Cureus

Open Access
Abstract

Correlation between Treatment Plan Quality and Deliverability for Conventionally Fractionated and Hypofractionated VMAT Treatments

Laura Apicello [1] , Brian Wang [2] , Joshua James [1] , Elijah Martin [1] , Benjamin E. Nelms

1. Radiation Oncology, University of Louisville 2. Radiation Oncology, University of Louisville, Louisville, USA 3.

Corresponding author: Laura Apicello, l0apic01@louisville.edu

Categories: Medical Physics, Radiation Oncology
Keywords: hypo-fractionated radiotherapy, plan quality

How to cite this abstract
Apicello L, Wang B, James J, et al. (November 02, 2017) Correlation between Treatment Plan Quality and Deliverability for Conventionally Fractionated and Hypofractionated VMAT Treatments . Cureus 9(11): a181

Abstract

Objectives: Several retrospective studies have examined the correlation between beam- and plan-complexity metrics and dose QA results for Intensity Modulated Radiation Therapy (IMRT). The purpose of this study is to examine dose QA results vs. plan quality for conventionally fractionated and hypofractionated VMAT treatments using rigorous plan quality formalism and sensitive QA metrics.

Methods: Five Volume Modulated Arc Treatment (VMAT) plans of increasing quality were created for each of seven controlled patient datasets (i.e. fixed CT images and structures, per dataset). Five patient datasets from AAPM MPPG 5.a (prostate, abdomen, lung, anus, and head and neck) were used for standard fractionation treatments. Two additional patient datasets (prostate and spine) were used for Stereotactic Body Radiation Therapy (SBRT) and Stereotactic Radiosurgery (SRS) plans. The plans were created on a Varian Eclipse planning station (version 11). A single QA fraction from each plan was delivered by a Varian TrueBeam to a ScandiDos Delta4 phantom. The criteria of the gamma analysis was 2%/2mm global with a threshold of 10% of max dose.

Results: The progressive levels of plan quality were measured with an objective and comprehensive plan score calculated from a collection of metrics (e.g. DVH points) and a "score function" per metric. A higher score indicates better target coverage and conformality, along with better sparing of OARs. For the conventional VMAT plans, the scores varied from 65.50 to 143.21 on a scale of 0 to 150. The minimum passing rate was 83.8%, with four of the five sites all over 90%. For the SRS/SBRT plans, the plan scores varied from 80.28 to 146.01, with a minimum gamma passing rate of 91.3%. Surprisingly, we found strong, positive correlations between QA results and plan quality, meaning the gamma passing rate increased with increasing plan score. This stands in contrast to conventional wisdom assuming QA results degrade with plan complexity. The R values were +0.628, 0.822, 0.778, 0.913, and 0.976 for prostate, lung, anus, head and neck, and abdomen respectively. The R values for the SRS/SBRT plans were +0.176 and -0.542 for prostate and spine respectively. The SRS/SBRT plans did not show strong correlations, but they still demonstrated that the dose QA is not compromised by increasing complexity.

Conclusions: This study reveals that dose QA (calculation accuracy and beam deliverability)

Open Access
Abstract
Published 11/02/2017

does not degrade when a plan's complexity is increased for VMAT plans created in the Eclipse planning station and delivered on a Varian TrueBeam. The SRS/SBRT gamma analysis shows no significant correlation, while the standard fractionation passing rates increase with increasing complexity. Therefore, it is wrong to assume that a plan's dose QA will suffer as plan quality increases, at least for this TPS-linac combination.