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**MEDICAL CENTER**

# Understanding Variations in Dose Fall-off for Low Energy Electrons vs. Mid and High Energies in Presence of Different Cutouts at Different SSDs'.

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## Introduction

Majority of electron treatments are setup clinically with physicians palpating the tumor site and drawing a PTV that encompasses typically ~1cm margin for the electron block. Prescription is written based on percent depth dose (PDD) curves and desired isodose line for a satisfactory depth coverage. We evaluate variations in dose fall-off at the field edge as a function of energy, block size and SSD to ensure adequate target coverage in the treatment of smaller and more superficial lesions.

## AIMs

1. Show that dose fall off is sharper with addition of block, especially for smaller applicators
2. Show dose fall off varies with different SSD.
3. Define suitable margin for electron beams especially for small fields.

## Methods

Profiles for both open and block applicators were acquired at reference depth from a Varian TrueBeam Linac for 6, 9, 12, 16 and 20MeV electron beams using a 3D water tank (IBA Blue phantom2). Open field sizes of 6, 10, and 25cm<sup>2</sup> were used for SSDs of 100, 105 and 110cm. Then profiles were acquired for blocked fields of 4, 8, and 20cm<sup>2</sup> respectively. Gafchromic EBT3 films calibrated with 6MV beam, 10x10 cm<sup>2</sup> field size at SSD=100cm in a solid water phantom were used. Films were scanned by multichannel scanner (EPSON Expression 10000 XL) and raw images of irradiated films were imported from the scanning system into the RIT (Radiological Imaging Technology, Inc.), for further image processing and analysis.

## Result

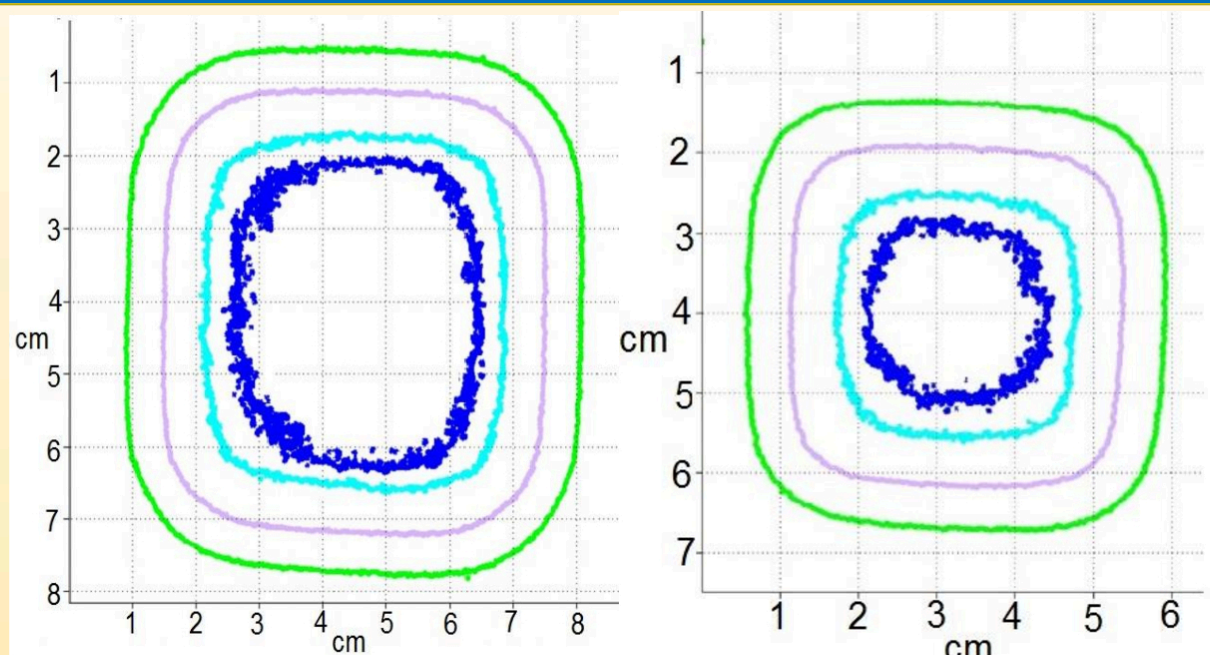


Figure.1. Isodose distribution for applicator 6x6-Open (left) vs blocked (4x4) (right). Film Isodose lines: 90% (dark blue), 80%, 50%, 20%, SSD=100 cm from EBT3 Gafchromic film.

