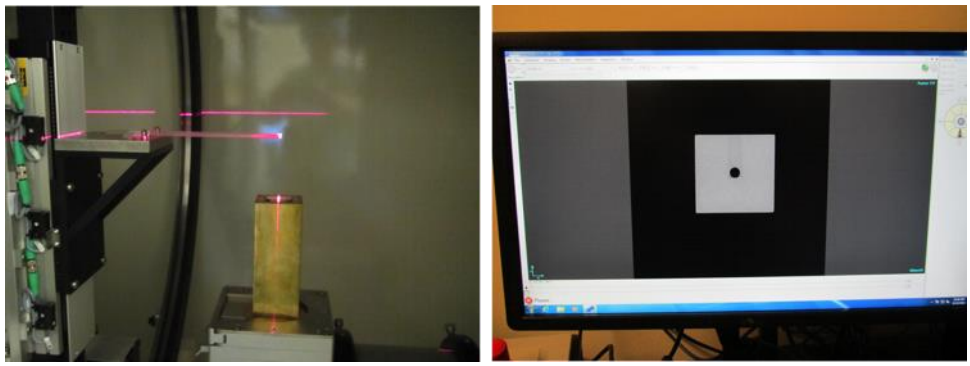
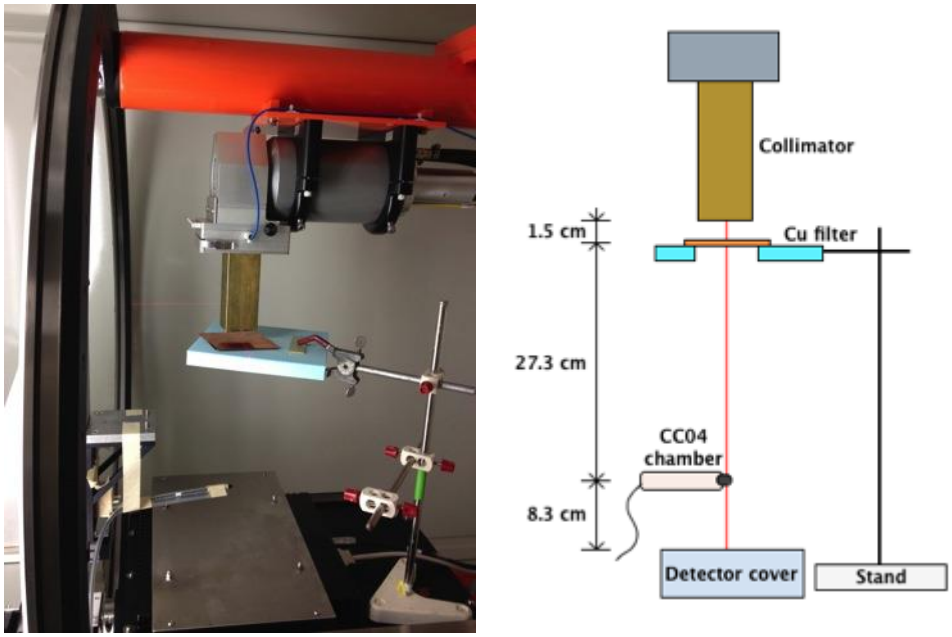
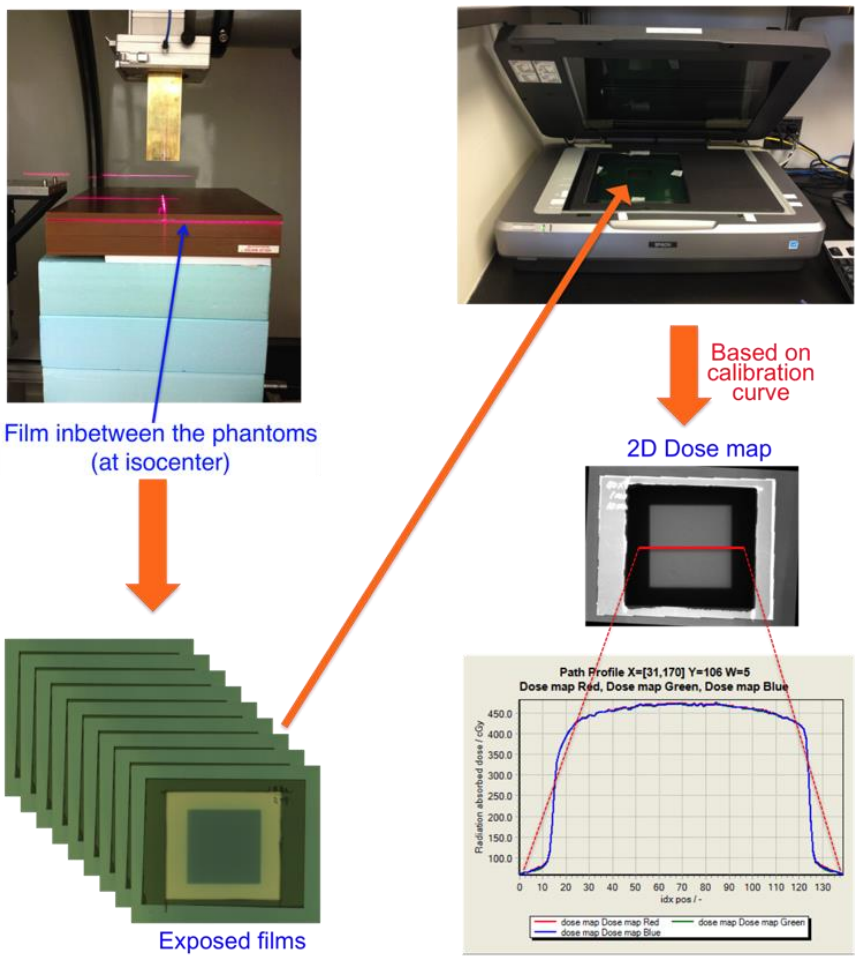
Supplementary materials



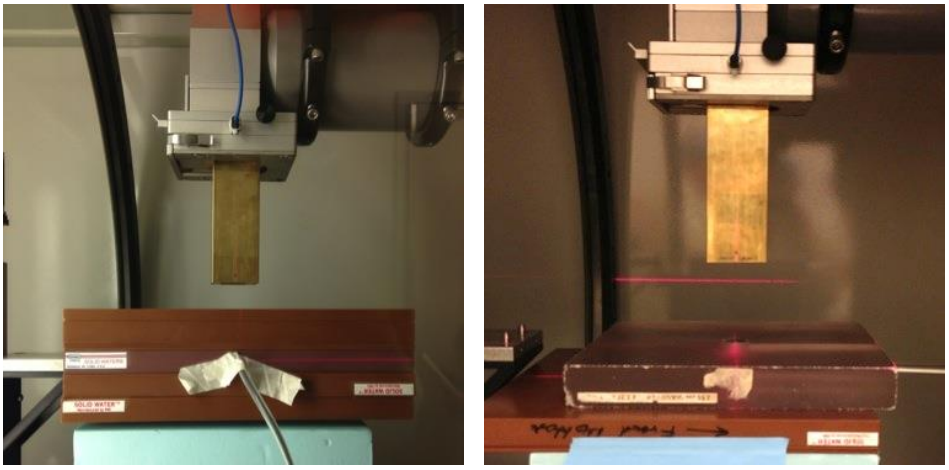
Supplemental figure 1. Verification of laser-based isocenter using fluoroscopic image of a 'BB' with 40×40 mm^2 collimator during gantry rotation.



