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# Quality Assurance of Dynamic Multileaf Collimator for Intensity Modulated Radiation Therapy & Rapid Arc Treatment Using Portal Imaging and Films

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## Short Communication

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## INTRODUCTION

The most effective part of the linear accelerator is dynamic MLC, so the accuracy of positioning of the dMLC leaf is very importance in the treatment technique such as Intensity Modulated Radiation Therapy (IMRT) and Rapid Arc, the radiation transmission through MLC must controlled. To investigate different parameters of dynamic MLC (dMLC) for the commissioning of IMRT and Rapid Arc such MLC transmission factor, Dosimetric leaf gap (DLG), leaf speed and positional accuracy using standard test patters provided by vendor.

## MATERIALS AND METHODS

All the works were performed with dual energy (6 MV & 10 MV) linear accelerator provided by Clinac iX (varian medical system) equipped with millennium-120 MLC. The EPID attached to the Linac is based on amorphous silicon type flat panel detectors (a-Si 1000), As the part of MLC QA, Initially measured the MLC transmission factor by using 0.65 cc ionization chamber at depth 10 cm in solid water phantom, The MLC transmission factor is the ratio of meter reading obtained for the closed MLC field to the meter reading obtained for the open field. The mean reading of the MLC transmission factor of the two banks of MLC was taken to be the MLC transmission factor [1].

Dosimetric leaf gap (DLG) computed from graph. Leaf transmission and leakage through the rounded leaf ends is known as dosimetric leaf separation (DLS). The DLS is the quantity added to the leaf gap to compute the dose more accurately, especially for small gaps. It is used by the leaf motion calculator as an offset value on leaf position In order to check positional accuracy, MLC gap, Leaf speed and complex dynamic field, different dMLC test patterns provided by Varian are executed using EPID [2]. dMLC QA for IMRT using Amorphous silicon based EPID is attached to the exact arm of Clinac iX. A-Si1000 (Varian medical systems) calibrated for hardware and dosimetric purpose for different energies and various dose rates. The active area of EPID consists in a matrix of 1024 X 768 for 40 X 30 $cm^2$ at source to detector distance (SDD) of 100 cm. The different QA test patters for dMLC provided by Varian such as picket fence test, pyramid test, complex tests, Synchronized Segmented Stripes test, Non Synchronized Segmented Stripes test, X Wedges Y Wedge, Continuous strip test were performed.

## RESULTS

The MLC transmission factor is the ratio of meter reading obtained for the closed MLC field to the meter reading obtained for the open field. The mean reading of the MLC transmission factor of the two banks of MLC was taken to be the MLC transmission factor. The tabulated values were shown **Table 1**.

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**Table 1.** MLC transmission.

| Energy | $R_{open}$ | $R_{T,A}$ | $R_{T,B}$ | $R_{closed}$ | MLC Transmission (%) |
|---|---|---|---|---|---|
| 6 MV | 16.40 | 0.24 | 0.24 | 0.24 | 1.46 |
| 10 MV | 18.27 | 0.30 | 0.31 | 0.305 | 1.67 |

The average leaf transmission was found to be 1.46%, 1.67% for 6 and 10 MV respectively; Dosimetric leaf gap obtained from the graph is found to be 1.3 and 1.4 mm for 6 and 10 MV respectively **Figures 1-4**. Various dMLC tests patters for IMRT and Rapid arc were measured using EPID and therapy verification films.

