Purpose: To quantify the impact of the tungsten eye shield on the dose to various structures around the eye and to characterize the impact of the oblique incidence of the beam using Monte Carlo simulation.
Methods: A commercially available tungsten eye shield kit (tungsten eye shield + aluminum cap) was simulated along with the NCRP human adult eye model via a Monte Carlo simulation code, MCNPX, in great detail. The thickness and diameter of the tungsten eye shield that were implemented for the study were 3 mm and 14.4 mm, respectively, whereas the accompanying aluminum cap thickness was 0.5 mm. A 9 MeV electron beam of field size 10 x10 cm from the Varian linear accelerator was simulated and the dose distributions were tallied at different irradiation angles. The absorbed doses to lens, orbit, retina, optic nerve, macula, and eyelid were calculated and the relative dose was estimated against the dmax dose.
Results: The dose to the eyelid decreased to 43 % at 60 degree oblique beam as compared to 0 degree, while the dose to the lens increased by 85 % at respective angles. At normal incident angle, the lens dose (transmission) received 0.96 % of the dose to the eyelid, while at 60 degree it increased to 4.14 %.
Conclusions: This study has revealed the detailed dosimetry for the sensitive structures around the eye under the electron treatment with the tungsten eye shield. The impact of the oblique beam angle to the dose to those structures was investigated via detailed modeling of the eye shield design. The unique design and material compositions of the tungsten–aluminum eye shield can pose significant uncertainties without accurate understanding of the impact of oblique beam angle.