Supplemental figure 2. Geometric setting for half value layer (HVL) measurement.

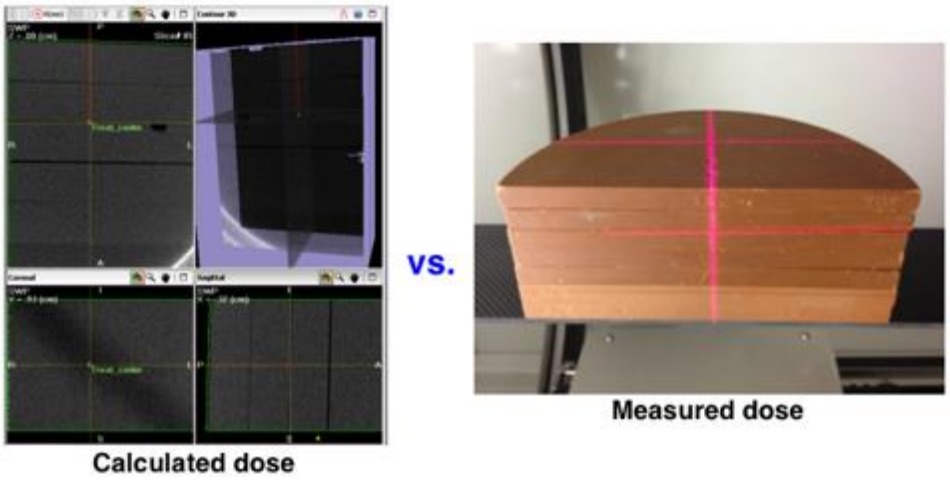


Supplemental figure 3. EBT3 film dosimetry procedure for beam commissioning.

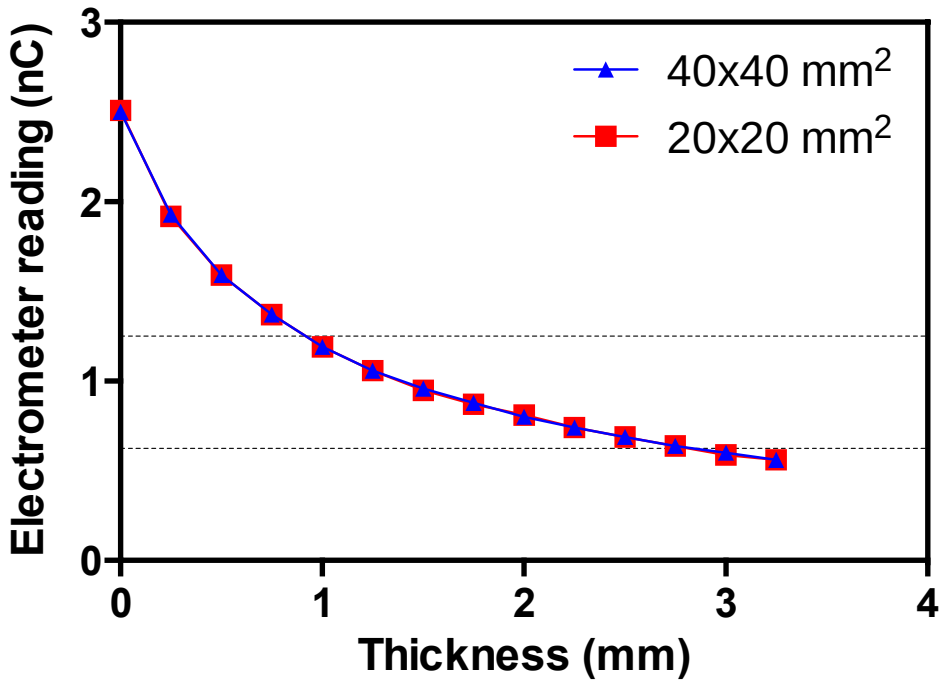


(a) **(b)**

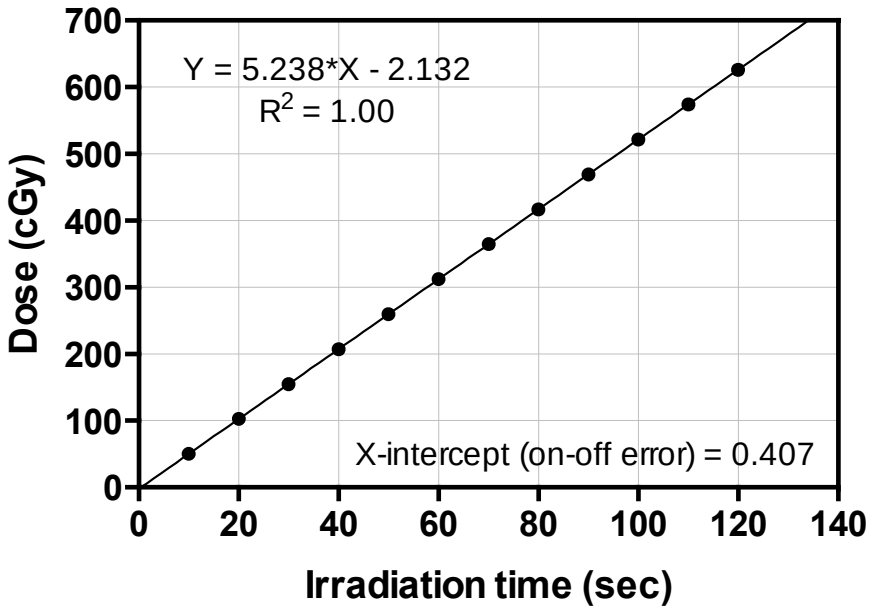
Supplemental figure 4. Two different ion-chamber measurements for absorbed dose at the isocenter for various depths: (a) the CC04 chamber inside the solid-water phantom and (b) the parallel-plate chamber at the surface in the polystyrene phantom.



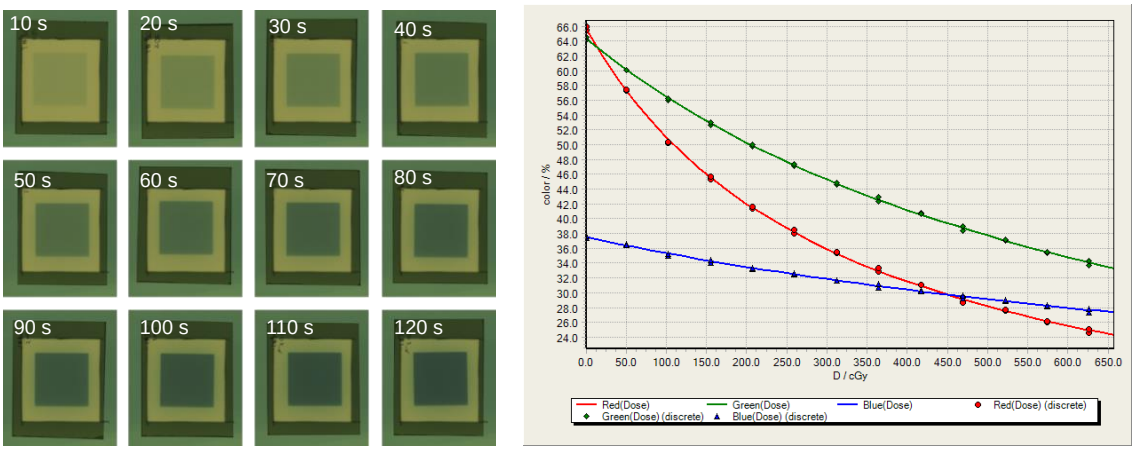
Supplemental figure 5. Verification of dose calculation in Metropolis. The calculated dose was compared with the dose measured with EBT3 film in a solid-water phantom.



