

AbstractID: 4321 Title: Dose Rate Dependence of Film Dosimetry in Radiation
Treatment: Study of Reciprocity Law

Purpose: Film has become an important tool for dose verification in individualized IMRT treatment fields. The optical density (OD) is related to dose rate also known as reciprocity law; ($D = D_r \cdot t$). However for modern films (EDR and XV) reciprocity law has not been investigated which is presented in this study.

Method and Materials: Using a Varian linear accelerator, dose rate dependence was studied for Kodak films (XV and EDR). The dose rate on this unit could be varied in the range of 80-400 MU/min for both (6 MV and 15 MV) photons beams. A large dose rate range; 5 cGy/min –1100 cGy/min was achieved in conjunction with distance (1-4 meters) and machine dose rate. This was verified using ion chamber. At each dose rate, films were exposed in a solid phantom at a depth of d_{max} for 300 cGy and 50 cGy for EDR and XV films, respectively. Calibration curves (dose vs. OD) were also established during this experiment in a standard condition. The measured dose through film and ion chamber were compared and analyzed.

Results: Reciprocity law holds good in the dose rate range of 20-400 cGy/min for both energies but deviates at low and high dose rates. The effect is more pronounced at dose rate beyond 400 cGy/min where deviation up to 7.5% was noted for both the films. At low dose rate, the deviation is –3.5% for both films and energies.

Conclusion: Low and high dose regions are created in the same time of exposure in IMRT and hence reciprocity law becomes critical for film dosimetry. The reciprocity law failure is due to the interaction of ion pairs to form latent image, which could be suppressed at extreme dose rates. The dosimetric impact is noted to be up to 7.5% for both films.