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Viability of EBT3 Film in Small Dimensions to Be Use for in-Vivo Dosimetry in Radiation Therapy

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Abstract : The Gafchromic EBT3 film has the characteristic of high spatial resolution, weak energy dependence and near tissue equivalence which makes them viable to be used for in-vivo dosimetry in External Beam and Brachytherapy applications. The aim of this study is to assess the smallest film dimension that may be feasible for the use in in-vivo dosimetry. To evaluate the viability, the film sizes from 3 x 3 mm to 20 x 20 mm were calibrated with 6 MV Photon and 6 MeV electron beams. The Gafchromic EBT3 (Lot no. A05151201, Make: ISP) film was cut into five different sizes in order to establish the relationship between absorbed dose vs. film dimensions. The film dimension were 3 x 3, 5 x 5, 10 x 10, 15 x 15, and 20 x 20 mm. The films were irradiated on Varian Clinac® 2100C linear accelerator for dose range from 0 to 1000 cGy using PTW solid water phantom. The irradiation was performed as per clinical absolute dose rate calibratin setup, i.e. 100 cm SAD, 5.0 cm depth and field size of 10x10 cm2 and 100 cm SSD, 1.4 cm depth and 15x15 cm2 applicator for photon and electron respectively. The irradiated films were scanned with the landscape orientation and a post development time of 48 hours (minimum). Film scanning accomplished using Epson Expression 10000 XL Flatbed Scanner and quantitative analysis carried out with ImageJ freeware software. Results show that the dose variation with different film dimension ranging from 3 x 3 mm to 20 x 20 mm is very minimal with a maximum standard deviation of 0.0058 in Optical Density for a dose level of 3000 cGy and the the standard deviation increases with the increase in dose level. So the precaution must be taken while using the small dimension films for higher doses. Analysis shows that there is insignificant variation in the absorbed dose with a change in film dimension of EBT3 film. Study concludes that the film dimension upto 3 x 3 mm can safely be used up to a dose level of 3000 cGy without the need of recalibration for particular dimension in use for dosimetric application. However, for higher dose levels, one may need to calibrate the films for a particular dimension in use for higher accuracy. It was also noticed that the crystalline structure of the film got damage at the edges while cutting the film, which can contribute to the wrong dose if the region of interest includes the damage area of the film

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