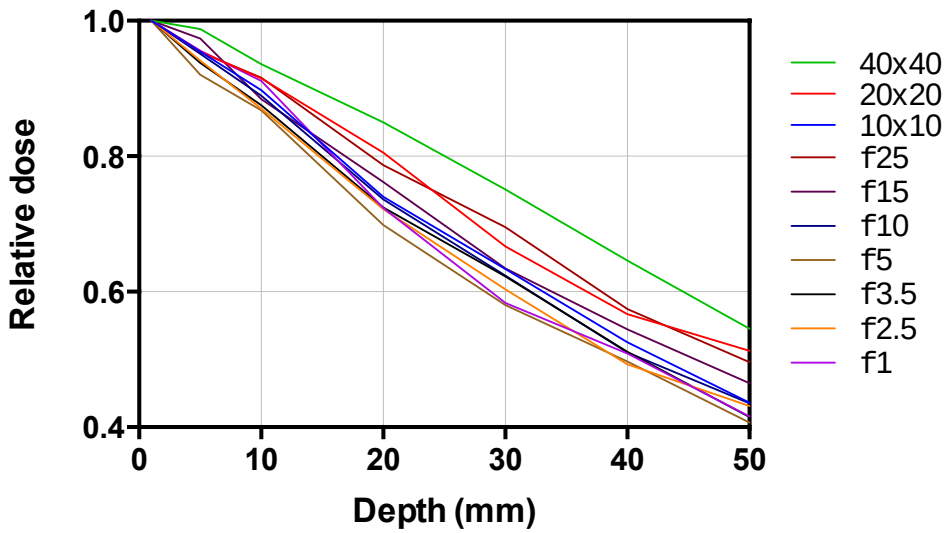
Supplemental figure 6. Half-value layer (HVL) plot for two different square collimators (40×40 mm^2 and 20×20 mm^2).



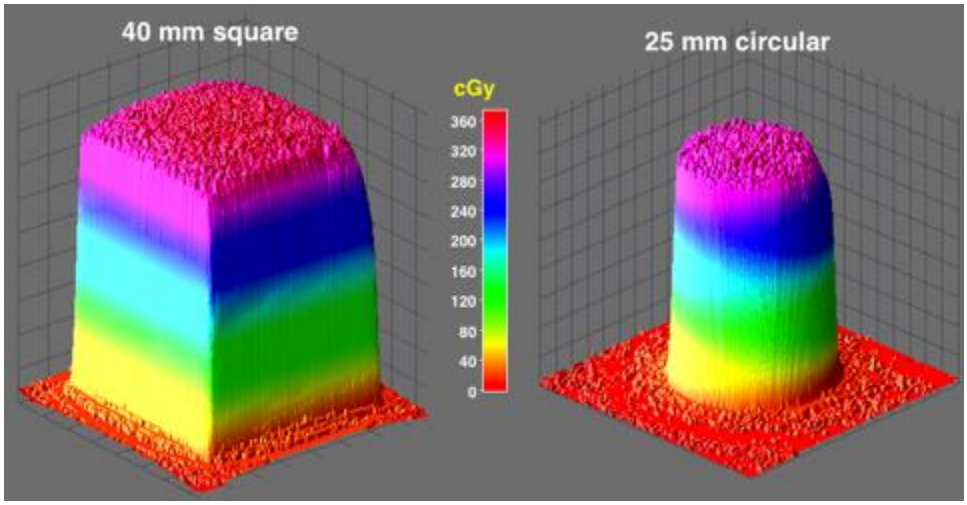
Supplemental figure 7. Absorbed dose measured with the CC04 chamber at 2cm depth of solid water phantom for different timer settings.



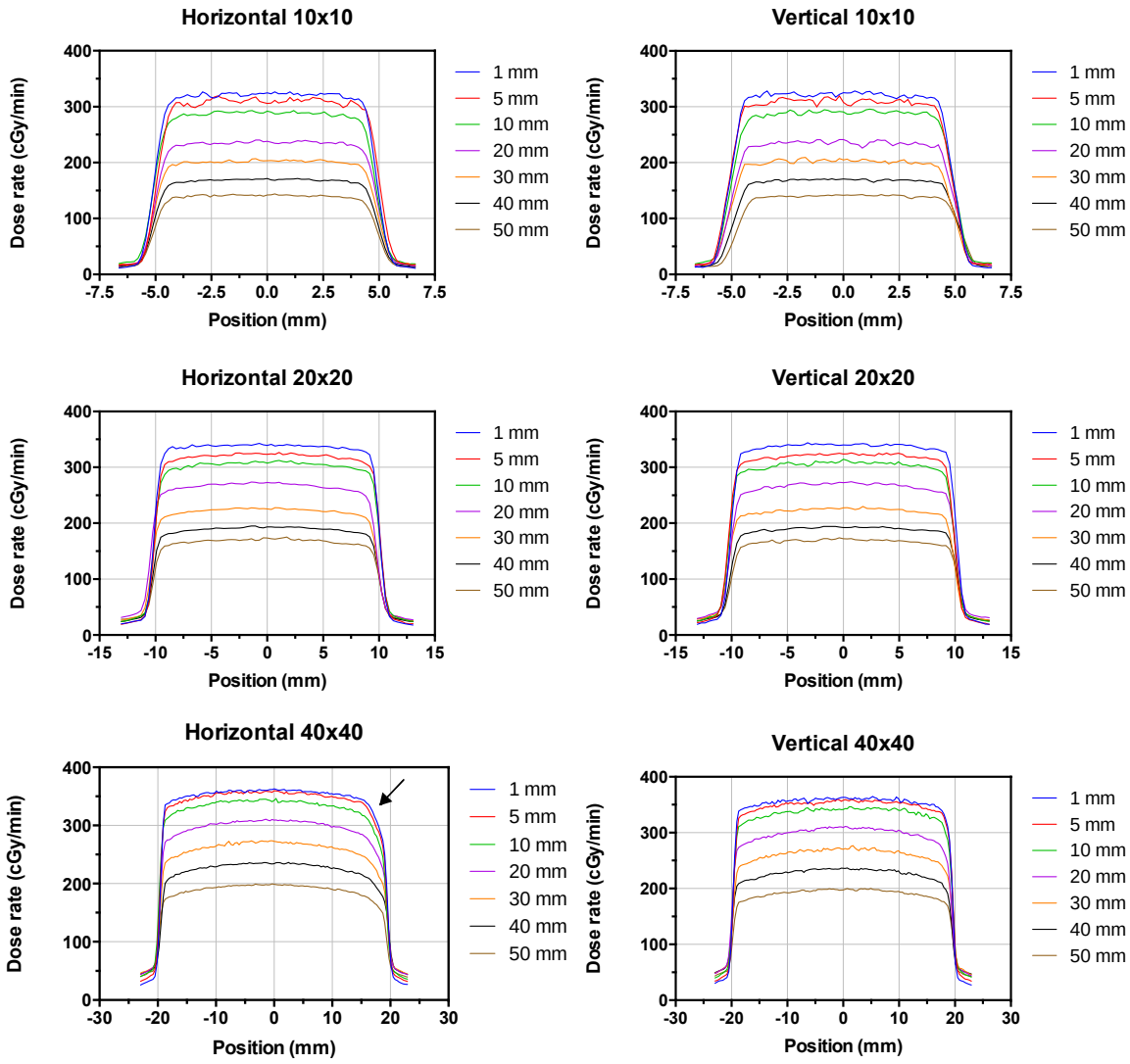
Supplemental figure 8. Calibration set of films and calibration curve for the EBT3 film.



