

Dose Measurements and Monte Carlo Simulations of a Directional LDR Brachytherapy Source Array



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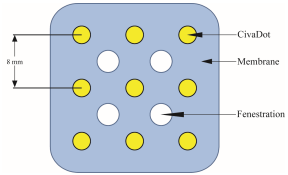
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Therapy Scientific Session: Brachytherapy and Radionuclide Therapy

Wednesday, 8/1/2018, 8:00 AM – 8:10 AM

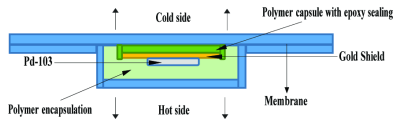


- CivaSheet is a planar array of discrete directional ^{103}Pd sources called CivaDots.

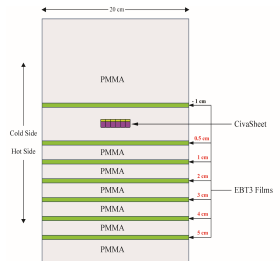


- A directional device can potentially improve the therapeutic ratio by selectively targeting diseased tissue and sparing the surrounding healthy structures. Ongoing trials — NCT03109041, NCT02843945, NCT02902107.

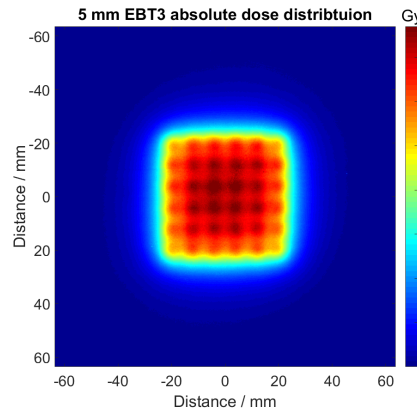
- A CivaDot consists of a polymer capsule with epoxy sealing and a gold shield, encased in a bioabsorbable membrane. The gold shield helps define the “hot” and the “cold” side of a source.



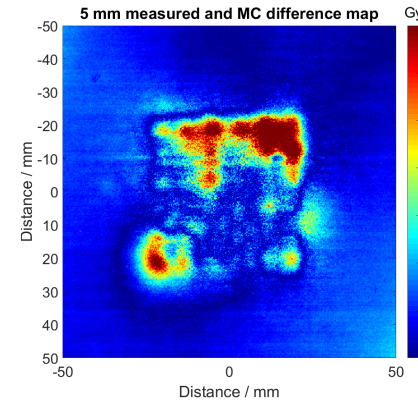
- A PMMA phantom was used to measure the dose distribution of a CivaSheet (6x6 CivaDots) using an EBT3 film stack phantom.



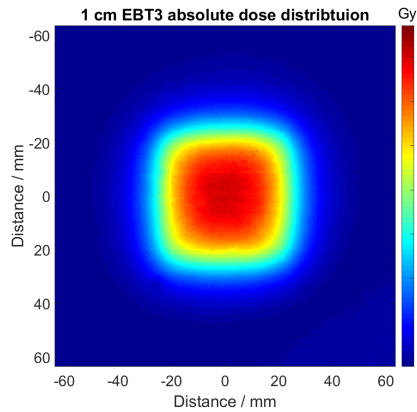
- Monte Carlo simulations of the CivaSheet and CivaDots were performed using MCNP6, the validity of dose superposition was also tested.



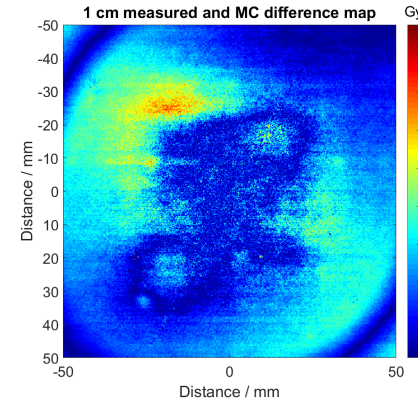
(a)



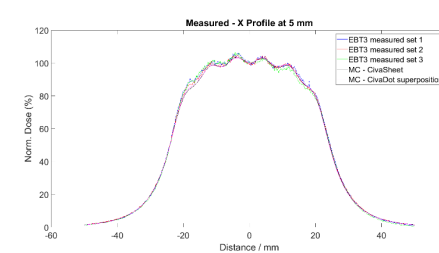
(c)



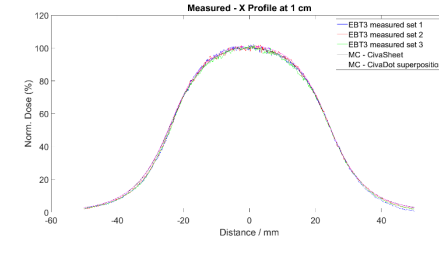
(b)



(d)



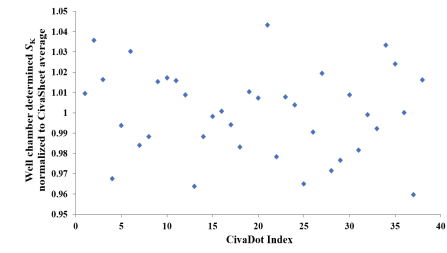
(e)



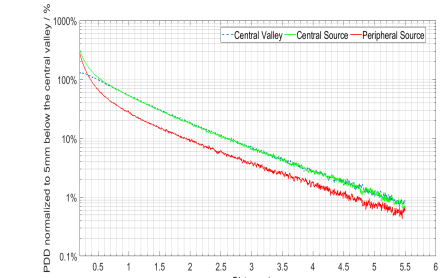
(f)

Distance (cm)	EBT3 measured (%)	CivaSheet calculated (%)	CivaDot MC superposition (%)	Measured and CivaSheet difference (%)	Measured and CivaDot MC difference (%)
0.5	100.00%	100.00%	100.00%	—	—
1	52.42%	50.25%	50.09%	2.17%	2.33%
2	15.53%	14.91%	14.83%	0.62%	0.70%
3	5.74%	5.02%	4.96%	0.72%	0.78%
4	2.13%	1.80%	1.78%	0.33%	0.35%
5	0.71%	0.68%	0.68%	0.03%	0.03%
-1.0 (cold)	4.31%	3.73%	3.79%	0.58%	0.52%

(g)



(h)



(i)

Figure descriptions: (a) and (b) Measured dose distributions at 5 mm and 1 cm plane on the CivaSheet hot side (prescribed 7 Gy dose @ 5 mm CAX), (c) and (d) Pixel-by-pixel dose difference maps between measured and Monte Carlo simulations at 5 mm and 1 cm depth, (e) and (f) Measured horizontal profile (multiple measurements) at 5 mm and 1 cm plane compared to CivaSheet MC simulations and MC-CivaDot superposition, (g) Measured percent depth dose values compared to CivaSheet MC simulations and MC-CivaDot superposition, (h) Air-kerma strength of the individual CivaDots cropped from the CivaSheet (post measurement) normalized to the batch average measured using a well chamber, (i) Percent depth dose curves calculated for the CivaSheet using Monte Carlo simulations under the central valley, a central CivaDot source and a peripheral source.