

COMPARISON OF PHOTON BEAM DATA AND BEAM MODELING RESULTS FOR TRUEBEAM, TRILOGY AND CLINAC 2100 LINEAR ACCELERATORS

1. Introduction

The TrueBeam™ is a new linear accelerator model from Varian Medical Systems. It is designed to operate in both standard and flattening filter free photon modes and standard electrons. The purpose of this study is to evaluate the measured beam data for two photon beam energies in standard mode from the new TrueBeam linear accelerator, and to compare that data with beam data obtained from the existing models Varian Trilogy™ and Clinac® 2100C linear accelerators. The three different photon beam data sets were used to generate the AAA Eclipse photon model and some of the resulting algorithm modeling parameters were compared.



Figure 1: Varian TrueBeam linear accelerator with the Scanditronix-Wellhofer phantom positioned for data collection

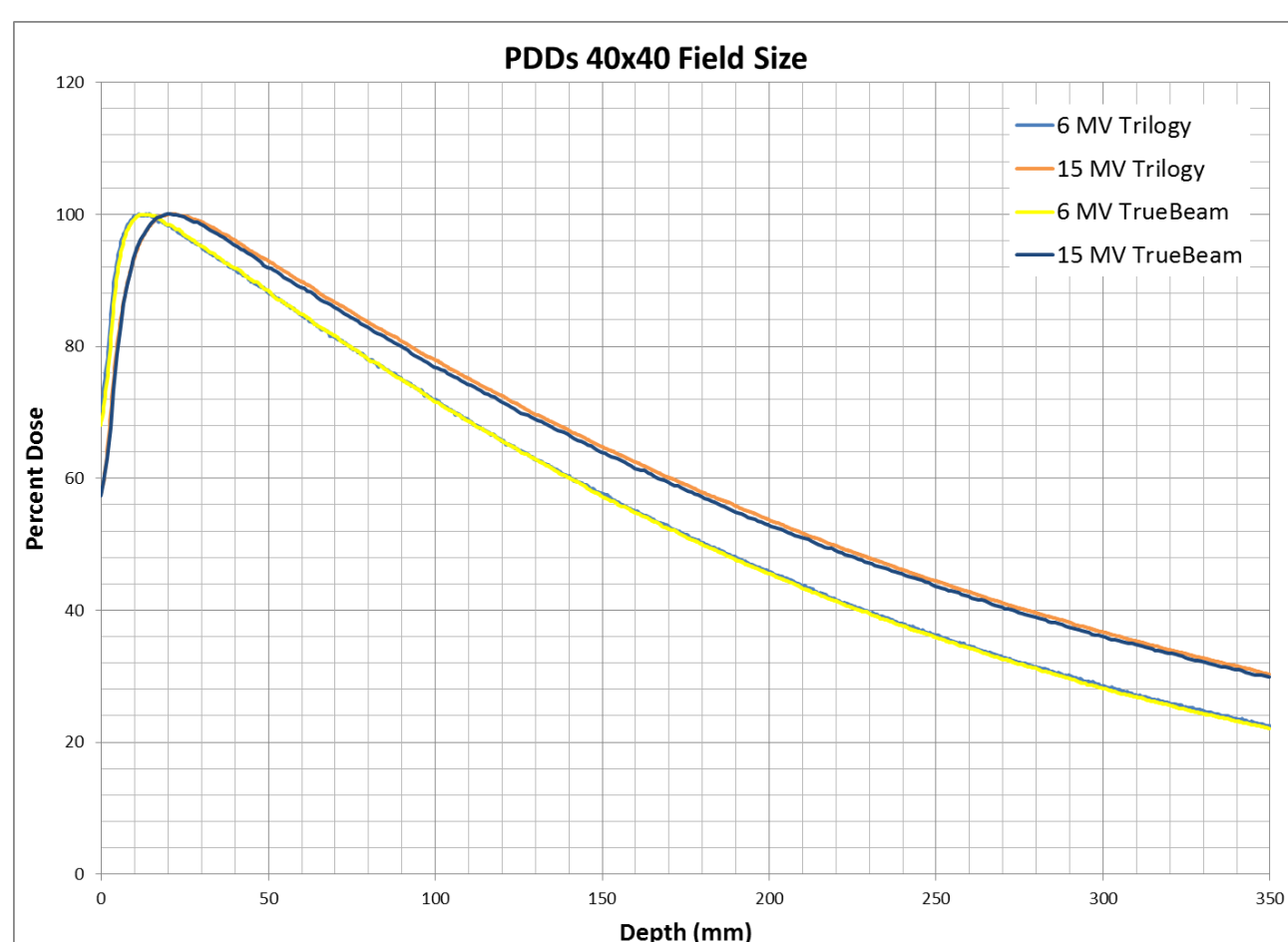
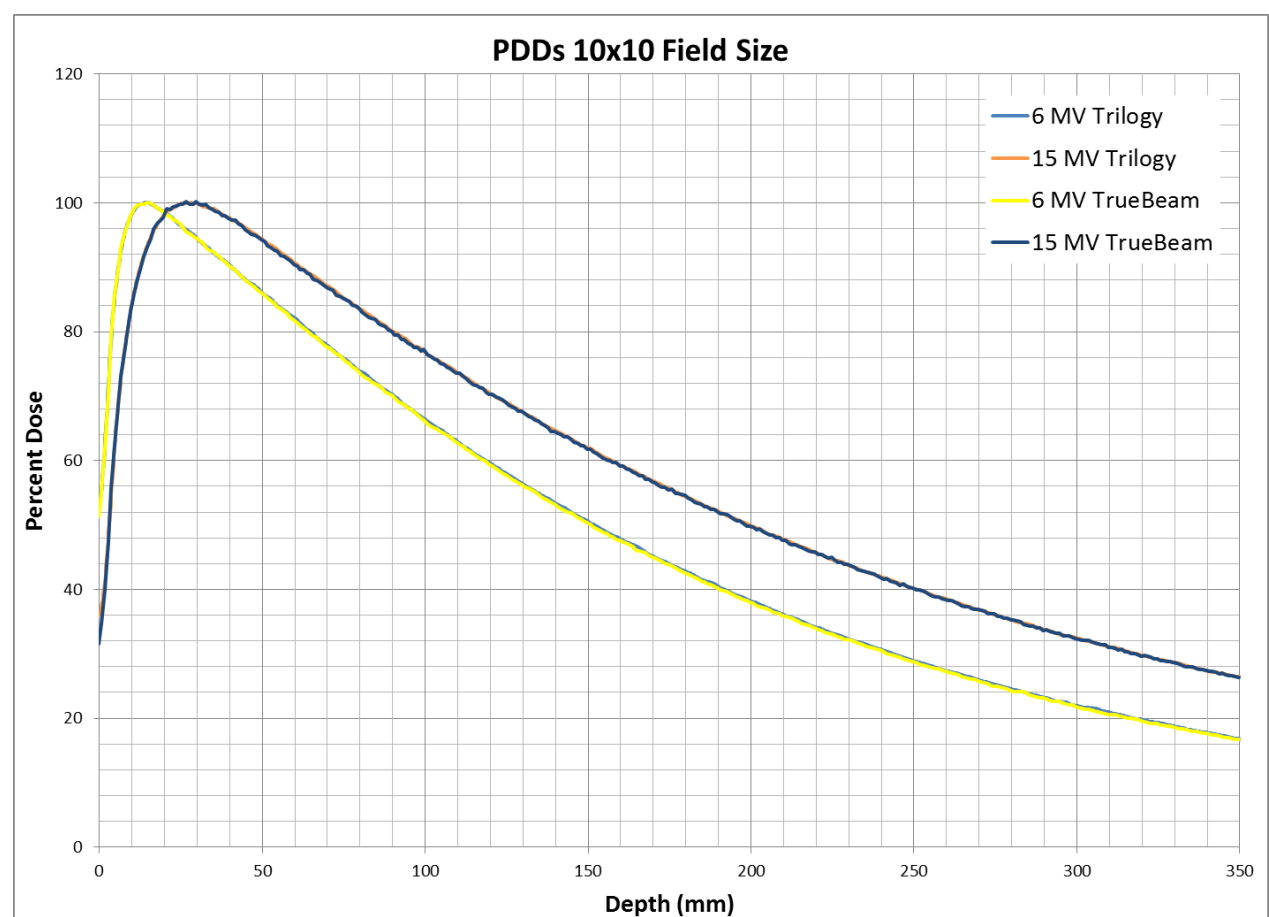
2. Materials and Methods