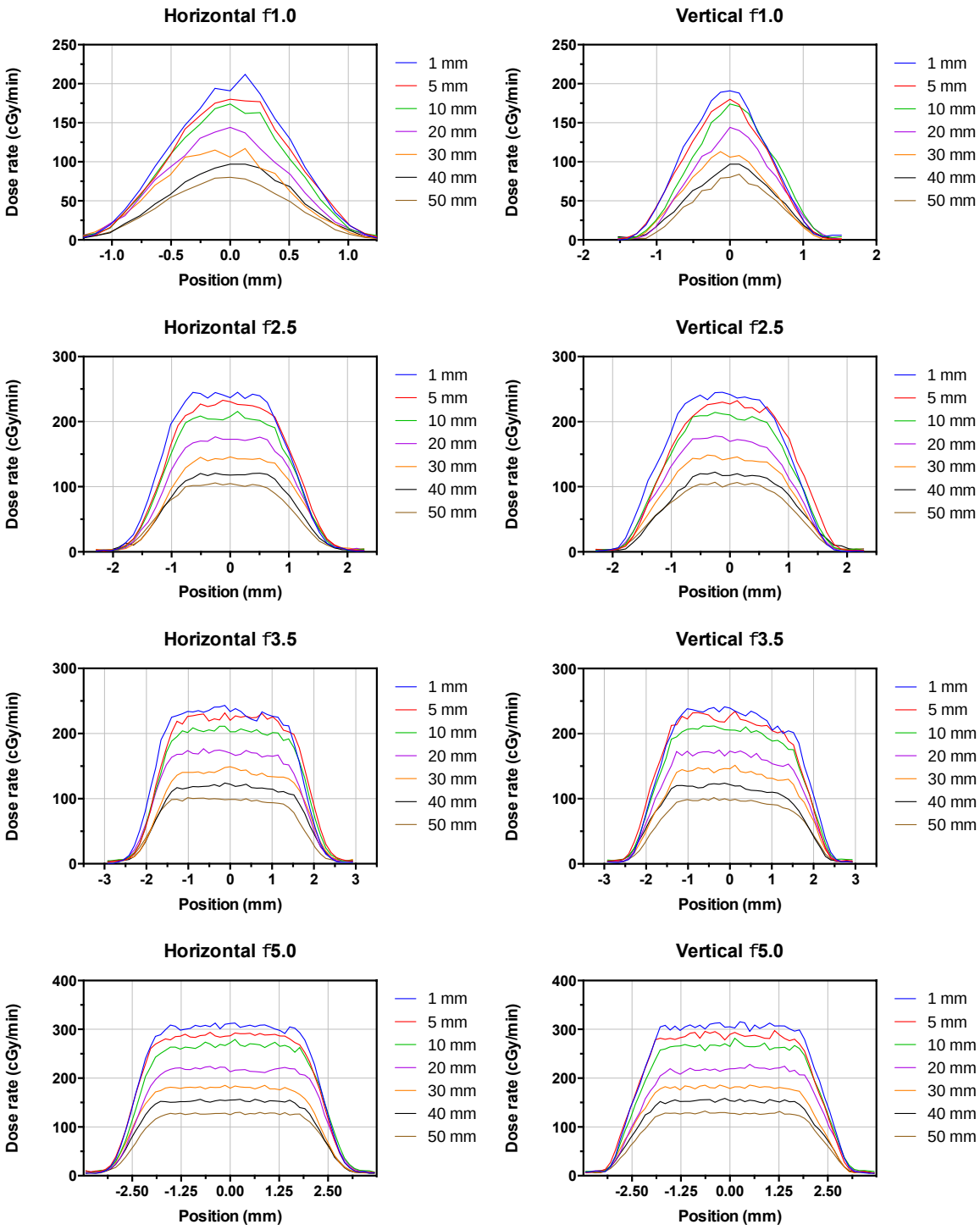
Supplemental figure 9. Depth doses relative to the maximum dose (1-mm) for each collimator. The dose decreased more rapidly with increasing depth for smaller collimators, due to less scatter. The symbol "ϕ" refers to the diameter of circular collimators.



