Cureus

Open Access
Abstract

Cureus

FFF for lung SBRT - dosimetric accuracy or delivery efficiency?

Mahesh Mundayadan Chandroth [1] , Anthony Venning [1] , Brendan Chick [1] , Brett Waller [1]

1. Radiation Oncology, Mid North Coast Cancer Institute, New South Wales, AUS

Corresponding author: Mahesh Mundayadan Chandroth, mahesh.mundayadanchandroth@health.nsw.gov.au

Categories: Medical Physics, Quality Improvement, Radiation Oncology
Keywords: flattening filter free, lung sbrt, monte carlo tps, versa hd, treatment delivery, treatment accuracy

How to cite this abstract
Mundayadan Chandroth M, Venning A, Chick B, et al. (March 21, 2019) FFF for lung SBRT - dosimetric accuracy or delivery efficiency?. Cureus 11(3): a396

Abstract

Purpose: Flattening filter free (FFF) beams have shown to improve treatment delivery efficiency in stereotactic body radiation therapy (SBRT). Our clinic is equipped with 6MVFFF and 10MVFFF beams to be used predominantly for hypo-fractionated treatments. Treatment planning is done on a commercial treatment planning system (TPS) which uses a Monte Carlo (MC) dose calculation engine. This study evaluated the accuracy of beam modelling, dose calculation accuracy of the TPS in the presence of lung equivalent media, treatment delivery times with the two beams and the suitability of these beams for lung SBRT treatments. Methods: 6MVFFF and 10MVFFF beams were commissioned on Elekta® linac and were modelled in Monaco® TPS for Monte Carlo (MC) dose calculation algorithm. The basic validation of the beams is performed in a stack of water equivalent plastic. To test the accuracy of dose calculation in low density materials like lung, tissue equivalent slabs and phantoms are used. First, a set of treatment plans with simple geometries were created and dose calculated, for both dose to medium (Dm) and dose to water (Dw). Monaco reported radiological depths are compared to calculated depths. Then, five complex clinical 6MVFFF SBRT lung VMAT plans were recalculated on a CIRS E2E SBRT phantom®. By retaining the segments and MU, the plans were recalculated for 10MVFFF. The same plans were recalculated again by scaling the MU to match the dose of 6MVFFF plans. Dose measurements were performed using an ion chamber and EBT3 films in both cases and compared against Dm and Dw calculations. Peripheral dose to the tumour was assessed using normoxic polymer gel and EBT3 films. The treatment times for 6MVFFF and 10MVFFF plans were compared. Results: Monaco reports radiological depths accurately with inhomogeneous beam path. In water, calculated dose (Dc) agreed to delivered dose (Dd) for fields down to 2x2cm2. With decrease in the electron density of the medium and increase in beam energy, the dose agreement becomes poor, about 15% for 10XFFF for 2x2cm2 (Table 1). For the SABR plans, point dose at the centre of the lung tumour in E2E SBRT phantom agrees better for 6XFFF (3.1%) compared to 10XFFF (5.5%). On the periphery, the films and GEL shows that Dc overestimates the Dd, more for 10XFFF than 6XFFF. This is due to the effect of inaccurate modelling of the secondary dose build-up from lung tissue to tumour. On an average, 10XFFF plans deliver faster by 2.7sec/Gy of prescription (Table 2) compared to 6XFFF plans. Conclusion: This study shows that, for VMAT lung SABR treatments, 6XFFF plan have better dosimetric accuracy compared to 10XFFF plans but delivers slower. The minimal treatment time advantage of 10XFFF beam should be weighed against the uncertainty on the tumour peripheral dose for lung SBRT. Careful consideration should be given in the selection of beam energy while planning SBRT lung treatments, especially with low density targets.

Open Access
Abstract
Published 03/21/2019