toronto, Ontario, Canada

INTRODUCTION

The ability to visualize anatomy with exquisite detail on a daily basis with an MRI-Linac (MRL) offers opportunities for tailoring patient treatments. For prostate SBRT, we wanted to assess if there were advantages to performing a full online replan to account for the anatomy of the day compared to performing a simpler isocentre shift based approach.

AIM

To quantify the dosimetric advantage of performing daily online re-planning over rigid shift corrections in prostate SBRT (40Gy in 5 fractions) using a 1.5-T MRL.

METHODS

The workflow developed for the present study is shown in Fig 1. For each fraction, an isocentre shift is determined between the daily MR and the reference image, and used to generate a new distribution on the reference scan (does not account for the daily anatomy). The dose distribution is subsequently re-calculated on the daily MR that contains the “true” anatomy (i.e. contours drawn by the physician that day) to form the Adapt to position (ATP) plan. The ATP plan is subsequently compared to the fully online adapted plan (Adapt to shape (ATS) plan) treated.

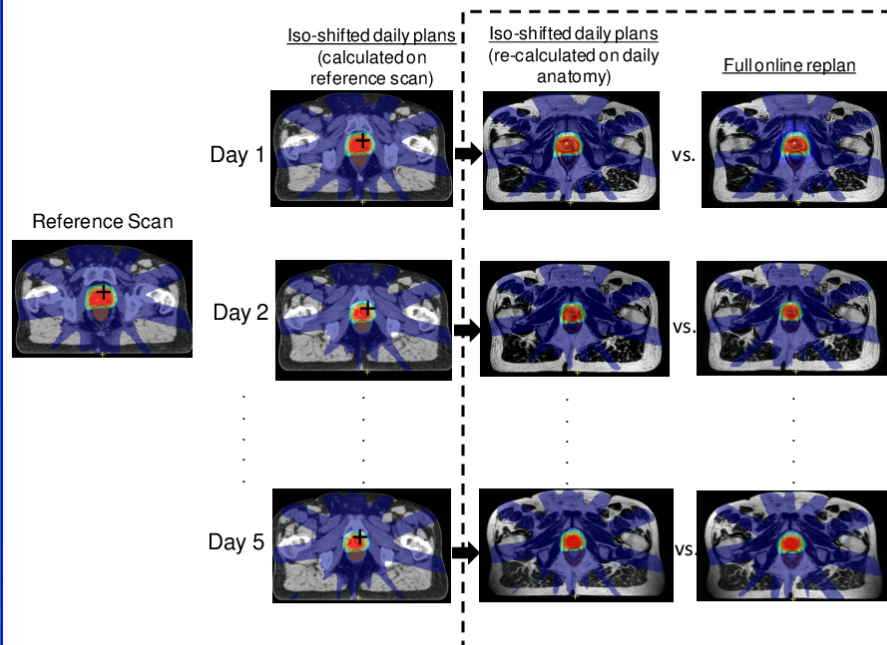


Fig 1: Illustration of workflow used in the present study

RESULTS

The numerical values for the 4 dosimetric criteria for all 14 fractions analyzed are illustrated in Fig 2 below. The dashed line in all four cases represents the pass value for each individual criterion.

- Of 56 analyzed criteria (14 fractions \times 4 criteria/fraction), there were 28 (50%) versus 8 (14.2%) violations using ATP and ATS, respectively.
- All ATP plans yielded CTV V40Gy <99% (range: 91.5%-98.7%) whereas ATS always yielded CTV V40Gy >99%.
- For rectum Dmax, ATP yielded 3 violations for which ATS passed and additional 5 violations occurred with both workflows.
- For bladder V39.5Gy, ATP yielded 3 violations for which ATS passed and 1 violation occurred with both workflows.
- There were no criteria for which ATS failed and ATP passed.
- The CTV Dmin was >36.25Gy in 14 and 11 plans for ATS and ATP, respectively