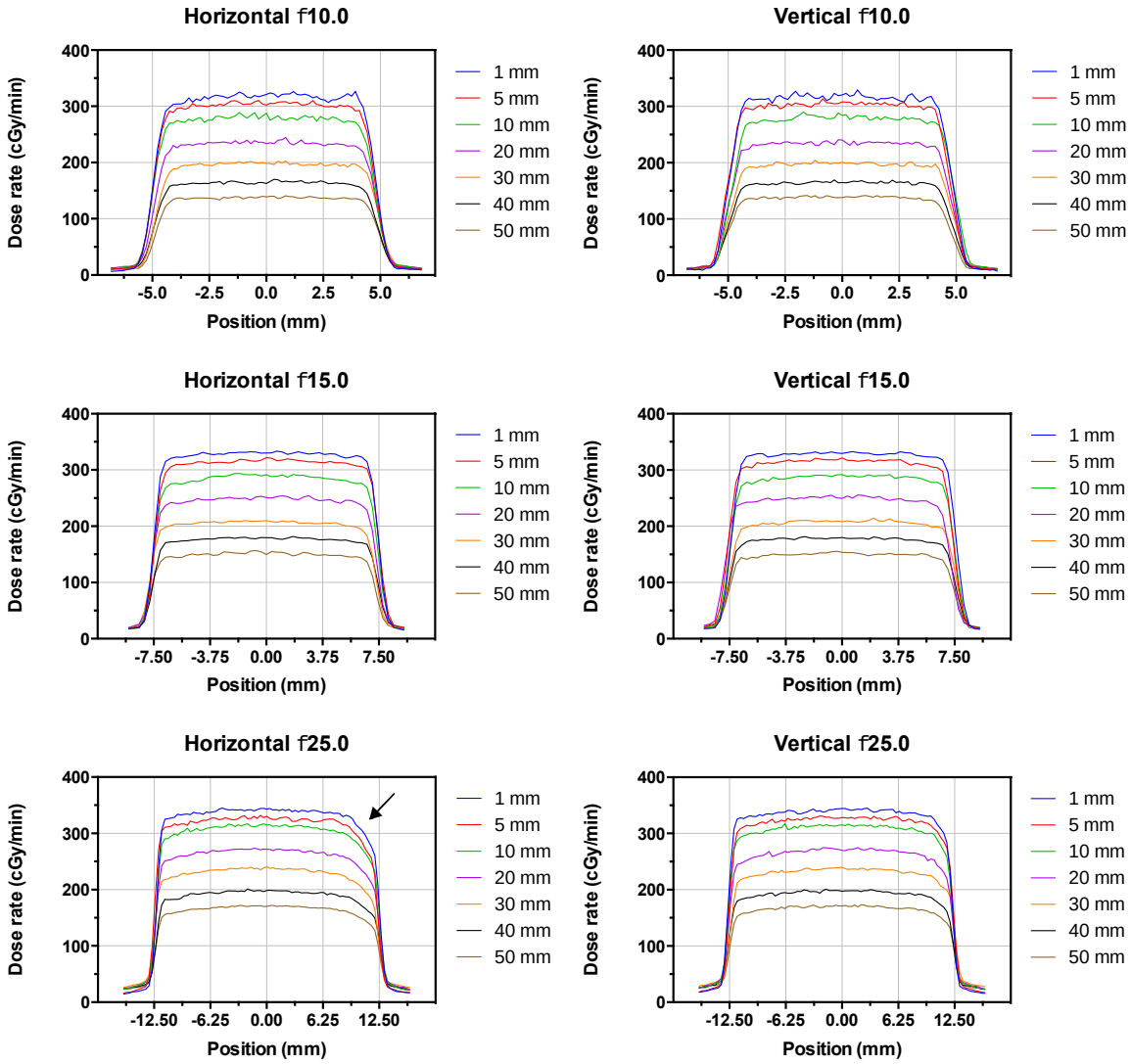
Supplemental figure 10. Examples of 2D dose map plots for the 40x40 mm^2 square collimator and a ϕ25mm circular collimator at a depth of 1mm.



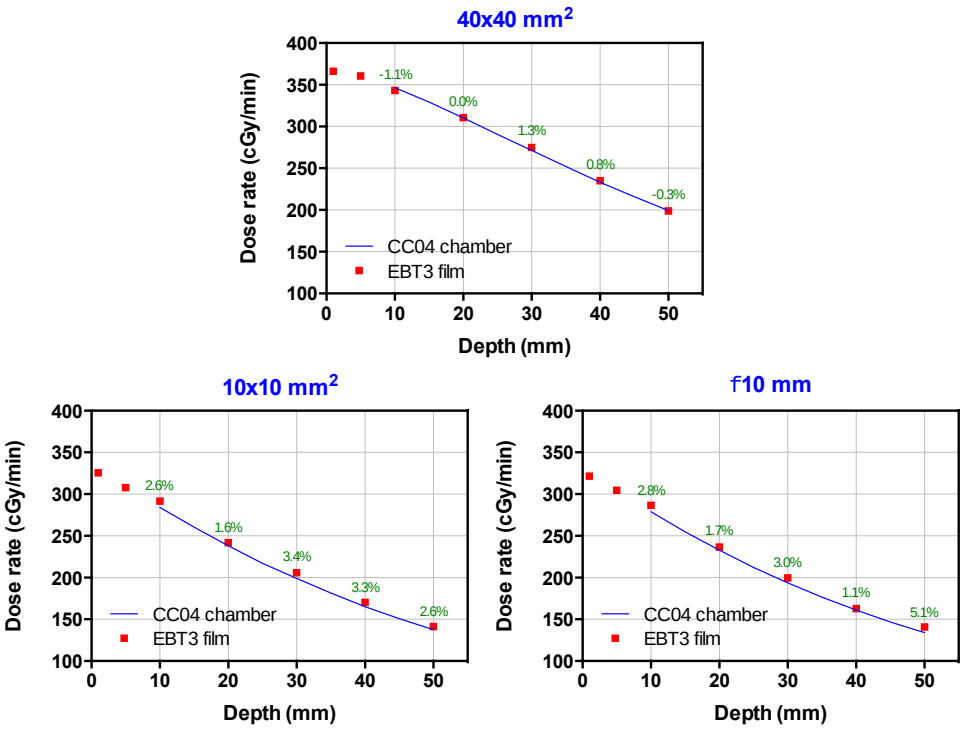
Supplemental figure 11. Horizontal (left column) and vertical (right column) dose rate profiles for three square collimators. Arrow indicates location of asymmetry in the horizontal profiles for the largest collimator with field size of 40×40 mm^2.



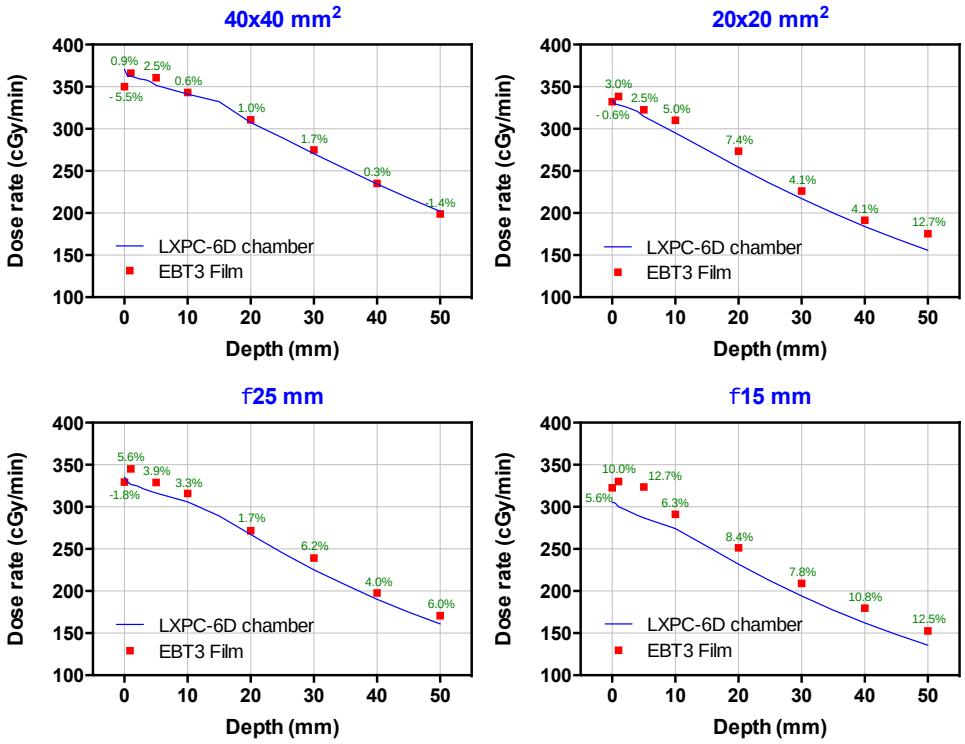
Supplemental figure 12. Horizontal (left column) and vertical (right column) profiles for circular collimators with diameter of 1.0, 2.5, 3.5, and 5.0 mm.



