

Verification of two beam-matched linear accelerators using volumetric modulated arc therapy plans

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D. TINNAGORN¹, Y. SUMALEE², R. KULACHATR¹

¹Department of Radiotherapy, Mahavajiralongkorn Thanyaburi Hospital, Thailand

²Department of Radiological Technology, Naresuan University, Thailand

* Corresponding author: tinnagorn.armrt@gmail.com

Background and Objective

After completion of the acceptance test and initial vendor-recommended beam-matching test, the extent of beam-matching was measured to confirm the level of beam matching in two identical LINACs. This work aimed to verify the dosimetric accuracy of beam-matching by using VMAT plans after completed the extent beam-matching.

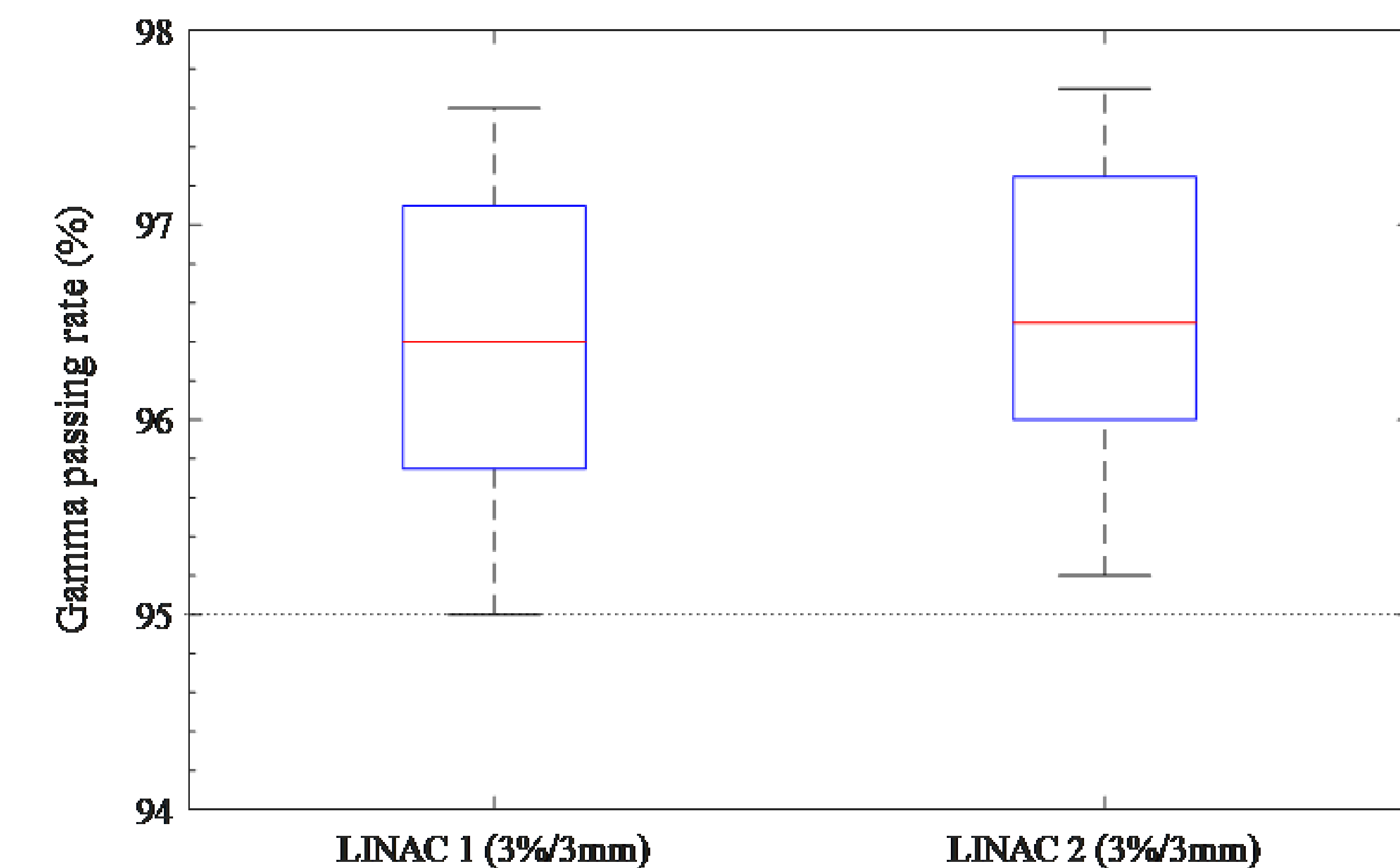
Methods

For planar dose measurement, previously treated thirty patients from our database were selected. Sites included were head and neck, thorax and pelvis with ten patients for each site. The VMAT plans were generated in Monaco (version 5.11.02) Treatment Planning System (TPS) using the same 6 MV photon beam model. The doses were computed using the Monte Carlo algorithm with a calculation grid size of 0.3 cm. TPS doses calculated on LINAC1 is taken as a reference for all measurements. The LINAC1's verification plans have been beamed ON in all LINACs by doing the machine override option available in LINAC2 consoles. All the VMAT plans were measured using Octavius^{4D} phantom with Octavius detector 1500 and VeriSoft[®] verification software. Octavius measurement was compared with the TPS calculated planar doses through absolute dose gamma comparison using criteria of 3% dose difference and 3 mm distance to agreement (3%3mm). The statistical significance of differences for gamma passing rates of Octavius measurements between two LINACs was analyzed using a t-test at 95% confidence limit.

Results and Discussion

For all thirty cases, the passing rate of Octavius measurements on two beam-matched LINACs were all higher than were 95% using 3%3mm gamma criteria, as shown in Figure1. The average gamma passing rates of LINAC1 and LINAC 2 were $96.23 \pm 0.81\%$ and $96.28 \pm 0.85\%$, respectively. There was no statistical difference in the gamma passing rates between LINAC1 and LINAC2, with a p-value of 0.463.

Figure 1. Distributions of absolute dose gamma passing rate of VMAT plans delivered on two beam-matched LINACs.



Conclusions

- The assessments of beam matching with pre-verification plans showed good agreement with the 6 MV beams of two LINACs.
- The dosimetric analysis of VMAT plans swapped between two LINACs were well within acceptable limits.
- Small differences in gamma passing rates between two LINACs proved the viability of interchanging VMAT patients between two beam-matched LINACs without re-planning of VMAT plans to manage the machine downtime.

References

- [1] Sangaiah A et al. Dosimetric validation of volumetric modulated arc therapy with three 6 MV beam-matched linear accelerators. Asian pacific journal of cancer prevention 2017; 18(12):: 3439-44.
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