Measurements of percent depth-doses (PDDs), beam profiles, and output factors were performed on three Varian linear accelerators (linacs): a TrueBeam, a Trilogy and a Clinac 2100. Measurements were performed with 6 MV and 15 MV photon energies in standard mode. The measurements were performed in a Scanditronix Wellhofer Blue Phantom with a CC13 scanning ion chamber. The measured data was used to configure the AAA photon algorithm in the Eclipse treatment planning system. A preliminary evaluation of the resulting parameters in Eclipse was performed to evaluate the effects of any differences between the three obtained data sets.

3. Results

PDD data varied less than 1% between the linear accelerators at all field sizes measured. All square field profiles measured were also essentially identical for the three machines (variation <1%).

*Figure 1:
PDDs for 10x10 field size
Trilogy and TrueBeam*



*Figure 2:
PDDs for 40x40 field size
Trilogy and TrueBeam*

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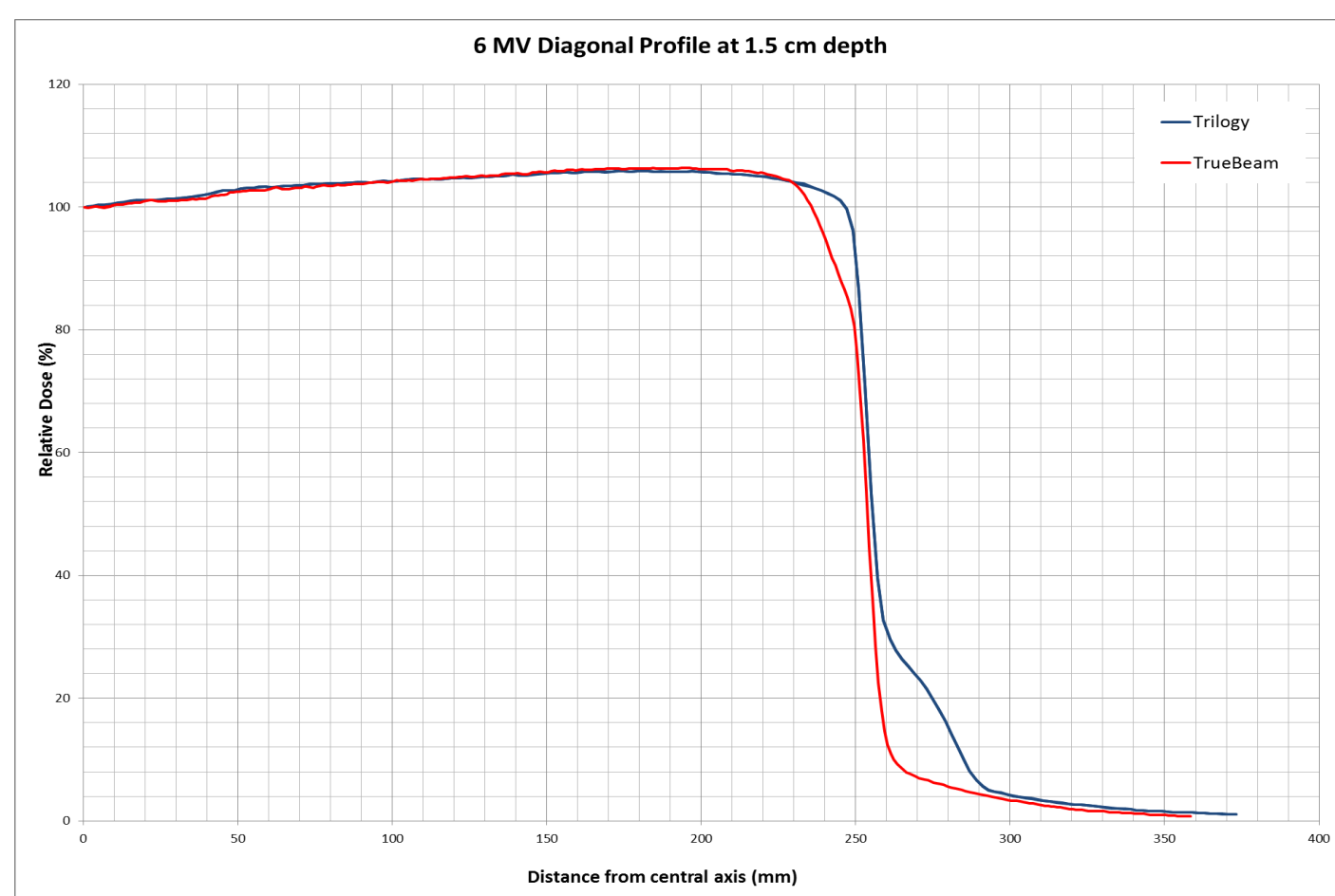
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3. Results (cont.)