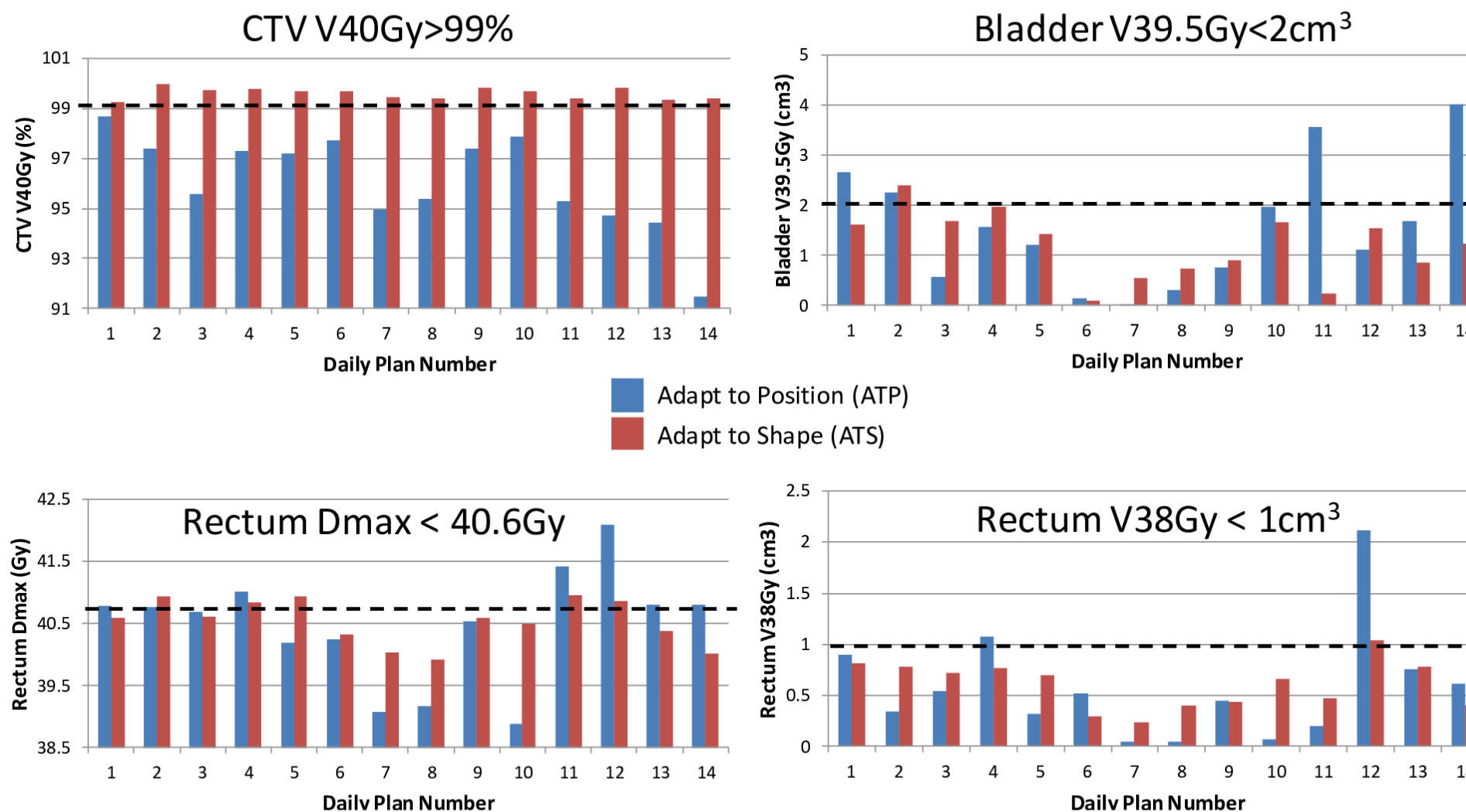


Fig 2. Graphical representation of all 14 fractions analyzed in the present study. The dashed line represents the pass value for each individual criterion

ACKNOWLEDGMENTS

We would like to acknowledge the Radiation Therapy MR-Linac team of Shawn Binda, Anne Carty, Susana Sabaratnam, Christina Silverson, Helen Su, Thanh Truong, Katie Wong, and Danny Yu

