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Penumbra Measurements in Water and Lung Materials

Penumbra measurements have been made in solid water and solid lung equivalent material using ion chamber (2 mm radius), diodes, film on a Varian 2100 EX with a 120 multileaf collimator (MLC). Penumbra measurements were made for the adjustable collimator and the MLC at the depths of maximum dose, 10 cm, and 20 cm for 6 MV and 18 MV photon beams for 5 cm x 5 cm and 10 cm x 10 cm field sizes. In addition to classic penumbra measurements, the same data was used to establish the 90% to 50% distance, which is used to approximate the distance to the beam edge required to treat the PTV.

As expected, the measured penumbra is a function of the measurement technique, the field size, the depth, the material, and the photon energy. For example, the following data is for the 10 cm x 10 cm field size at 10 cm depth with the MLC in solid water and lung equivalent material:

Method	Solid Water		Lung Equivalent Material	
	Penumbra 6 MV	Penumbra 18 MV	Penumbra 6 MV	Penumbra 18 MV
Chamber	8.9 mm	9.4 mm		
Diode	5.6 mm	7.2 mm		
Film	5.1 mm	6.6 mm	9.4 mm	14.9 mm

Penumbra and beam edge data will be presented in detail. The distance to the block edge may be significantly greater in low density material (lung) than is generally appreciated.