The diagonal profiles measured on the TrueBeam were observably different than those from the Trilogy and Clinac, especially at large distances from the central axis.

Figure 3:
6 MV diagonal profiles
for Trilogy & TrueBeam



The TrueBeam data showed small variations in the output factors when compared to the other linacs. These differences were more noticeable for larger field sizes. However, the differences were less than 2% as compared to the other two linear accelerator models.

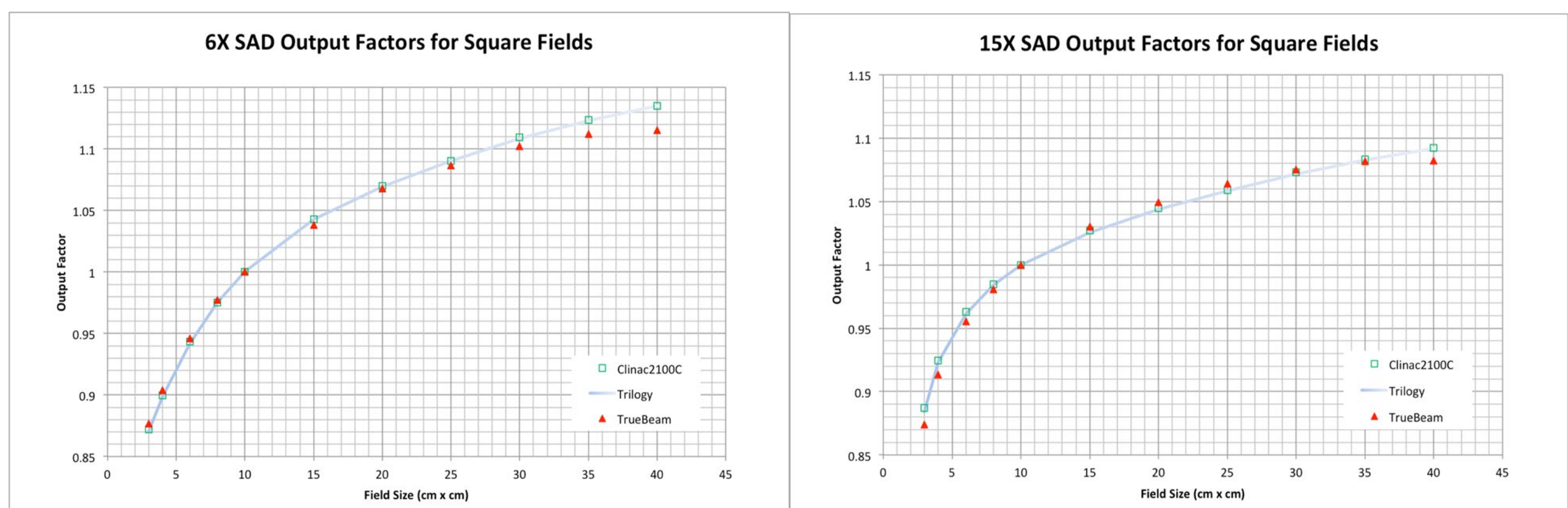
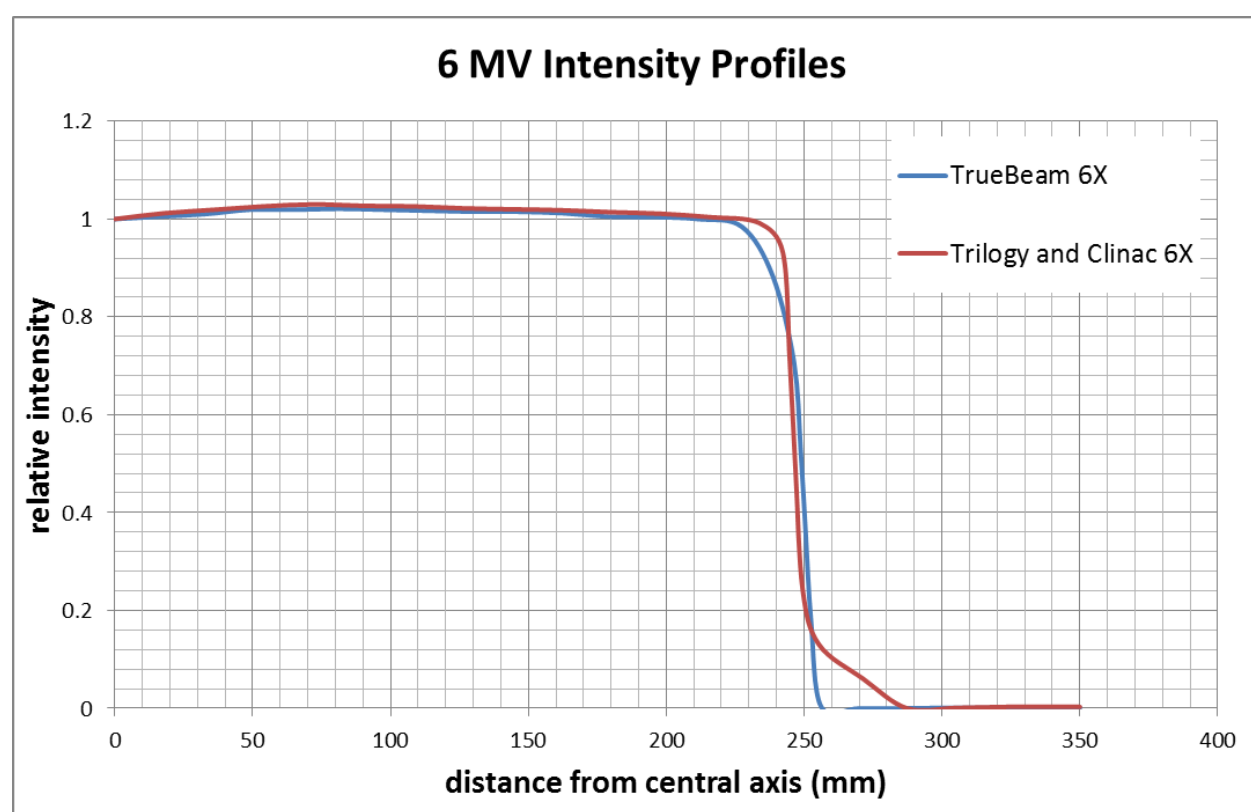


