Effect of Nominal Collimator Angle on IMRT QA Pass Rate

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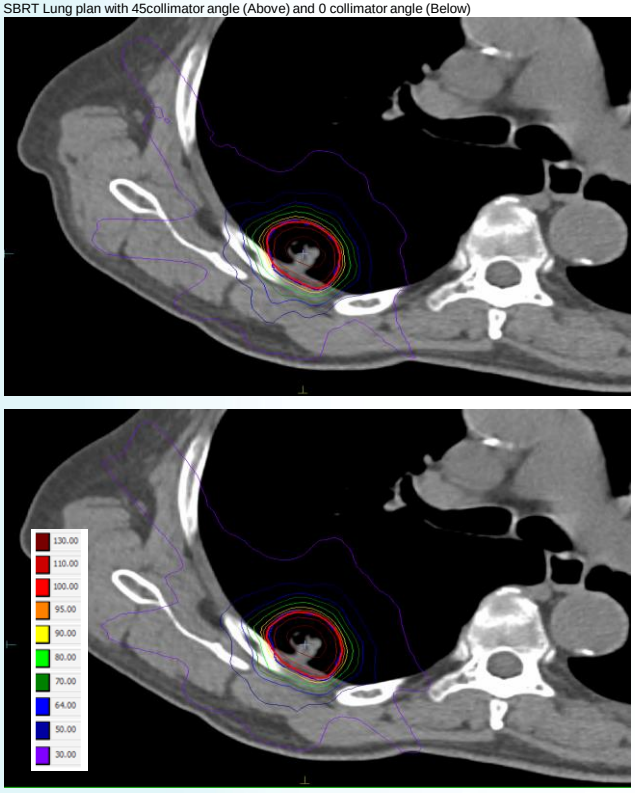
Introduction: Changing the collimator angle in external-beam treatment planning is one of the many techniques that can be used to increase plan quality and achieve dose metrics for various disease sites. The purpose of this study was to investigate the effect of using nominal angle collimator rotation for arc-based EBRT.

Background: Our institution's prior study, presented virtually at AAMD in 2022, showed that for the Elekta Monaco treatment planning system, collimator variation had no statistically significant effect on QA pass rate, However, the collimator angles used in this study were all non-zero. We intended this investigation to supplement those findings by investigating the relative impact of zero vs. non-zero collimator angle on IMRT QA pass rate for arc-based EBRT treatments.

Methods and Materials: In the first part of this study, we created two different plans each for a given anatomical site (H&N, Prostate&Nodes, Lung SBRT) using a zero and non-zero collimator angle, keeping all optimization parameters constant.

SBRT Lung plan with 45collimator angle (Above) and 0 collimator angle (Below)



For the SBRT Lung, we also similarly created two plans using unflattened beams as well as DCAT technique.QA plans were created delivered and analyzed using γ criteria of 3%3mm, 3%2mm and 2%2mm.
The second part of the study analyzed 124 clinically treated fields representing 12 different collimator angles. QA pass rates for each of these fields was analyzed using the same γ criteria as above.

Results: For the comparison of clinical cases which used nonzero vs zero collimator angles, we found no statistical difference in the average pass rates. However, for cases planned using standard optimization temples it was found that the average pass rate for cases planned with 0 collimator was lower than those with nonzero.

QA pass rates for three anatomical sites planned using standard optimization parameters using zero and nonzero collimator angles

Patient	Energy	Technique	Disease Site	Collimator Angle	3%3mm γ	3%2mm γ	2%2mm γ
A	6	VMAT	H&N	0	99.70	99.00	98.10
A	6	VMAT	H&N	15	99.9	99.6	98.3
B	6	VMAT	Pros&Nodes	0	100.00	99.70	98.60
B	6	VMAT	Pros&Nodes	25	100.00	99.90	98.30
C	6	DCAT	Rlung SBRT	45	99.70	98.30	97.00
C	6	VMAT	Rlung SBRT	45	100.00	98.60	97.50
C	6FFF	VMAT	Rlung SBRT	45	98.10	96.20	93.50
C	6	DCAT	Rlung SBRT	0	100.00	97.40	94.50
C	6	VMAT	Rlung SBRT	0	95.70	92.40	87.70
C	6FFF	VMAT	Rlung SBRT	0	96.80	91.30	88.50

These plans still met departmental criteria for clinical acceptability. Since this trend was not seen in clinically delivered plans using 0 collimator angle, this pass rate degradation may indicate that iterative planning during optimization can and routinely does counteract the effects of using 0 collimator angle.

Conclusion: The results of this study supplement and confirm the original hypothesis that collimator angle does not have a significant impact on plan quality or QA pass rate. Additionally, historical reasons for not planning with nominal collimator angle were shown to be unsubstantiated. While using different collimator angles based on target and OAR location may be useful based on the Monaco optimization algorithm, generally using 0-angle collimation for planning does not lower plan quality or QA pass rate. These findings were used to implement a policy at our institution allowing any collimator angle for planning.

AAMD American Association of Medical Dosimetrists

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