

Dosimetric comparison between rectal sparing partial arc versus full arc in prostate VMAT planning

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Objective: The purpose of this study is to dosimetrically compare the plan quality when utilizing rectal sparing partial arcs in prostate volumetric arc therapy treatments compared to full-arc technique.

Background/Purpose

When treating patients with prostate cancer using volumetric modulated arc therapy (VMAT) technique, treatment planning utilizes full arcs (FA) to cover the target volume. With FA, beams are attenuating the tissue in every direction to modulate on the MD drawn target volume. Additionally, MDs tend to have tight volumetric rectum constraints that lead to the rectum being highly optimized. Moreover, during simulation, patients would have difficulty with rectal emptying that would impact beam attenuation posteriorly day to day. Therefore, would the use of rectal sparing partial arcs (PA) in prostate VMAT planning maintain adequate coverage to the target volume compared to full arcs?

Material and Methods

Twenty patients from 2025-2026 with prostate tumors treated with a prescription dose of 70 cGy using volumetric modulated arc therapy on TrueBeam were analyzed. 10 patients from Perelman Center for Advanced Center and 10 patients from Northwell Health were utilized for this study with FA versus PA of 100-degree difference. Each patient had a FA plan and a PA plan with angles from 230-130 degrees. These plans were then evaluated by collecting the dosimetric metrics of bladder mean, rectal mean, D0.03 cc of the femoral heads and the D95% of the target volume.

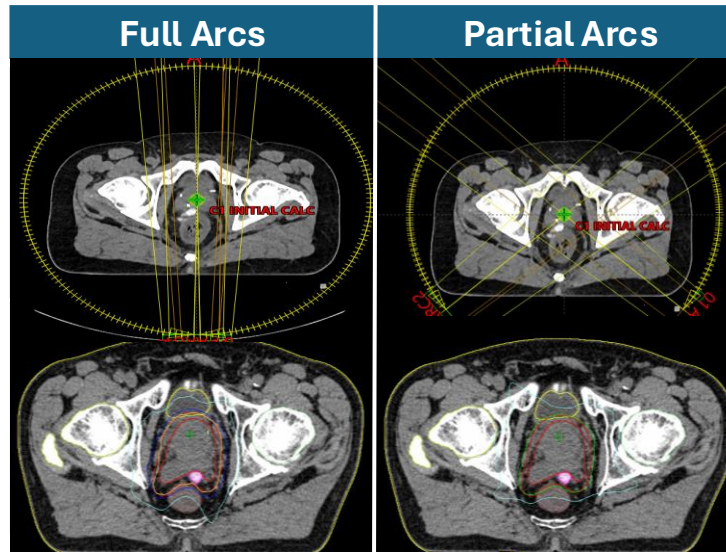


Figure 1. Comparison of isodose distribution a FA plan on the left and PA on the right. IDL shown in the 60%, 95% and 100% Dosimetric Values Using Full vs Partial Arcs

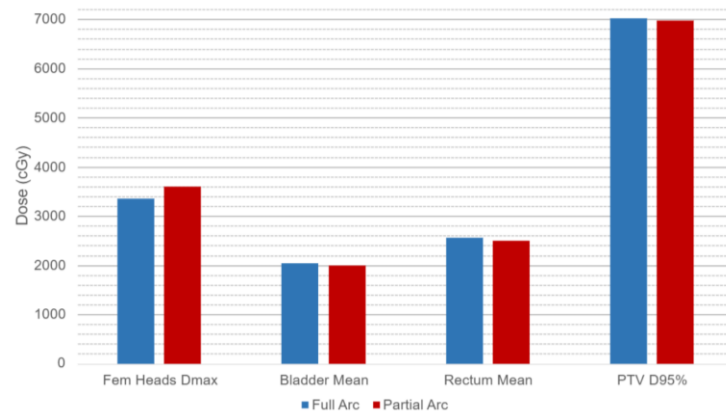


Figure 2. Average dose in cGy between FA and PA for rectal and bladder mean, fem head D0.03cc, and PTV D95%

Result/Conclusion

Incorporating PA into treatment planning has demonstrated improved dose sparing to the average rectal and bladder mean, with femoral heads increasing, all while maintaining similar target coverage. From the data collected against the average between FA and PA, it was found that the rectal mean improved by a 2.31% margin, and bladder mean by 1.96%. Whereas the femoral head mean increased by 7.4% with a slight decrease in the target volume coverage of 0.72%. From our study, we found that the utilization of PA technique allows for less low dose exit into the bladder and decreases higher doses to enter posteriorly to the rectum all while performing similar target coverage. However, this in turn does increase dose laterality to compensate for the reduced arc geometry and results in the 50% IDL to be less conformal compared to FA plans. In addition, though the results show averages, some PA plans did show some slight increases in bladder mean due to more modulation on the anterior side. Overall, this study provides a baseline assessment to consider the possible use of PA in prostate planning.

Limitations

A limitation that is evident in this retrospective study is the small sample size of twenty patients. With the finite data metrics collected, it is limited in its ability to be robust and generalized to a much larger study. Therefore, more research needs to be done to widen the scoop of these findings.

About Penn Health

The Perelman Center for Advanced Medicine (PCAM) in Philadelphia is a premier Penn Medicine outpatient facility using the Abeam System Cancer Center, radiation oncology, and specialized surgical services. It is also over 300 faculty members focusing on cancer research and patient care. Penn Medicine's Cancer System is led by the Abimem Cancer Center with locations at the Hospital of the University of Pennsylvania, Pennsylvania Hospital, Perelman Medical Center, Christie E. Packer Hospital, and outpatient locations in the Philadelphia and NJ suburbs. Beyond the greater Philadelphia region, the system includes programs at the Ann B. Slossinger Cancer Institute at Lancaster General Health, Doylestown Health, and Princeton Medical Center.

About Northwell Health

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