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Automated MLC Quality Control using XML Script and developer mode in TrueBeam STx

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INTRODUCTION

In an intensity-modulated in arc (VMAT) the multileaf collimator (MLC) is very important but present uncertainties inherent in the equipment. Therefore, quality control procedure is essential [1]. Today, MLC controls use the Electronic Portal Imaging Device (EPID) to acquire positioning images and some companies have developed commercial software that facilitates data processing [2]. However, not cover all controls [2] and are costly. Therefore, internal development of automation is a good alternative. It is possible thanks to Developer Mode present in TrueBeam accelerators [3], where it allows giving instructions to LINAC, following a series of specific commands written in XML format.

AIM

Quality control of multileaf collimator (MLC) for VMAT are critical and time-consuming. The purpose of this work was to develop an XML sequence to automate this task.

METHODS

A TrueBeam STx v2.7 equipped with EPID aS1200 (Varian Medical Systems, Palo Alto, CA) and HDMLC with Developer Mode vs 2.0 and Microsoft Visual Studio 2019 development environment were used for XML generation. Four QA Tests for MLC were automated: T1-Static Picket Fence (0 °, 90 °, 180 °, 270 °), T2-Picket Fence during RapidArc (179 to 181 °), T3-Gantry Speed and T4-MLC Speed. The control points (CP) of T1 test contain leafs movements and monitor units (UMs) for four static gantry angles and T2 test uses variable gantry angles for each CP (Figure 3). Both tests were programmed with constant dose rate of 600 UM/min. For T3 and T4 tests two stages were generated: static field and gantry movement by CP following the “Trajectory functions” where MUs difference and gantry positions generate the gantry speed and dose rate variation. Test T3 and T4 have seven and four bands respectively (Figure 3), where dose rate, gantry speed and leafs for each band are varied. Images obtained are saved in DICOM format on disk network for analysis by RIT (Radiological Imaging Technology) software (Figure 1). All automated controls were verified by comparison with manual controls and execution times in each control were recorded and analyzed.

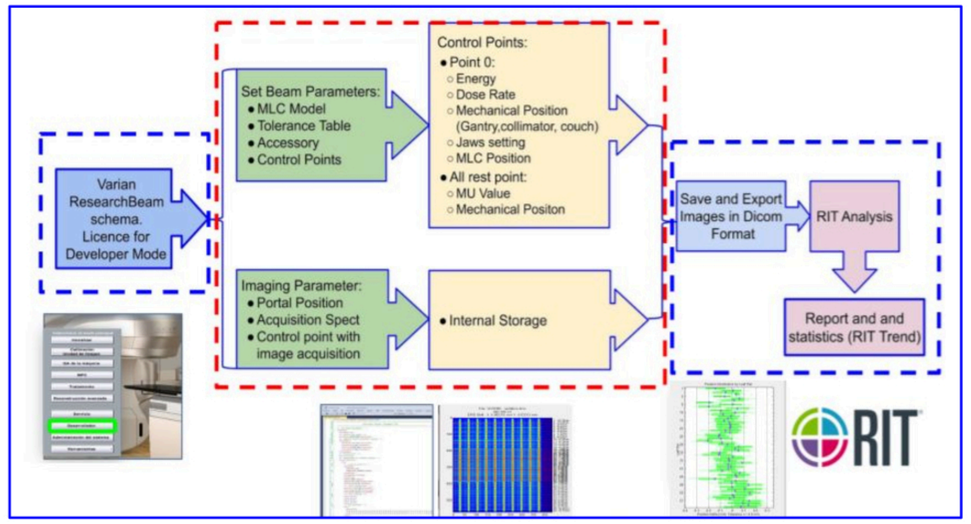

Figure 1. Process for control automatization. Workflow diagram of process in QA MLC automatic.