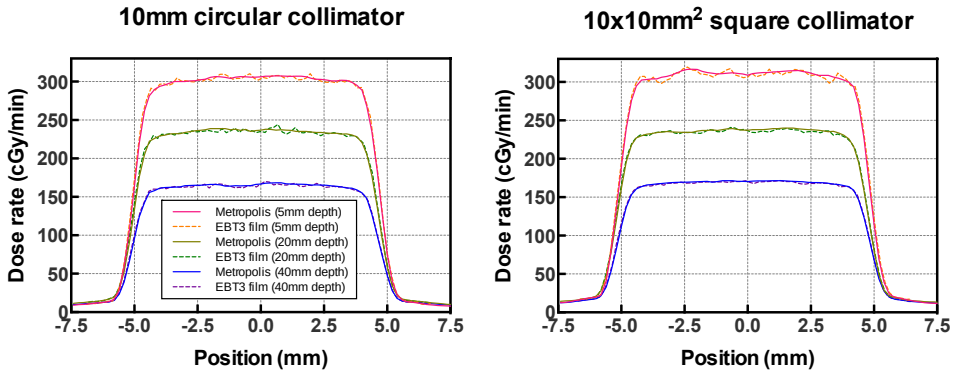
Supplemental figure 13. Horizontal (left column) and vertical (right column) profiles for circular collimators with diameter of 10, 15, and 25 mm. Arrow indicates location of asymmetry in the horizontal profile for the largest collimator with diameter of 25 mm.



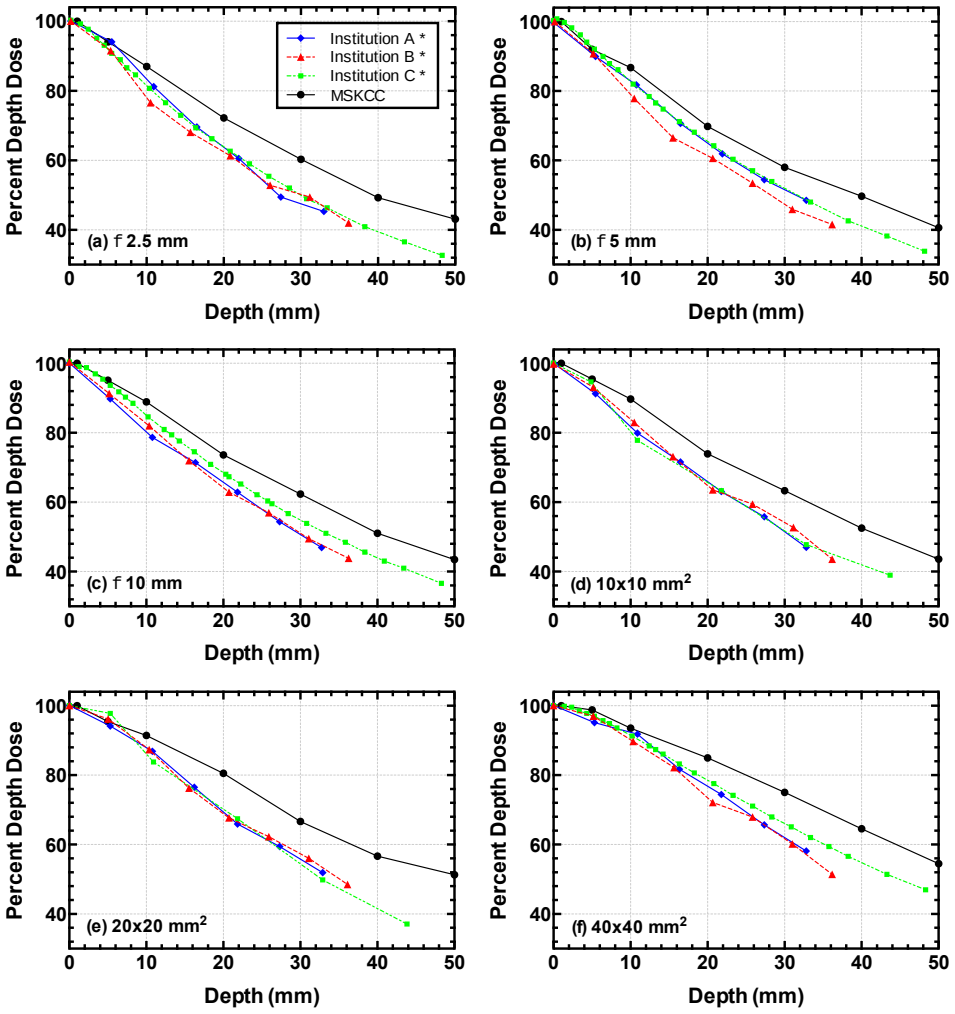
Supplemental figure 14. Comparison of dose rates between CC04 chamber and EBT3 film.



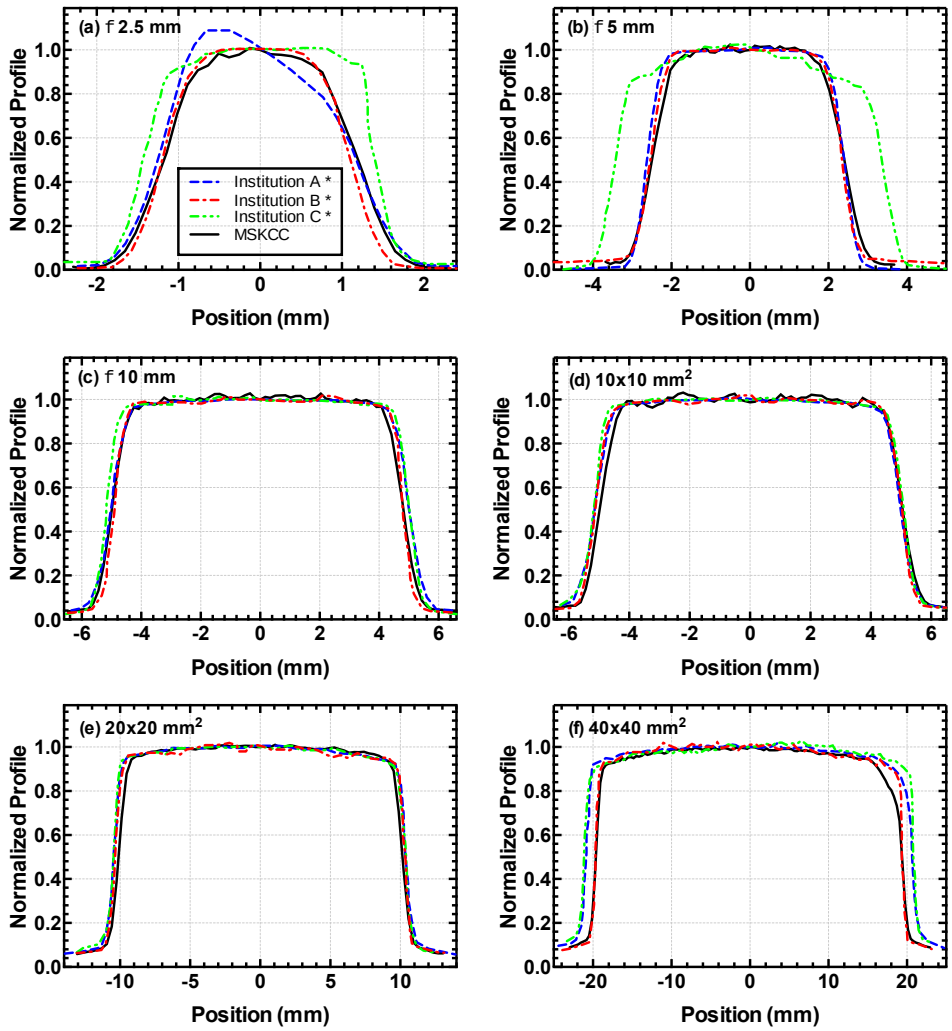
Supplemental figure 15. Comparison of dose rates between LXPC-6D chamber and EBT3 film.



