Efficient Delivery of MLC-based Grid Therapy Using a Flattening Filter Free Beam

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Objectives

- It has been shown:
  - Grid Therapy is a simple yet viable option for treating large, bulky and unresponsive tumors
  - MLC-based grid therapy holds a greater risk of intrafraction motion
- This study aims to reduce the treatment time by utilizing a high dose rate flattening filter free (FFF) beam on the Varian TrueBeam treatment machine, while maintaining comparable plan quality with regular MLC based grid therapy.

Methods

- 5 patients with bulky tumors were selected.
- Two MLC based grid therapy plans were created for each patient: a FFF 10x treatment plan manually flattened with a field in field (FiF) technique and a flattened 10x treatment plan

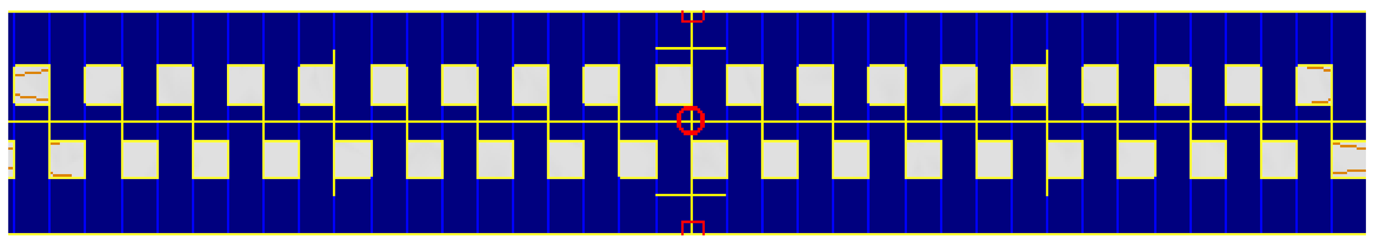


Figure 1: Beam-eys's View (BEV) of grid pattern formed by multi-leaf collimator (MLC)

- The grid sizes were 1 cm x 1 cm with 1 cm spacing
- The maximum dose rates were 2400 MU/min for FFF beam and 600 MU/min for flattened beam
- All treatment plans were prescribed to have a peak dose of at least 15 Gy
- Treatment plans were created for treatment sites including head and neck, breast, and extremity
- The treatment plans were created in the Eclipse Treatment Planning System and delivered on a Varian Truebeam System with Millennium 120 MLC

Results

- The average increase in MU for FFF plans was about 36%
- The average beam on time for FFF plans was about 66% less than flat beam plans
- Preliminary data from the 5 cases revealed that the FFF plans were more efficient at delivering MLC-based grid therapy
- The valley to peak ratio was 11% and 15% for the FFF plans and flat beam plans respectively

Table 1: Summary of the percentage increase in monitor units (MU), the decrease in beam-on time (min) and the comparison of the maximum dose

Patient	MU			Beam-on time (min)			Max dose (Gy)	
	FFF	Flat	% increase	FFF	Flat	% decease	FFF	Flat
Case 1	5476	4171	31.3 %	2.3	7.0	-67.2 %	19.2	17.4
Case 2	2053	2064	-0.5 %	0.9	3.4	-75.1 %	17.7	16.4
Case 3	11223	7778	44.3 %	4.7	13	-63.9 %	19.4	17.9
Case 4	5686	3912	45.3 %	2.4	6.5	-63.7 %	19.3	18
Case 5	9384	5953	57.6 %	3.9	9.9	-60.6 %	18.6	19.1
Average	6764	4776	35.6 %	2.8	8.0	-66.1 %	18.8	17.8
Std. Dev.	3597	2172	22.3 %	1.5	3.6	5.6 %	0.7	1.0