RESULTS

The results obtained do not show a significant difference between automatic and manual QA (table 1). The automatic and manual QC were done in 10.3 ± 2.2 min and 17.5 ± 5.2 min respectively. Generating a time saving of up to 6 min. The mechanical and dosimetric results of the different tests, both manual and automatic, are presented in Table 1, the results show that both methods are equivalent, confirming the robustness of the system. Furthermore, these files are built to perform all the control automatically without need to change execution files this generates that all controls are fully automatic and images are saved automatically.

Method	T1 Picket Fence Static		T2 Picket Fence Dynamic		T3 Gantry Speed & Dose Rate	T4 MLC Speed
	Abs. Max. Leaf (mm) Position Deviation	Leaf Average FWHM (mm)	Abs. Max. Leaf (mm) Position Deviation	Leaf FWHM Average(mm)	Max. Deviation Leaf Profile (%)	Max. Deviation Leaf Profile (%)
Manual	-0.34 ± 0.11	2.39 ± 0.07	-0.14 ± 0.12	2.43 ± 0.08	2.01 ± 0.47	-0.99 ± 0.62
Automatic	-0.41 + 0.09	2.37 + 0.05	-0.11 + 0.07	2.40 +0.06	1.91 + 0.39	-1.22 ± 0.52

Table 1. Summary of automated controls result, where you can see the maximum deviations, maximum percentages and FWHM of Test 1 and 2

