Impact of the Enhanced Leaf Model in Eclipse v18.1 Compared with the Simple Leaf Model in Eclipse v15.6

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ABSTRACT

Accurate multileaf collimator (MLC) modeling is essential to ensure dosimetric accuracy in modern radiotherapy. This study evaluated the performance of the Enhanced Leaf Model (ELM) implemented in Eclipse v18.1 compared with the Simple Leaf Model (SLM) available in Eclipse v15.6. Validation was performed using standard IMRT test patterns and TG-119 clinical cases on a Novalis TX linear accelerator. Treatment plans were verified using Portal Dosimetry, the Delta4 phantom, and independent dose calculations with PRIMO and RadCalc.

Results demonstrated improved agreement between calculated and measured doses when using the ELM. Gamma passing rates exceeded 90% for IMRT test patterns and 95% for TG-119 cases evaluated with Delta4 and PRIMO. Independent calculations further confirmed the superior performance of the new model.

These findings indicate that the Enhanced Leaf Model provides a more accurate representation of MLC behavior, contributing to improved treatment planning accuracy and verification of complex radiotherapy treatments.

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INTRODUCTION

Multileaf collimators (MLCs) are essential components of modern radiotherapy, enabling beam shaping and modulation to optimize dose distribution within the target volume while minimizing irradiation of surrounding healthy tissues. Since MLC modeling directly affects dosimetric accuracy, its proper representation within the Treatment Planning System (TPS) is crucial for safe and effective treatments.

The Enhanced Leaf Model (ELM), introduced in Eclipse v18.1, aims to provide a more realistic representation of MLC behavior compared with the Simple Leaf Model (SLM) used in previous versions. This study compares the performance of both models using standard IMRT test patterns, TG-119 clinical cases, and different dosimetric verification tools to assess their impact on treatment planning accuracy.

METHODS AND MATERIALS

The Dosimetric Leaf Gap (DLG) was experimentally determined following the manufacturer's recommendations described in the Enhanced Leaf Modeling Measurement Procedure Guide, using a Novalis TX linear accelerator equipped with a high-resolution multileaf collimator and 6X, 10X, 6X FFF, and 10X FFF photon beams. DLG measurements were performed using a Farmer ionization chamber (SN 6725) and a PTW Semiflex 3D ionization chamber (SN 14147). Dosimetric comparison was carried out using standard IMRT test patterns consisting of fixed fields with different fluence modulations, including chair, wedge, peaks, pyramid, and open field patterns. In addition, the four clinical cases from the TG-119 protocol [1] were evaluated in heterogeneous phantoms. Plan verification was performed using Portal Dosimetry and the Delta4 phantom (ScandiDos) , complemented by independent dose calculations with RadCalc v7.3 and PRIMO (Monte Carlo 3D dose calculation software.

RESULTS

The Enhanced Leaf Model (ELM) implemented in Eclipse v18.1 demonstrated improved dosimetric performance compared with the Simple Leaf Model (SLM) in Eclipse v15.6 across all evaluated configurations. Analysis of the standard IMRT test patterns using portal dosimetry yielded gamma passing rates consistently above 90% using a 3%/2 mm criterion with a 10% threshold [Table 1, chart 1], indicating accurate modeling of the different fluence modulation patterns.

The evaluation of the TG-119 clinical cases allowed assessment of both models under more complex and clinically relevant scenarios. Verifications performed with the Delta4 phantom and independent calculations using PRIMO achieved gamma passing rates above 95%, demonstrating excellent agreement between the planned and measured or simulated dose distributions. Independent dose calculations performed with RadCalc v7.3 also showed passing rates exceeding 90% under the same evaluation criteria [Table 2, 3, 4, chart 2].

Table 1. Portal dosimetry with global gamma analysis 3%2mm, th10% for standard IMRT patterns. Energy of 6X,10X, 6X FFF and 10x FFF.

	6X	10X	6X FFF	10X FFF
Wedge	100.0	98.6	100.0	100.0
Peaks	97.7	99.3	93.1	99.3
Pyramid	99.9	99.9	99.3	100.0
Valley	100.0	99.3	100.0	100.0
Chair	97.2	100.0	96.3	99.9
Open field	100.0	98.7	100	100.0

Chart 1. Portal dosimetry with global gamma analysis 3%2mm, th10% for standard IMRT patterns. Energy of 6X,10X, 6X FFF and 10x FFF.