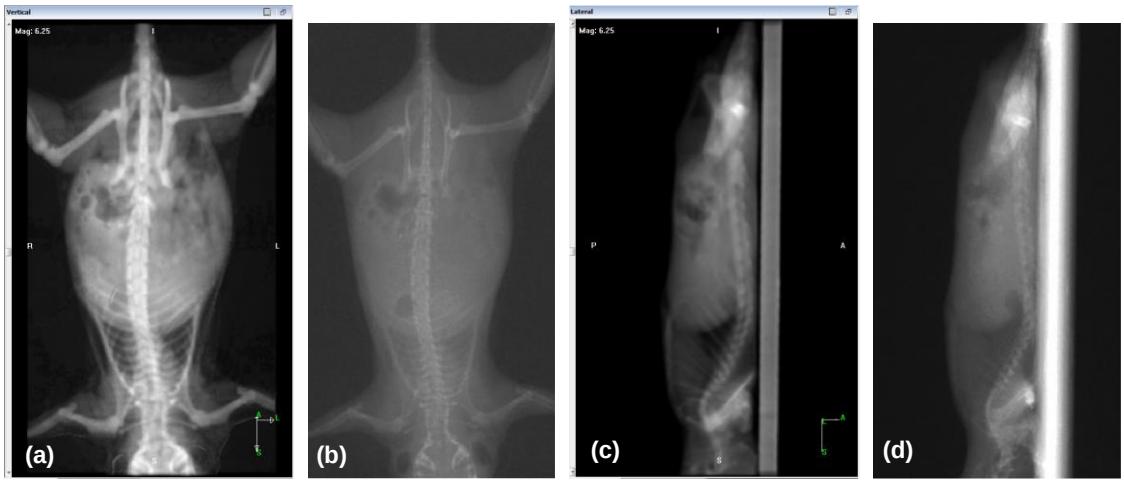
Supplemental figure 16. Comparison of dose profiles between Metropolis calculation and EBT3 film measurement for two collimators at three depths.



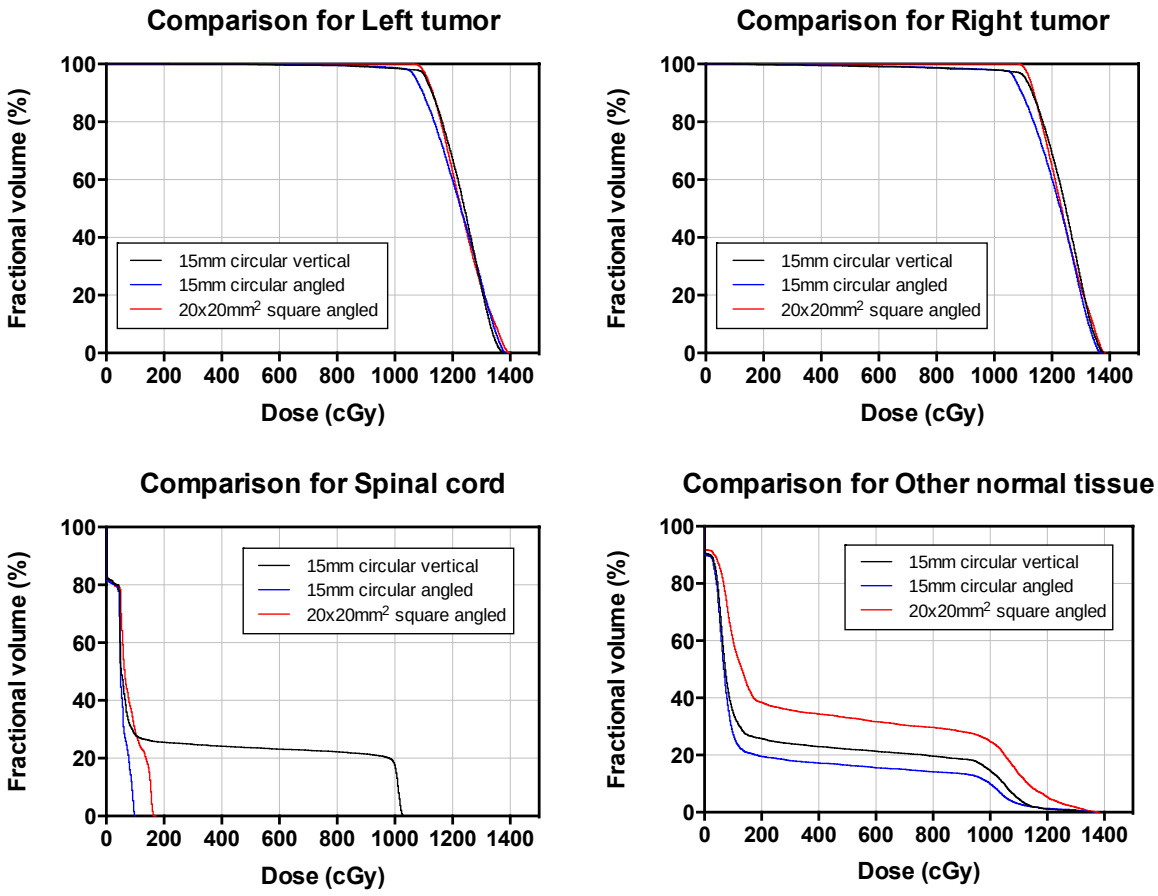
Supplemental figure 17. Comparison of measured percent depth dose with other institutional data reported by Lindsay *et al*. (Med. Phys. 2014;41:031714) for six different collimators.