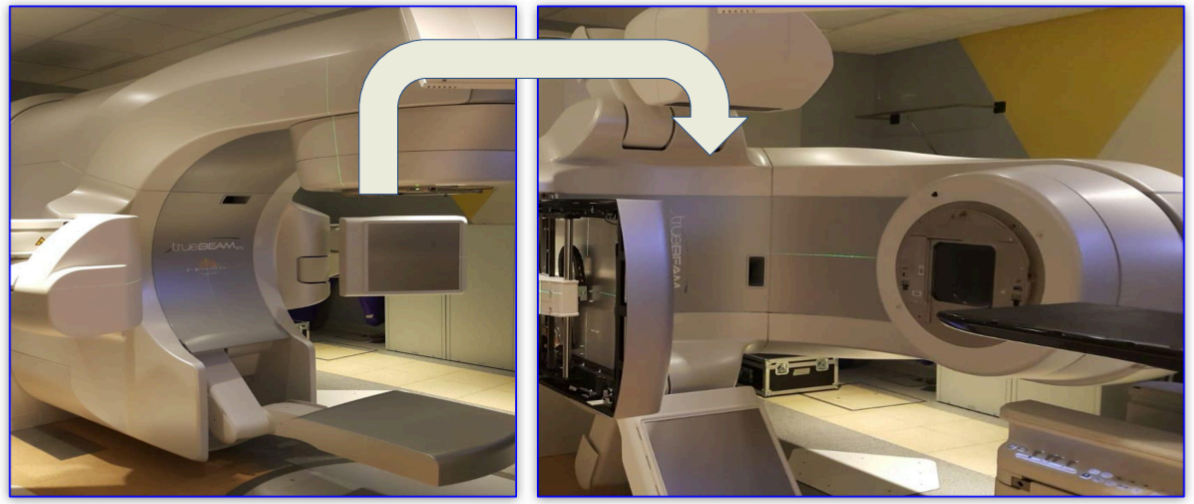

Figura 2. Set up and execution for realization of QA MLC

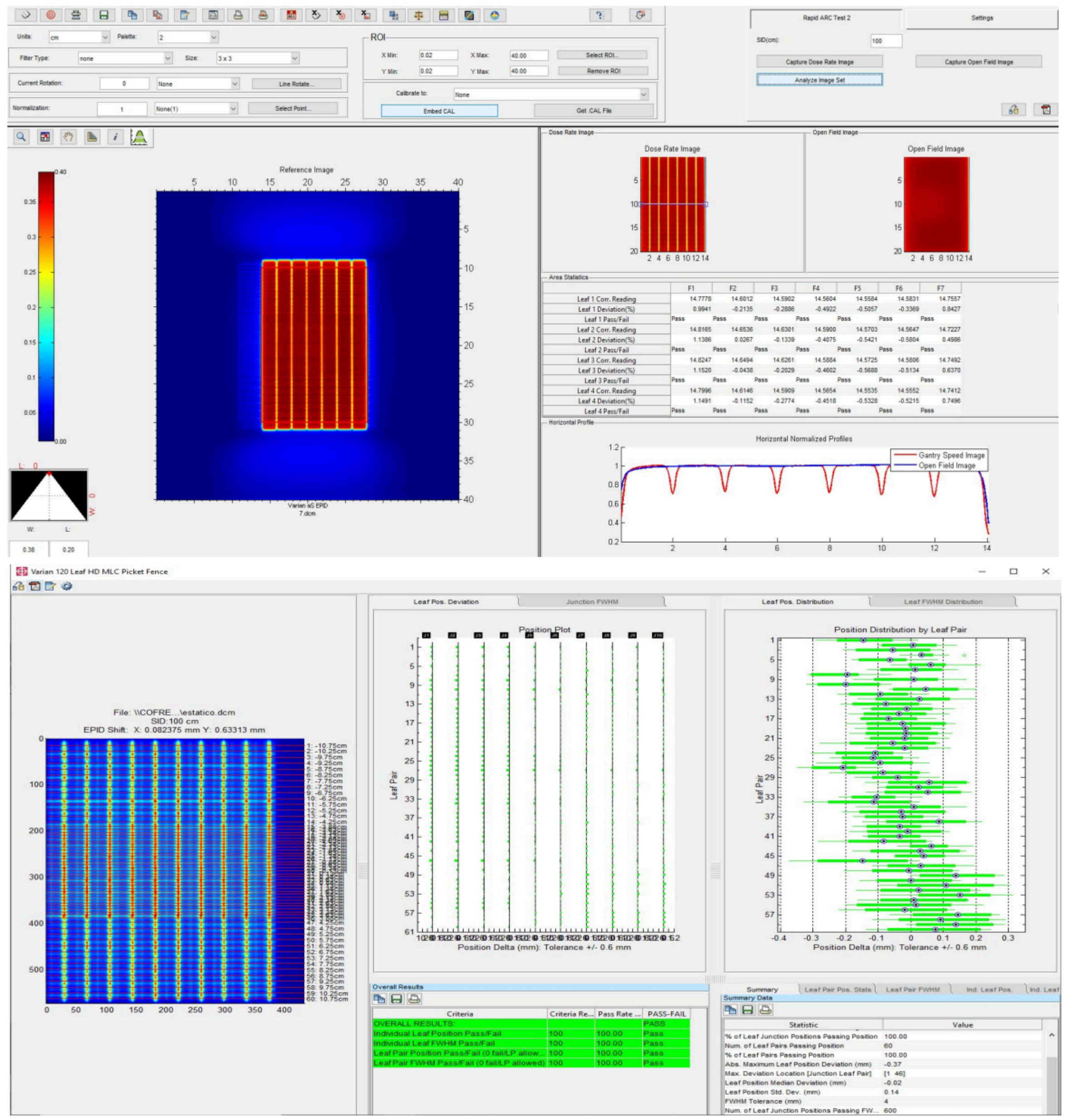

Figura 3. Analysis and result of: a) Dynamic Picket Fence and) MLC speed test automatically.

CONCLUSIONS

The automation of MLC controls using XML files is feasible and the duration of the control is reduced. The results obtained are same as obtained manually. All the results of the controls are within tolerance according to the protocol TG-142 [2] and TG-179 [3]. The adaptations of the current XML are being extended to other quality controls in our institution.

REFERENCES

1 Eric E. Klein, Joseph Hanley, John Bayouth, Fang-Fang Yin, William, et al. Task Group 142 report: Quality assurance of medical accelerators. The International Journal of Medical physics Research and Practice, 2009.

2 Michael P Barnes and Peter B Greer. Evaluation of the truebeam machine performance check (mpc) geometric checks for daily igrt geometric accuracy quality assurance. Journal of applied clinical medical physics, 18(3):200–206, 2017.

CONTACT INFORMATION

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