



Purpose

We assessed the feasibility of HDR Ir-192 brachytherapy treatment of patients with choroidal melanoma using RapidBrachyMCTPS, a Monte Carlo-based treatment planning system.

Methods

A preliminary design of a 20 mm gold eye plaque with four equidistant plexiglass catheters was made in Solidworks (2019) for HDR treatments. CT, structures, STL files were imported into the RapidBrachyMCTPS<sup>(1)</sup>, following TG-129 recommendations<sup>(2)</sup>. Three simulations, each with 100,000 histories using a 10 Ci GammamedPlus source model at different positions in the right eye of a dummy patient were performed. Each history started with the radioactive decay of Ir-192. The standard COMS prescription dose of 85 Gy was converted to an equivalent single fraction dose for Ir-192 HDR treatment of 35 Gy. Uniform and optimized dwell times were used to calculate 35 Gy to 8 mm depth from the center of the plaque. Dosimetric parameters were analyzed for ipsilateral and contralateral eyes, lenses, optic nerves, and lacrimals, as well as the chiasm and brainstem, contoured by physicians and planners.

Results

Dose to critical structures were obtained. Specifically, the range of max dose over 3 simulations for the ipsilateral eye and, lens was 79.9 Gy - 103.7 Gy, and 18.3 Gy to 26.5 Gy, respectively. For the contralateral lens, chiasm, and brainstem the max dose range was 0.59 Gy - 0.99 Gy, Gy 0.99 - 1.19 Gy, and 0.38 Gy - 0.58 Gy, respectively. Dose profile calculations inside the treated eye were comparable to the ones showed by Luxton et al with LDR Co-60, I-125, and Ir-192 <sup>(3)</sup>.

Table 1. Summary of the dosimetric parameters for different eye plaque placements

Organs	Plaque placement		
	MEDIAL	LAT POST	LATERAL
	Dmax (Gy)	Dmax (Gy)	Dmax (Gy)
Brainstem	0.58	0.39	0.38
Ipsilateral Eye	103.7	100	79.9
Contralateral Eye	1.477	0.89	0.88
Chiasm	1.19	1.09	0.99
Contralateral Lacrimal	0.69	0.49	0.49
Contralateral OptNrv	0.89	0.75	0.79
Ipsilateral OptNrv	17.79	59.09	12.5
Ipsilateral Lacrimal	4.05	60.2	48.7
Ipsilateral Lens	21.9	18.3	26.5
Contralateral Lens	0.99	0.6	0.59

Conclusion

This proof-of-principle study shows the clinical feasibility of treating choroidal melanoma patients using HDR Ir-192. HDR treatments can reduce the length of treatment and eliminate a second OR procedure for plaque removal. Further simulations using I-125 are needed to obtain an appropriate comparison of HDR Ir-192 treatments.

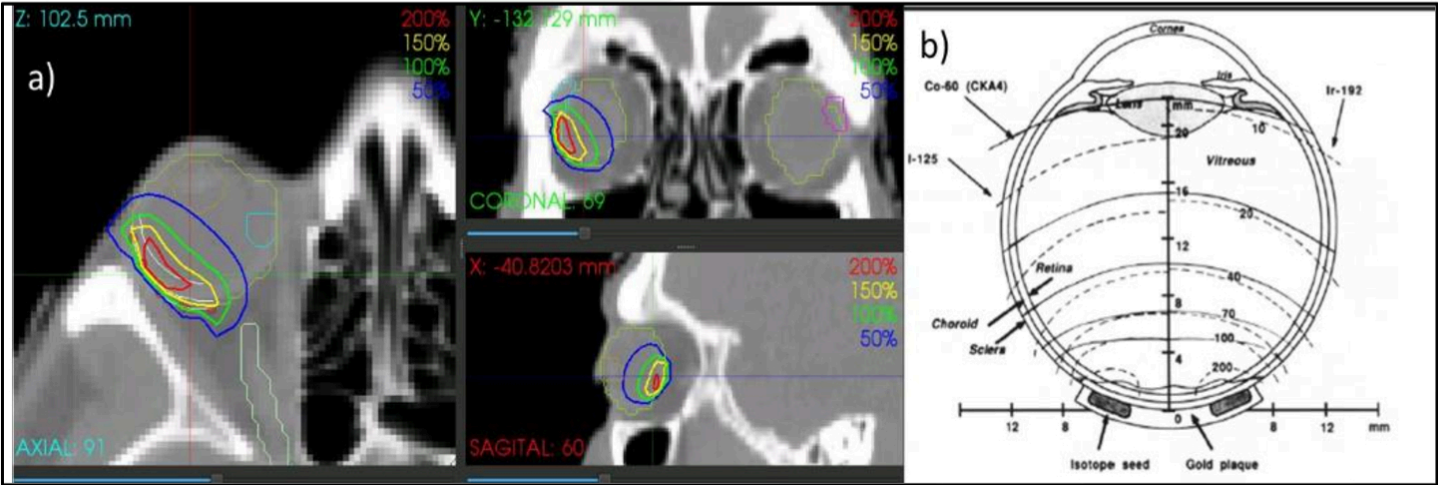


Figure 1. Example of a simulation of posterior lateral plaque placement using the MCTPS (a) done in this study, and prior comparison of I-125, Co-60, and Ir-192 dose profiles for LDR plaques by Luxton et al (IROBP 1988) (b).

1. RapidBrachyMCTPS: a Monte Carlo-based treatment planning system for brachytherapy applications. Gabriel Famulari et al 2018 Phys. Med. Biol. 63 175007; 2. Dosimetry of I-125 and Pd-103 COMS eye plaques for intraocular tumors: Report of Task Group 129 by the AAPM and ABS. Sou-Tung Chiu-Tsao et al Medical Physics Volume 39, Issue 10; 3. Dosimetric calculations and measurements of Gold Plaque Ophthalmic Irradiators using Iridium-192 and Iodine-125 seeds. Luxton et al. Int. J Radiation Oncology Biol. Phys., Vol 155 pp 167-176 (1988)