Cureus

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Abstract

Dose Discrepancy of External SRS Audit - Investigation of Linac Deliverability Factors

Kirsty Blythe [1] , Savvas Rizkalla [2] , Tony Greener [3]

1. Radiotherapy Physics, Guy's and St Thomas Nhs Foundation Trust, London, GBR 2. Medical Physics, Royal Cornwall Hospitals Nhs Trust, Truro, GBR 3. Radiotherapy Physics, Guys and St Thomas Nhs Foundation Trust, London, GBR

Corresponding author: Kirsty Blythe, kirsty.blythe@gstt.nhs.uk

Categories: Medical Physics, Radiation Oncology
Keywords: srs, sbrt

How to cite this abstract
Blythe K, Rizkalla S, Greener T (March 21, 2019) Dose Discrepancy of External SRS Audit - Investigation of Linac Deliverability Factors. Cureus 11(3): a370

Abstract

Objectives: As part of commissioning of TrueBeam STx for use in intracranial Stereotactic RadioSurgery, in November 2016 Guys and St Thomas NHS Foundation Trust took part in a UK Cranial Stereotactic Radiosurgery Dosimetry Audit. The measured results across a number of alanine pellets within the planning target volume of an anthropomorphic phantom were +5% higher than predicted values from Eclipse. This study aimed to validate this result using several small chambers and phantoms, and to investigate possible machine deliverability factors which may have contributed to the discrepancy.

Methods: Five different plans of increasing complexity (1. Simple 10x10 square fields, 2. Prostate VMAT 3. Neuro VMAT 4, SBRT Lung VMAT 5. NPL Audit SRS non-coplanar SRS VMAT plan) and range of energies (6X, 10FFF) were measured with four different measurement setups (1. A1SL Chamber inside STEEV phantom, 2. SemiFlex Chamber inside STEEV phantom, 3. SemiFlex3D Chamber inside STEEV phantom, 4. A1SL using CHEESE phantom).

All chambers were cross calibrated using two methods, a side by side method in a Perspex block and by chamber exchange method in a water phantom.

Results: After initial cross calibration of the SemiFlex 3D chamber, it was found to give results of +3.2% for 10x10cm 10FFF orthogonal fields in the STEEV phantom. Despite repeated cross calibrations the SemiFlex3D chamber continued to over-respond for all subsequent setups and these results have been disregarded.

Otherwise, 10x10cm orthogonal fields with all phantom and chamber combinations at 6MV and 10FFF agreed within 1% of predicted values for remaining chambers and setups. The prostate VMAT plan agreed within 2.5% for the SemiFlex chamber and within 2% for the A1SL chamber in STEEV and within 1% for the A1SL in CHEESE. The more complex neuro VMAT plan agreed within 3% for both chambers in STEEV and within 1.5% in CHEESE. A SBRT Lung VMAT plan agreed within 3% in STEEV and 1.3% in CHEESE using both SemiFlex and A1SL chambers.

The SRS audit plan was measured as +3% high in STEEV with the A1SL chamber and SemiFlex chamber. This is 2% lower than as measured during the audit, which used the same phantom but different detectors (alanine pellets). This plan measured +1.3% using the A1SL chamber in

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Published 03/21/2019

the CHEESE phantom, which may be due to the greater homogeneity of this phantom.

Conclusions: Agreement between expected doses and measured doses may worsen with increasing plan complexity (MU/Gy). The dose per fraction also increased in these cases from 2Gy/# (Prostate VMAT) up to 24Gy/# (SRS VMAT). Further audit visits were carried out and DLG has been considered to be influential in this dose discrepancy. Further work is required to identify what elements in the plans contribute to worse agreement between planning system and measurement. A study was conducted which evaluated planning parameters by making systematic adjustments to the audit plan in Eclipse, and is reported on in a separate abstract.