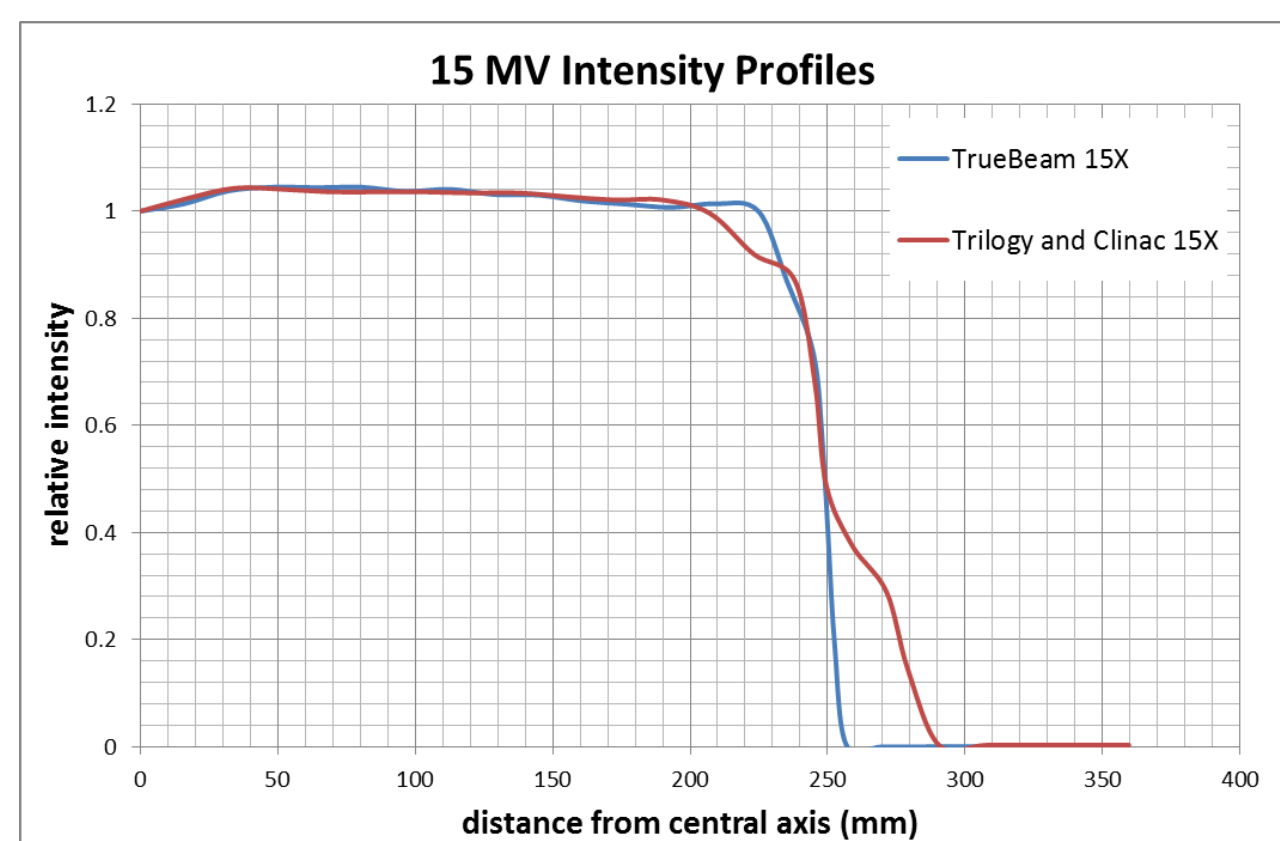
Figure 4: Output factors measured at 95 cm SSD and 5 cm depth for all linacs: (a) 6 MV and (b) 15 MV

The final results for the Eclipse AAA model showed some variations in the intensity profiles at distances beyond 20 cm from the central axis caused by the different shape of the diagonal profile.



*Figure 5:
6 MV AAA intensity profiles*

*Figure 6:
15 MV AAA intensity profiles*



Minor differences were also seen in the AAA collimator back scatter factors obtained from the output factors. The observed differences are likely the result from the different shape and thickness of the primary collimator of the TrueBeam.

Conclusions

Photon beam data PDDs and profiles from TrueBeam (6 and 15 MV) as compared with the Trilogy and Clinac were essentially identical. Small differences (<2%) were found in output factors, mainly for large field sizes. Differences were found in the diagonal profiles at large distances from the central axis. These showed as differences in the final intensity profile from the photon algorithm at distances beyond 20 cm. These results should only affect very large field sizes and thus should not have clinical significance.