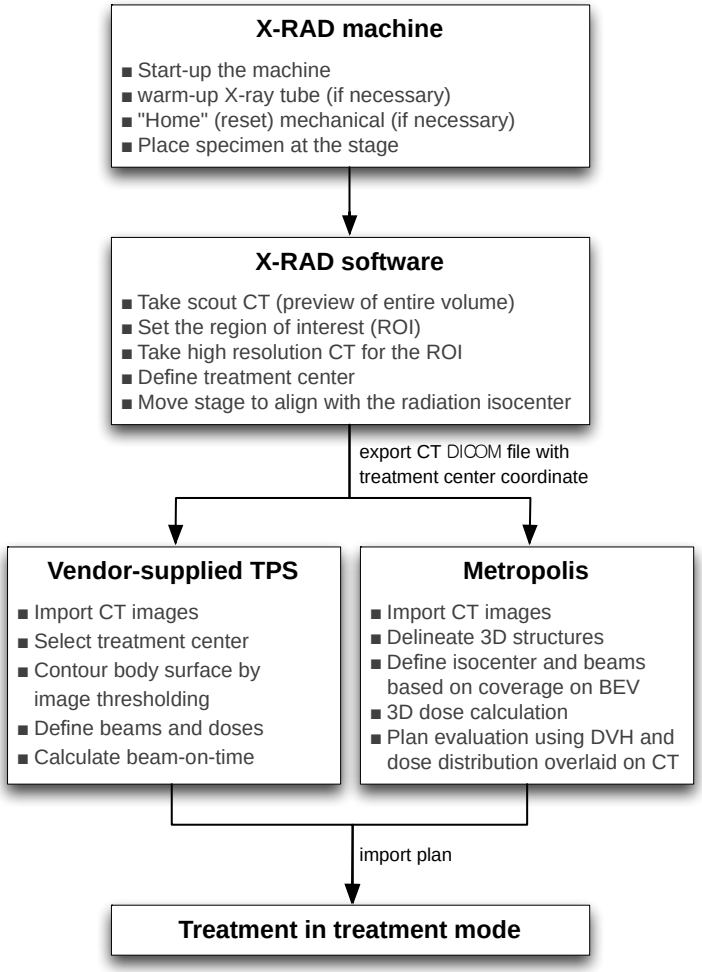
Supplemental figure 18. Comparison of normalized dose profile along the horizontal axis (the transverse axis for the animal) with other institutional data reported by Lindsay *et al*. (Med. Phys. 2014;41:031714) for six different collimators.



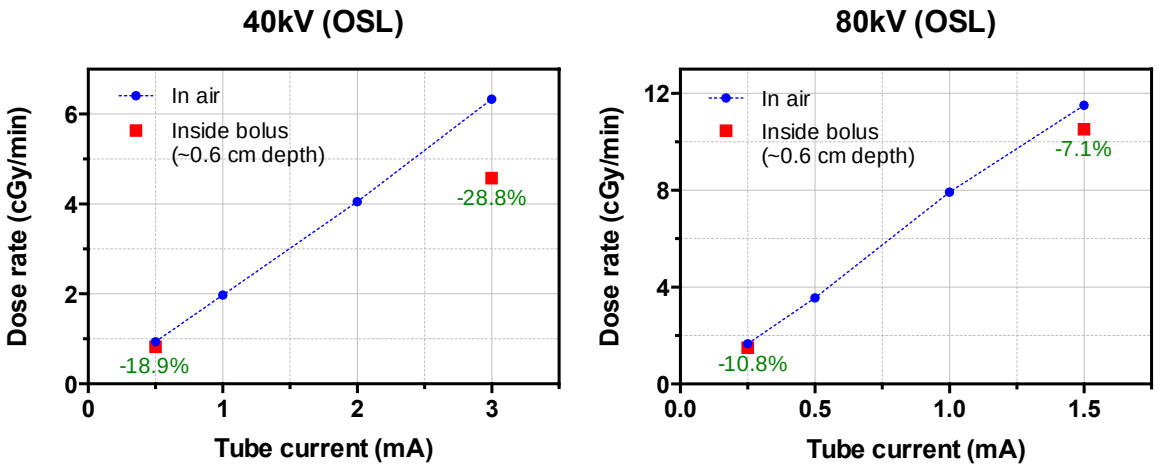
Supplemental figure 19. Verification of DRRs generated in Metropolis (a,c) based on imported CT images, compared with the orthogonal radiographic images taken at the same position (b,d).



Supplemental figure 20. Dose volume histograms (DVHs) for the target volumes and normal structures.



Supplemental figure 21. Experiment workflow of the microirradiator using either vendor-supplied TPS or Metropolis for treatment planning.



Supplemental figure 22. CT dose measured with OSL dosimeter inside bolus in comparison with the in air measurement.

Supplemental table 1. Dose rate at central axis measured with CC04 chamber for three collimators.

Depth (mm)	Dose rate (cGy/min)		
	40x40	10x10	ϕ10
10	346.7	284.1	278.8
15	329.3	260.7	254.9
20	310.4	238.1	232.8
25	290.7	217.1	212.2
30	271.3	199.2	193.9
35	252.1	181.5	176.7
40	233.1	165.0	161.0
45	215.8	150.8	146.8
50	199.4	137.7	134.0

Supplemental table 2. Dose rate at central axis measured with LXPC-6D chamber for four collimators.

Depth (mm)	Dose rate (cGy/min)			
	40x40	20x20	ϕ25	ϕ15
0	370.7	334.1	335.3	305.6
0.5	362.4	329.6	329.6	304.3
1	362.9	328.3	326.7	300.2
1.5	361.4	-	-	-
2	360.0	326.4	324.9	296.9
2.5	359.2	-	-	-
3	358.7	323.6	321.3	293.3
3.5	357.8	-	-	-
4	356.3	320.6	318.8	289.8
5	351.7	314.7	316.5	287.0
10	341.0	295.1	305.8	274.0
15	332.0	274.8	289.0	253.1
20	307.5	254.4	267.1	231.8
25	289.3	235.1	245.3	212.2
30	270.3	217.0	225.2	194.1
35	252.3	200.2	207.4	177.3
40	234.3	183.9	190.1	162.1
45	217.8	169.4	174.8	148.3
50	201.8	155.7	160.8	135.6

Supplemental table 3. Comparison of dose distribution parameters for three different plans.

Plan	Structure	Volume (cc)	D_{max} (cGy)	D_{min} (cGy)	D_{mean} (cGy)	D_{95} (cGy)	D_{05} (cGy)
Plan 1	Left tumor	1.19	1377.0	216.4	1229.7	1107.1	1344.4
	Right tumor	1.17	1379.2	95.3	1229.4	1107.6	1350.8
	Spinal cord	0.03	1028.7	0.0	270.3	0.0	1016.0
	Other normal tissue	12.83	1352.1	0.0	279.4	0.0	1095.7
Plan 2	Left tumor	1.19	1385.6	470.7	1219.7	1071.4	1356.2
	Right tumor	1.17	1372.9	119.6	1211.2	1069.7	1342.2
	Spinal cord	0.03	99.6	0.0	48.5	0.0	91.6
	Other normal tissue	12.83	1362.8	0.0	220.8	0.0	1056.8
Plan 3	Left tumor	1.19	1396.2	1055.5	1216.4	1111.4	1325.0
	Right tumor	1.17	1382.9	1085.8	1218.0	1122.6	1320.1
	Spinal cord	0.03	134.3	0.0	43.5	0.0	108.6
	Other normal tissue	12.83	1379.9	0.0	392.5	0.0	1192.7