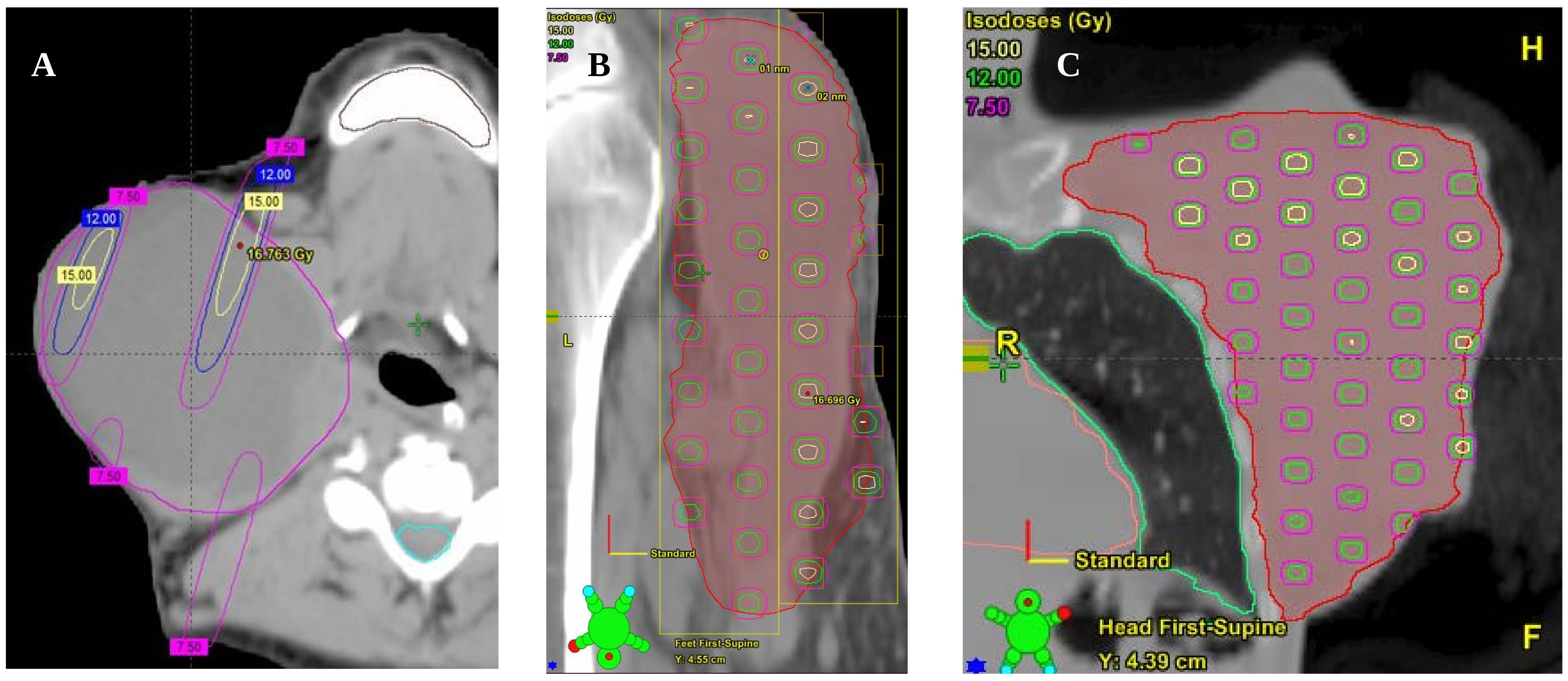
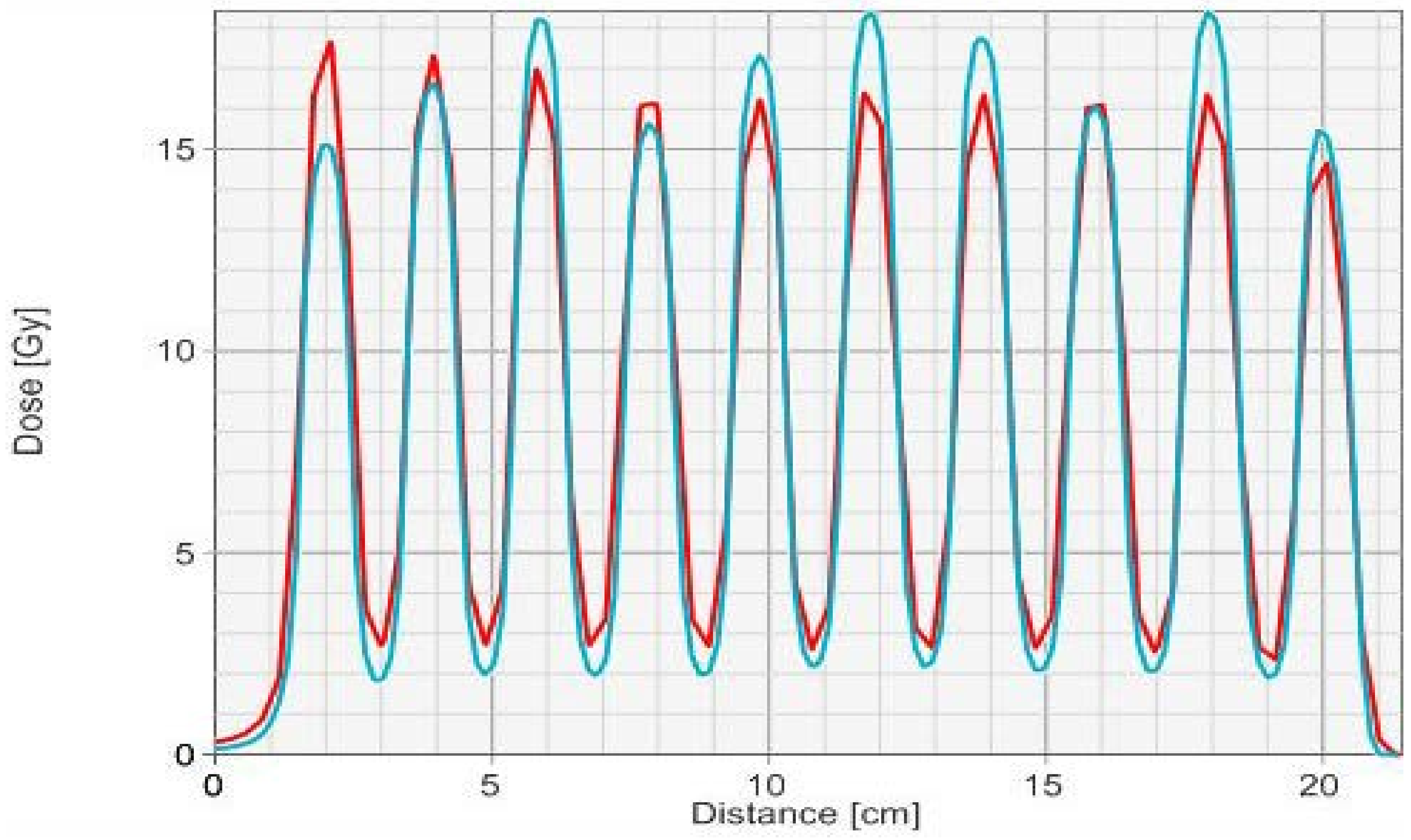


Figure 2: Examples of dose distribution: **A**: Head & neck; **B**: Left leg sarcoma; **C**: Left fungating breast mass

Figure 3: The dose profiles of the FFF plan and flattened plan from figure **2B**

Flat beam dose profile
FFF beam dose profile



Conclusions

Based on these preliminary results,

- Using FFF beams for MLC-based grid therapy can significantly reduce beam on time
- More efficient treatment delivery can potentially reduce the risk of intrafraction motion and increase patient satisfaction

References:

1. G. Neuner, M.M. Mohiuddin, N.V. Walde, *et al*, High-dose Spatially Fractionated Grid Radiation Therapy (SFGRT): A Comparison of Treatment Outcomes with Cerrobend VS. MLC SFGRT Int. J. Radiation Oncology Biol. Phys 82, 5, 1642-1649 (2012)
2. M. Mohiuddin, H. Park, Spatially Fractionated GRID Radiation Therapy (SFGRT) Using a Brass Collimator. AAMD webinar 2013