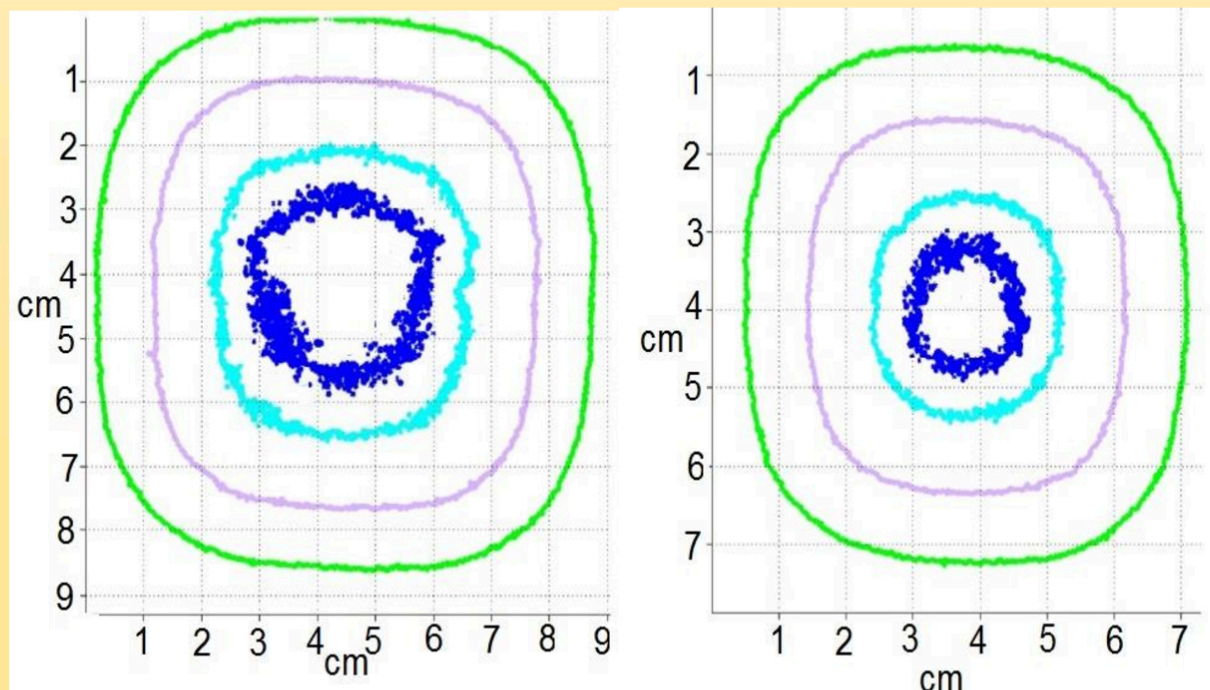


Figure.2. Isodose distribution for applicator 6x6-Open (left) vs blocked (4x4) (right). Film Isodose lines: 90% (dark blue), 80%, 50%, 20, SSD=110 cm from EBT3 Gafchromic film.

Energy			Applicator6x6	Applicator10x10	Applicator25x25
	SSD (cm)	Block	Distance from edge of the field to 95% (cm)	Distance from edge of the field to 95% (cm)	Distance from edge of the field to 95% (cm)
6MeV	100	0	1.33	1.44	1.54
		2 cm	1.09	1.26	1.28
	105	0	1.57	1.77	2.59
		2 cm	1.34	1.61	1.99
	110	0	1.875	2.17	2.75
		2 cm	1.575	1.98	2.22
9MeV	100	0	1.42	1.32	1.48
		2 cm	1.17	1.35	1.35
	105	0	1.55	1.35	1.82
		2 cm	1.35	1.57	1.74
	110	0	1.74	1.81	2.18
		2 cm	1.54	1.85	1.97
12MeV	100	0	1.53	1.69	1.53
		2 cm	1.25	1.59	1.48
	105	0	1.73	1.96	1.84
		2 cm	1.38	1.82	1.69
	110	0	1.84	2.17	1.95
		2 cm	1.52	2.04	1.81
16MeV	100	0	1.41	1.75	1.62
		2 cm	1.3	1.62	1.52
	105	0	1.47	1.93	1.75
		2 cm	1.37	1.81	1.67
	110	0	1.71	2.04	1.88
		2 cm	1.5	1.97	1.83
20MeV	100	0	1.69	1.8	1.73
		2 cm	1.43	1.77	1.66
	105	0	1.76	2.01	1.96
		2 cm	1.47	1.96	1.8
	110	0	1.84	2.06	2.05
		2 cm	1.59	2.01	2.02

Table1. Distances from edge of the field to 95% isodose line. Data obtained from water tank scanned profiles for different energies and applicator 6x6, 10x10 and 25x25 with and without blocks.

Measuring the distance between 50% (geometric field edge) and 95% isodose lines for each profile, marked differences were observed with addition of blocks as a function of field size, energy, and SSD. For example, for the 6x6 applicator, the 95% isodose line located 1.33cm from the field edge, shifted to 1.1cm when a 2cm block was inserted, resulting in 19.8% difference in target margin. Larger SSD's dictate larger distances from the edge to achieve 95% coverage, as evident from comparison of isodose distributions in figure1 (SSD=100 cm) and figure2 (SSD=110 cm). The complete list of data obtained from water scanned profiles for different SSDs and applicator sets of 6x6, 10x10 and 25x25 with and without block are shown in Table1.

## Conclusion

Caution is advised in determining margins for blocked fields in treatment of small lesions. Following the rule of thumb of 1cm margin around GTV to define the block size, which is prevalent in clinical electron setups, may not result in 95% PTV coverage of the distal edge. In most cases 1.5cm margin ensures better PTV coverage, and 2cm margin is more appropriate for extended SSD's.

## References

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