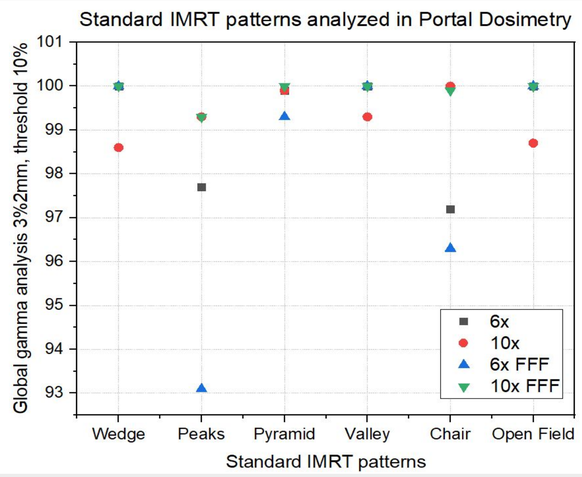


Table 2. Clinical plans of TG-119 with global gamma analysis 3%2 mm in Delta 4, Radcalc and Primo, 6X energy.

6X			
	Delta4	Radcalc	Primo
C1	100.0	99.6	98.9
C2	98.8	98.1	97.8
C3	100.0	98.1	99.9
C4	100.0	99.7	99.9

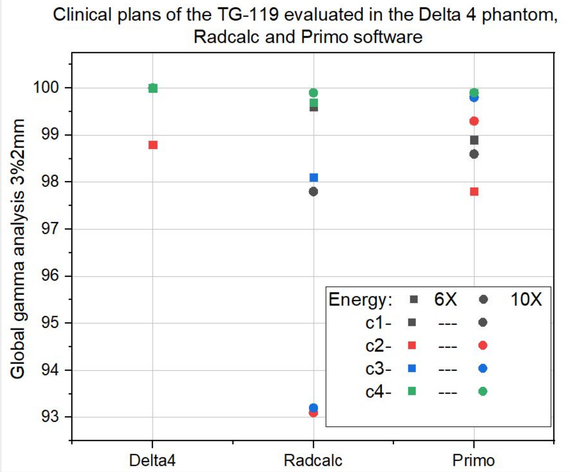
Table 3. Clinical plans of TG-119 with global gamma analysis 3%2 mm in Delta 4, Radcalc and Primo, 10X energy.

10X			
	Delta4	Radcalc	Primo
C1	100.0	97.8	98.6
C2	100.0	93.1	99.3
C3	100.0	93.2	99.8
C4	100.0	99.9	99.9

Table 4. Clinical plans of TG-119 with global gamma analysis 3%2 mm in Delta 4, Radcalc and Primo, energy of 6X FFF and 10X FFF.

	6XFFF		10X FFF	
	Delta4	Radcalc	Delta4	Radcalc
C1	98.9	95.7	99.5	94.3
C2	99.4	93.1	98.0	95.7
C3	98.6	96.3	99.4	97.1
C4	100.0	98.0	100.0	99.7

Chart 2. Clinical plans of TG-119 with global gamma analysis 3%2 mm in Delta 4, Radcalc and Primo, energy of 6X, and 10X.



DISCUSSION

Overall, the results indicate that the ELM provides a more accurate representation of multileaf collimator behavior, improving the agreement between planned and delivered dose distributions. This improvement was consistently observed in both test patterns and clinical cases, supporting the implementation of the new model for clinical applications requiring high dosimetric accuracy.

CONCLUSIONS

The Enhanced Leaf Model implemented in Eclipse v18.1 demonstrated superior dosimetric performance compared with the Simple Leaf Model available in Eclipse v15.6. Verification using TG-119 test cases, portal dosimetry, the Delta4 phantom, and independent dose calculations with PRIMO and RadCalc showed improved agreement between planned and measured dose distributions. These findings support a more accurate representation of multileaf collimator behavior and reinforce the clinical implementation of the Enhanced Leaf Model for advanced radiotherapy treatment planning.

REFERENCES

1. Ezzell, GA, Burmeister, JW, Dogan, N., LoSasso, TJ, Mechalakos, JG, Mihailidis, D., Molineu, A., Palta, JR, Ramsey, CR, Salter, BJ, Shi, J., Xia, P., Yue, NJ y Xiao, Y. (2009), Puesta en marcha de IMRT: Comparaciones de planificación y dosimetría en Múltiples instituciones, informe del Grupo de Trabajo 119 de la AAPM. Medicina. Phys., 36: 5359-5373. https://doi.org/10.1118/1.3238104.

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