RESULTS... CONTINUED

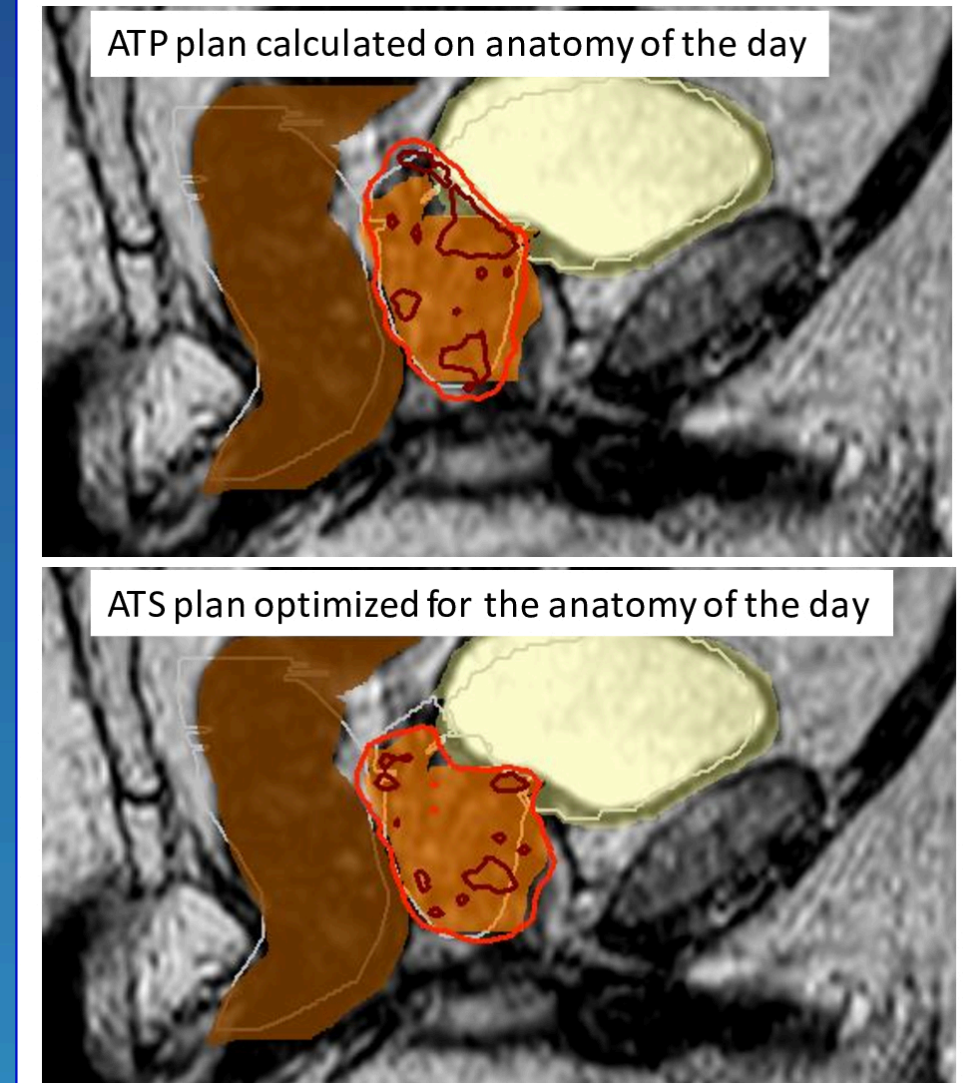


Fig 3. Dose distribution of ATP plan calculated on anatomy of the day (top) vs ATS plan optimized for the anatomy of day (bottom). Anatomy of the day is shown in colorwash: orange=CTV, yellow=bladder, brown=rectum. Also shown are the reference contours (in grey) used to make the ATP plan. Only the 40Gy (red) and 42Gy (maroon) isodose lines are shown.

CONCLUSIONS

With daily MR-guided online re-planning, greater dose can be safely allocated to the true target, which could pave the way for dose escalation or sub-volume boosting.

CONTACT INFORMATION

Mark.Ruschin@sunnybrook.ca