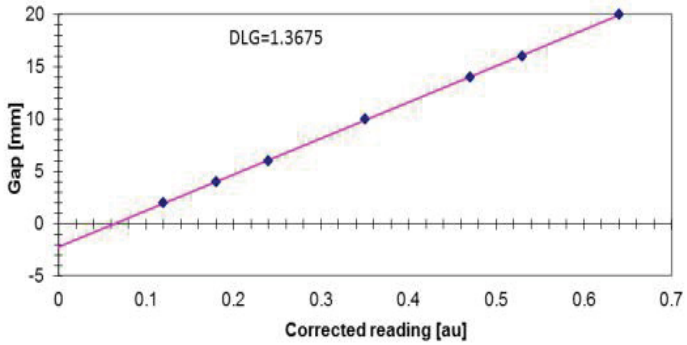


**Figure 1.** Measurement of DLG Clinac iX for 6 MV photon.

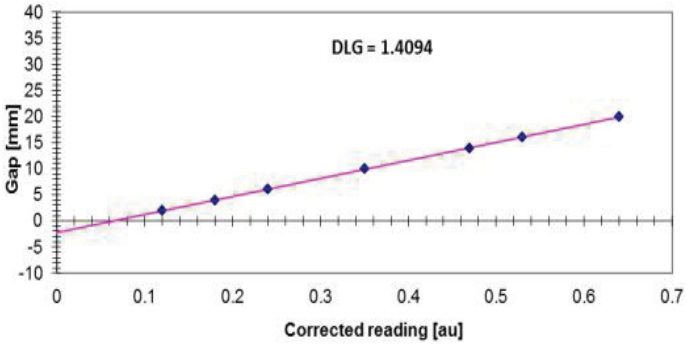


**Figure 2.** Measurement of DLG Clinac iX for 10 MV photon.

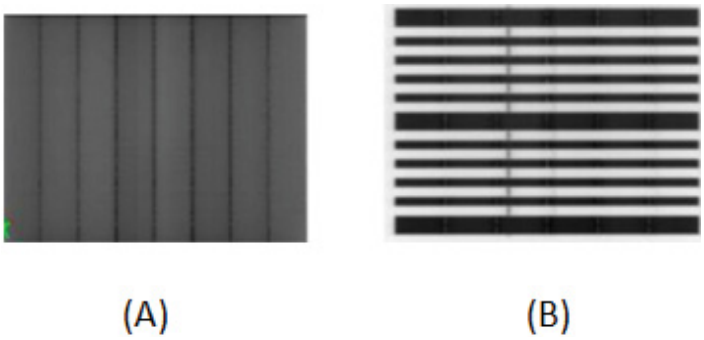


**Figure 3.** A) Picket Fence Test B) Synchronized Segmented Stripes Test.

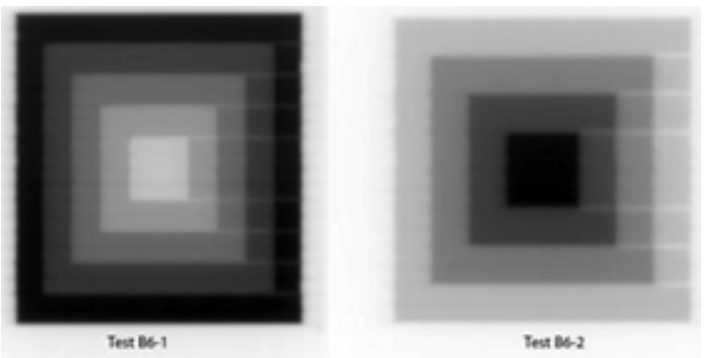


**Figure 4.** Pyramid.

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The match lines of picket fence test found to be at -15.0 ± 0.1; -10.0 ± 0.1; -5.0 ± 0.1; 0.0 ± 0.1; 5.0 ± 0.1; 10.0 ± 0.1; 15.0 ± 0.1 from the center of the field. The match lines of synchronized segmented stripes test appear at -12.0 ± 0.1 cm; -8.0 ± 0.1 cm; -4.0 ± 0.1 cm; 0.0 ± 0.1 cm; 4.0 ± 0.1 cm; 8.0 ± 0.1 cm; 12.0 ± 0.1 cm from the center of the field. The match lines of Non Synchronized Segmented Stripes test found to be -4.0 ± 0.1 cm; -2.0 ± 0.1 cm; 0.0 ± 0.1 cm; 2.0 ± 0.1 cm and 4.0 ± 0.1 cm from the center of the field. The match lines of X-wedge and Y wedge tests segments appeared as -4.0 ± 0.1 cm; -2.0 ± 0.1 cm; 0.0 ± 0.1 cm; 2.0 ± 0.1 cm and 4.0 ± 0.1 cm from the center of the field the match line segments of pyramid test found to at -4.0 ± 0.1 cm; -3.0 ± 0.1 cm; -2.0 ± 0.1 cm; -1.0 ± 0.1 cm; 0.0 ± 0.1 cm; 1.0 ± 0.1 cm; 2.0 ± 0.1 cm; 3.0 ± 0.1 cm; 4.0 ± 0.1 cm from the center of the field. All the match lines found to be less than 5 mm, so the QA result indicates that MLC opening is operating properly. All results are found to be within the tolerance limit.

## CONCLUSION

An initial attempt for commissioning of dMLC has been performed, and the dosimetric parameters of MLCs of such as MLC transmission factor and dosimetric leaf gap (DLG) are used to be modeled in TPS algorithm. All the dynamic MLC test patterns for IMRT and Rapid arc results are shown to be within acceptable limit. It can be concluded that the dosimetric properties of the MLCs can be precisely controlled and hence can be used for IMRT and Rapid Arc techniques.

## REFERENCES

1. Sajeev S, et al. Dynamic MLC-QA Based On Portal Dosimetry. J Eng Res App 2014;4:134-137.
2. Varian. DMLC QA test patterns and procedures.